Pot-smokers may be imperiled by paraquat-spraying program

In a program supported partly by U.S. government funds, the Mexican government attempted to destroy marijuana fields in the late 1970s through aerial spraying of the rapidly acting herbicide paraquat. But farmers, noting that the herbicide must be activated by sunlight, began harvesting their *Cannabis sativa* crops rapidly after a spraying, wrapping the paraquat-covered leaves in dark cloths and exporting some to the United States. As a result, hundreds of marijuana smokers in this country inhaled doses of paraquat "capable of producing pulmonary [lung] damage," and thousands more were exposed to doses that presented "a less serious but still heightened risk of pulmonary injury," Centers for Disease Control (CDC) scientists report in the July AMERICAN JOURNAL OF PUBLIC HEALTH.

The CDC report calls into question the State Department's announcement last December that it is "unlikely" that paraquat spraying endangers the health of marijuana smokers in the United States. Still, CDC's parent organization, the U.S. Public Health Service, endorses the finding by the State Department, which now intends to support paraquat-spraying in several Western Hemisphere nations.

Paraquat is a widely used herbicide that, with the aid of sunlight, appears to generate highly destructive superoxide radicals (O_2^-) within plant cells. The chemical also is highly toxic to animals: Inhalation toxicity tests indicate, for example, that doses as low as 0.5 milligrams of paraquat per kilogram of body weight in rats can lead to lung fibrosis (scar-tissue formation). Also, accidental or intentional (in suicide attempts) ingestion of less than 1 teaspoon of concentrated paraquat has been shown to cause irreversible progressive lung fibrosis in humans. About half the pulmonary fibrosis cases due to concentrated paraquat ingestion prove fatal.

Beginning in 1975, the United States supported the spraying of paraquat on marijuana fields in Mexico. But in March 1978, about 21 percent of marijuana samples that had been confiscated from late 1976 to mid-1977 in states adjacent to Mexico were found to be tainted with the herbicide. Congress directed CDC to evaluate the public health significance of this discovery, and it halted U.S. support for the Mexico program.

The recently published report — by Philip J. Landrigan of the National Institute of Occupational Safety and Health (an arm of CDC) in Cincinnatti and associates — traces the computer-assisted evaluation that followed. The researchers gathered various data to assess paraquat prevalence, smoker exposure and toxic dose:

- A CDC survey of the paraquat content of marijuana samples confiscated nationwide indicated that of 910 samples, 33 (3.6 percent) contained detectable levels of paraquat. (The origin of only 95 of the seized lots was known; 88 of these originated in Mexico.) Of those 33 tainted samples, 2 (6.1 percent) contained more than 400 parts per million of paraquat.
- A telephone survey provided an estimated pattern of marijuana consumption: About half of those surveyed, for example, reported smoking from 4 to 10 grams of marijuana per week. (It was assumed that one marijuana cigarette contains 1 gram of marijuana.)
- Previous combustion tests indicated that about 0.2 percent of paraquat on marijuana passes into smoke.
- Finally, extrapolating from animal test data, the CDC researchers judged that an annual dose of 500 micrograms of inhaled paraquat can produce lung damage. ("We did not consider the possible additional pulmonary injury which might result from the inhalation of 4,4′-dipyridyl, the principal combustion product of paraquat and a compound which has recently been shown to be itself a pulmonary toxin," the CDC researchers report.)

The computer-aided evaluation of these data indicated that each year from 1975 to 1979, 100 to 200 marijuana smokers in the southwestern United States and 150 to 300 nationally were exposed to 500 micrograms or more of paraquat in marijuana smoke — "a dose judged to represent a health hazard," Landrigan and colleagues report. Another 9,000 smokers inhaled between 100 and 499 micrograms annually, according to the computer analysis. While no clinical cases of paraquat poisoning were detected during the study, "This failure cannot...be taken as reassurance that exposure to paraquat-contaminated marijuana did not or might not in the future cause damage to the lungs of certain persons," Landrigan reported. "[T]he time from the beginning of the Mexican spray program to the time of this study may have been insufficient for chronic disease to have appeared," he explained.

On Dec. 15, 1981, Congress lifted its ban on the use of paraquat against *Cannabis;* the government completed the necessary "Environmental Impact Statement" on such use last December. At that time, Edward N. Brandt Jr., assistant secretary of the Public Health Service (PHS)—which is part of the Department of Health and Human Services, formerly Health, Education and Welfare (HEW) — stated that the PHS supports such a program if good aerial spraying practices are employed. In a letter to the State Department, Brandt wrote, "It should be noted that paraquat can cause serious health problems and even death. We do know that to smoke marijuana without paraquat is unhealthy and poses a number of health risks.... In assessing the balance of risks surrounding an eradication activity, one must include concerns of the health consequences of reduced supply and consumption of marijuana." Last week, in a statement to SCIENCE NEWS, Brandt said he already had available Landrigan's data when he made known this PHS position that supports paraquat spraying.

Landrigan declined to comment on that PHS position. However, in his recently published report, he notes that "HEW was not asked by the Congress to weigh the hazards of marijuana smoke against those of paraquat or otherwise to consider the benefits which might result from a herbicide spray program. ... HEW was directed by the Congress solely to evaluate the possible health hazards of exposure to paraquat." —*L. Garmon*

Curds, whey and recombinant DNA

Biotechnology seems to have something for everyone — the food processing industry as well as medicine and agriculture. In perhaps the most practical gastronomic advance so far, British scientists report synthesis in bacteria of the critical enzyme of cheese production. This enzyme is currently obtained from the fourth stomach of an unweaned calf when it is slaughtered for veal. But in the last five years, the market has declined, putting the calf enzyme in short supply.

In work at Celltech Limited in Slough, Berkshire, United Kingdom, J. S. Emtage, P. A. Lowe and colleagues constructed the gene for prorennin, a natural precursor of the cheese-making protein called rennin or chymosin. The gene was placed into a plasmid, a ring of bacterial DNA, with appropriate bacterial control regions. Bacterial cells containing the plasmid made prorennin in large amounts, up to 5 percent of their total protein synthesis or 50,000 to 250,000 molecules of prorennin per cell. The scientists purified the prorennin and converted it to active rennin by treating it with acid. The product, like natural rennin, partially breaks down the milk protein *kappa*-casein.

"Bacterially produced chymosin [rennin] is as effective in clotting milk as the natural enzyme isolated from calf stomach," the Celltech scientists report in the June PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol. 80, no. 12).

Although rennin is not the first animal enzyme whose gene has been expressed in bacteria, Emtage and colleagues say it is among the few to be produced in reasonably large amounts in active form and to be purified. If this process does become industrially feasible, Celltech — Britain's part-public, part-private corporation for applying genetic engineering techniques (SN: 12/13/80, p. 372), should be smiling "cheese." —*J. A. Miller*

News of the week continued on p. 58