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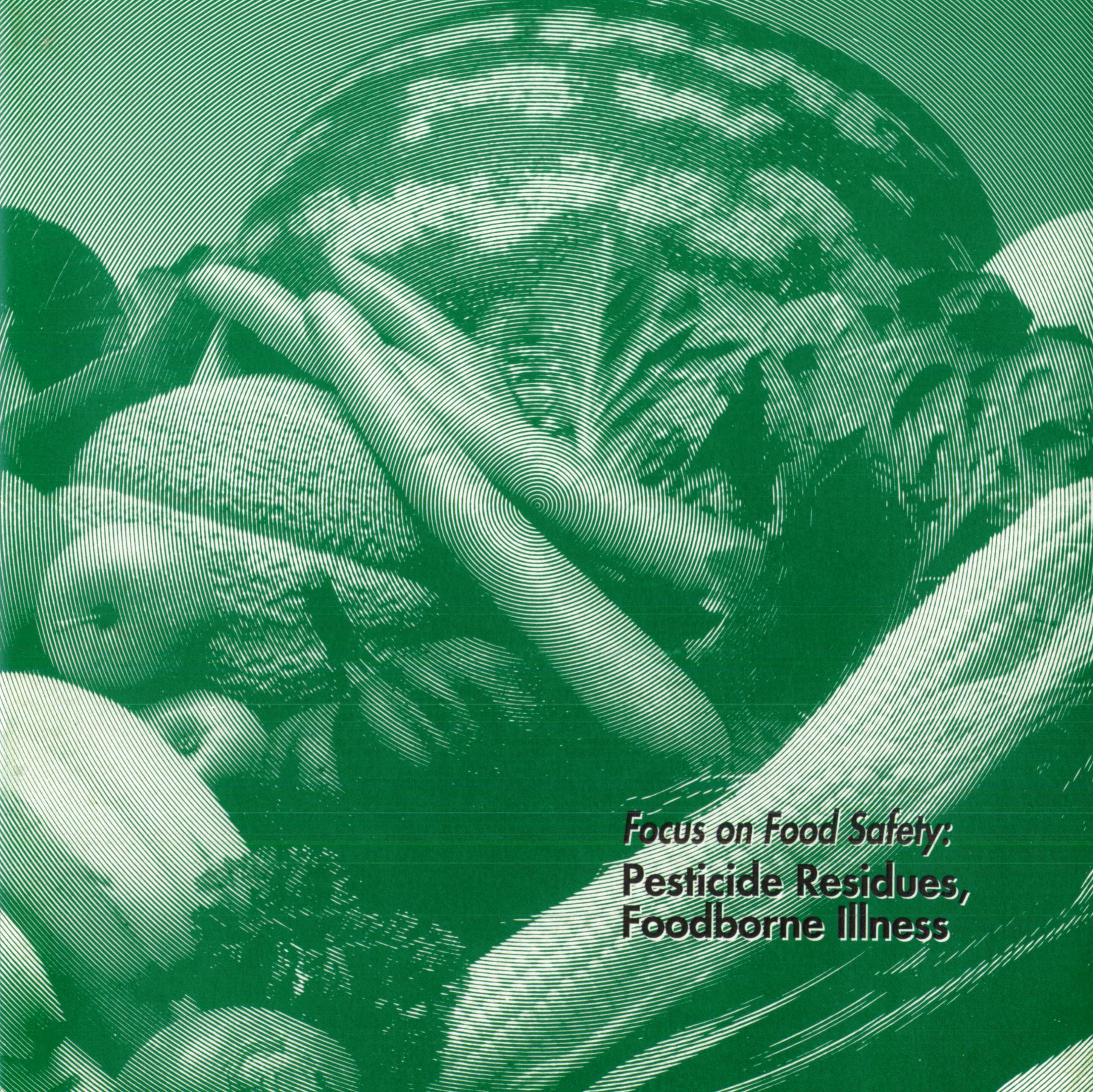

Focus on Food Safety:
Pesticide Residues, Foodborne Illness

UpFront

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New Report Assesses Industrial Uses of Ag Materials

With excess productive capacity, farmers are working with agribusiness and government to deliver a host of industrial products that use renewable resources. Chief among these products, which can be substituted for those from nonrenewable sources and are more environmentally friendly, are:

- Fuels, such as biodiesel—made from animal fats, oilseeds, etc.—to supplement or replace diesel fuels made from petrochemicals
- Biodegradable polymers and packaging materials—from corn starch and other agricultural products
- Fibers—new sources, techniques, and environmental benefits are making natural products more more attractive than synthetics

Other new industrial uses for agricultural products include biopesticides, inks, adhesives, pharmaceuticals, road deicers, and lubricants and coatings. For example, kenaf makes a good quality newsprint. And, many lubricants, coatings, and plastics are made from industrial rapeseed oil or its derivatives.

In response to the growing importance of nonfood uses of agricultural crops and materials, USDA's Economic Research Service is introducing a new situation and outlook report that will examine how agricultural materials are used by industry.

Industrial Uses of Agricultural Materials is designed for people involved in the research, development, production, processing, marketing, and policy issues surrounding agriculturally based industrial products.

Available in July and December, this semiannual report will cover seven categories of uses: starches and carbohydrates; oils, fats, and waxes; fibers; animal products; forest products; natural plant products; and natural rubber and resins. It will analyze markets and uses of new and traditional agricultural crops and products, as well as general economic and specific industrial sector trends on the national and international scene.

For more information about the series, call Greg Gajewski or Lewrene Glaser at 202-219-0888.

Or, call 1-800-999-6779 to subscribe to *Industrial Uses of Agricultural Materials Situation and Outlook* (stock # IUS). Subscriptions are $16 domestic ($20 foreign).

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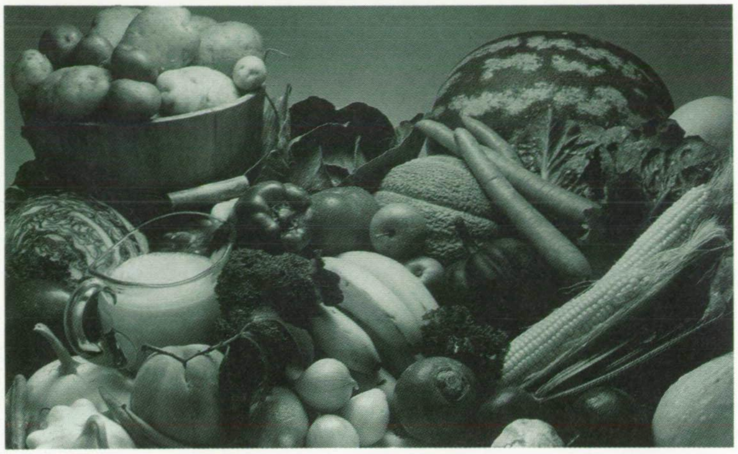

Addressing Pesticide Residues

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—Ann Vandeman, David Shank, Ram Chandran, & Utpal Vasavada

USDA's new Pesticide Data Program helps examine the relationship between pesticide use on the farm and residues found on produce. Monitoring of lettuce—which is consumed fresh, so any residues that would remain on the harvested produce would not be removed by processing—shows pesticide use is widespread and varied. But, few samples contained pesticide residues, most of which were below established tolerance limits.

6 Consumers Respond to Information About Pesticide Residues

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Despite food scientists' opinion to the contrary, consumers rank pesticide residues on produce as a major food safety concern. According to a recent survey, many consumers preferred to buy produce tested for pesticide residues—and would pay a premium price—after receiving information about risks. Yet consumers' ability to distinguish between risk levels depended largely on their demographic characteristics and their attitudes toward health.

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Along with the potential to give perishable food products a longer shelf-life and to substitute for chemical fumigants, irradiation may offer consumers safer food by retarding spoilage and by destroying microbial pathogens that cause foodborne illnesses. Yet irradiation first must overcome high investment costs, consumer wariness, and competition from other technologies.

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Last fall, USDA approved irradiation of uncooked poultry to control bacteria that cause diseases, such as salmonellosis and campylobacteriosis. With poultry treatment costs at a few pennies per pound, the public-health benefits could outweigh the irradiation costs and the longer shelf-life could offer expanded export opportunities. But irradiated poultry will enter the marketplace slowly with the uncertainty over consumer acceptance and the lack of approved facilities.

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Lettuce Provides Indication of Pesticide Use and Residues

Ann Vandeman, David Shank, Ram Chandran, and Utpal Vasavada
(202) 219-0405

Pesticides make an important contribution to high U.S. farm productivity and a low-cost, plentiful food supply. Some scientific evidence shows that pesticide residues are not a serious risk to the safety of the food supply. Yet there are widespread concerns based on contrary evidence about pesticide use and toxicity to humans, chronic health effects, food safety, water pollution, and threats to wildlife. Consumers frequently rank pesticide residues on food as the number one food safety risk.

These concerns, together with pressures to regulate and restrict agrichemical use in U.S. agriculture, are stimulating the search for alternative farming methods. Improved pesticide-application methods and techniques such as the close monitoring of pest populations, crop rotation, and developing a plant's genetic resistance to specific pests offer the possibility of limiting pesticide use while preserving the productivity and economic viability of U.S. farms.

USDA's Pesticide Data Program (see box) gathers information on pesticide residues remaining on produce and on growers' use of pesticides. These data offer an opportunity to study the relationships between pesticide use on the farm and the residues found on produce. They will also help in examining the evolution of production practices in agriculture.

Lettuce Monitored for Pesticide Residues

Pesticide use and residues on lettuce are of particular food safety interest. Lettuce is consumed fresh, so residues that may remain on the harvested produce are not removed by processing. Pesticide

Nearly all lettuce acreage in four States surveyed received one or more applications of pesticides—a total of 62 chemicals were applied.

The authors are with the Resources and Technology Division, Economic Research Service, USDA. Vandeman, Chandran, and Vasavada are agricultural economists. Shank is a statistical assistant.

USDA Surveys Pesticide Use

In 1990, USDA initiated the Pesticide Data Program, a new survey program focusing on chemical use in agriculture. The program responds to heightened public concern regarding the environmental and health consequences of chemical use by improving the quantity and reliability of available pesticide use and residue information.

Fruit and vegetables were among the first crops targeted for evaluations. Vegetable, melon, and strawberry producers were surveyed in Arizona, California, Florida, Michigan, and Texas. (To avoid duplication with State pesticide reporting rules, the California survey did not include questions on pesticide use. Therefore, California is not included in this study.) These States account for more than half of total U.S. vegetable production.

Four USDA agencies administer the program to collect and analyze pesticide use and residue data:

- The National Agricultural Statistics Service is responsible for collecting information on chemical use, other pest-control methods, and cost and return data from U.S. fruit and vegetable producers.
- The Economic Research Service collaborates with NASS in designing the survey program and uses these data to assess the economic effects of alternative pesticide regulations and of policies and practices which aim to reduce chemical use.
- The Agricultural Marketing Service implements a pesticide-residue monitoring program for specific fruit and vegetables at terminal markets and wholesale distribution centers.
- The Human Nutrition Information Service is developing methods to estimate chemical exposure through food consumption from the chemical residues found on food.

The Environmental Protection Agency, Food and Drug Administration, and U.S. Geological Survey also participate in the survey effort.

Table 1
AMS Residue Testing Monitors 13 Pesticides Used on Lettuce

Pesticide	Residue found
Acephate	yes
Azinphos-methyl	no
Chlorpyrifos	yes
DCPA	yes
Diazinon	yes
Dimethoate	no
Endosulfan[1]	yes
Iprodione	no
Malathion	no
Methamidophos	yes
Methyl parathion	no
Permethrin	yes
Vinclozolin	no

[1]Includes endosulfan I and II and endosulfan sulfate.

residues are detected in lettuce and other leafy vegetables more often than in other fresh vegetables. And lettuce is a major fresh-market vegetable crop.

In 1990, the Food and Drug Administration (FDA) found detectable pesticide residues in 55 percent of domestically produced lettuce samples. Two percent contained residues exceeding tolerance levels. (The tolerance level is the legal limit of a chemical residue, specified in parts per million, permitted on a food sold in interstate commerce. These limits are set by the Environmental Protection Agency (EPA) and enforced by the FDA for both domestically produced and imported food.) Residues were found in 50 percent of domestic spinach and swiss chard samples, 70 percent of domestic mustard, and 67 percent of domestic turnip greens sampled. In contrast, only 38 percent of domestic tomato and 27 percent of domestic cucumber samples tested positive for residues.

In 1990, USDA's National Agricultural Statistics Service (NASS) and Economic Research Service (ERS) designed a new survey program and began collecting data on the use of pesticides on vegetable and fruit crops. The following year, USDA's Agricultural Marketing Service (AMS) began collecting data on pesticide residues on produce. These data allow us to compare pesticides used on crops with residues found on foods.

In the first year of testing, AMS monitored 13 pesticides used in lettuce production (table 1). Seventeen percent of the lettuce samples tested positive for residues, and 9 of the 13 chemicals were detected. Residue concentrations in seven of the nine cases were below the established tolerance levels. These were acephate, diazinon, endosulfan, permethrin, and methamidophos (insecticides); DCPA (a herbicide); and DCNA (a fungicide).

Residues of two chemicals not permitted for use on lettuce were also found. One of these chemicals, the insecticide chlorpyrifos, was applied in 1990 but is not registered for use on lettuce. (Registration is the EPA regulatory process certifying the conditions under which a pesticide can be used on a particular crop without posing health risks to farmers or consumers. A chemical may not be legally applied to a crop unless it is registered for that use.) The other chemical, DDE, is a byproduct from the breakdown of DDT, a pesticide in common use during the 1950's and 1960's. Although DDE is not applied as a pesticide and DDT was banned in the United States in 1972, the persistence of DDT in the environment may account for the presence of low levels of derivatives such as DDE still being found on food.

Survey Finds Pesticide Use Widespread, Varied

U.S. lettuce production is concentrated in a handful of States on a relatively small number of large operations. California is the Nation's leading producer, followed by Arizona and Florida (fig. 1).

In the NASS/ERS survey of agricultural chemical use on vegetable crops, growers in Arizona, Florida, Michigan, and Texas indicated which pesticides they use in growing lettuce. Because State regulations require growers in California to periodically report all of their pesticide use to that State's Environmental Protection Agency, these growers were not asked to participate in the pesticide use portion of the survey. Michigan and Texas, relatively minor lettuce producing States, were included in the survey because of their importance to overall vegetable production and value.

Nearly all lettuce acreage in the four States surveyed received one or more applications of pesticides, but chemical use varied widely (table 2). Growers there applied a total of 62 chemicals to control pests on lettuce. Arizona growers were the primary users of acephate, diazinon, and endosulfan. Only Texas growers applied DCPA. Florida growers relied heavily on methamidophos. Permethrin was used in all four States. None of the surveyed growers applied the fungicide DCNA, which was detected in AMS residue testing. However, California State records show that DCNA is applied there.

This diversity of chemical use patterns suggests that applying the same restrictions to particular chemicals in all States could change where lettuce is produced and its seasonal price and availability. As pest problems differ by region, so does the availability of effective and economically feasible alternatives should one chemical be removed. And, because the growing season for lettuce varies across regions, restrictions on chemical use also may affect seasonal supplies.

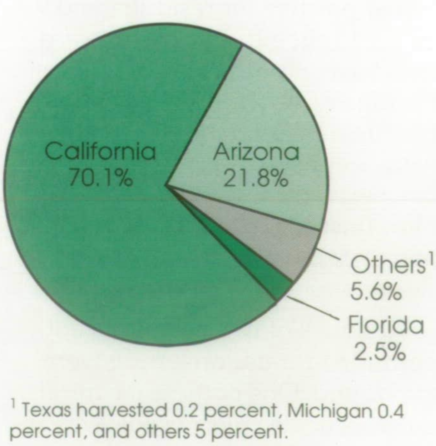
Among the pesticides detected as residues by AMS, permethrin was applied to the most lettuce acreage—over three-quarters of the area planted. Endosulfan was applied in the largest quantity. Most of this was applied in Arizona (42,199 pounds), where 58 percent of the lettuce crop was treated. Other pesticides used in large quantities were diazinon and acephate, most of which were applied to the Arizona crop. Farmers applied diazinon on more acres than acephate, but they applied acephate at higher rates per acre.

Chlorpyrifos was applied to a small percentage of total lettuce acreage in the four States, in apparent violation of EPA regulations. (It is registered for use on other vegetable crops, such as broccoli, sweet corn, onions, and cabbage.) The greatest use of this chemical on lettuce occurred in Texas and Michigan.

With few exceptions, these applications data are consistent with AMS pesticide-residue findings. The grower surveys confirmed the application of most of the pesticides detected as residues in the AMS testing program, including chlorpyrifos. Lettuce producers in Arizona, Florida, Michigan, and Texas applied all but one (DCNA)

In 1990, FDA detected pesticide residues in 55 percent of domestically produced lettuce samples. Two percent contained residues exceeding tolerance standards.

Figure 1
California and Arizona Are the Top U.S. Lettuce Producers



[1] Texas harvested 0.2 percent, Michigan 0.4 percent, and others 5 percent.

Table 2
Permethrin Widely Used in Lettuce Production

Active ingredient	Purpose	Acreage treated: Arizona	Florida	Michigan	Texas	Total[1]
		Percent of planted area				
Acephate	I	40.7	0	0	10.5	34.2
Chlorpyrifos	I	.2	1.1	16.8	31.3	1.6
DCPA	H	0	0	0	10.5	.4
Diazinon	I	50.1	3.5	3.4	22.6	42.9
DCNA	F	0	0	0	0	0
Endosulfan	I	58.9	0	0	7.9	49.2
Methamidophos	I	.8	87.3	0	0	11.1
Permethrin	I	74.6	89.8	93.2	78.6	76.8
		Acres				
Total planted area	NA	50,500	8,000	1,000	2,300	66,800

[1]Total of four survey States.
Note: I = insecticide, H = herbicide, F = fungicide. NA = not applicable.

of the chemicals used and detected as residues.

Growers Experiment with Alternatives

Vegetable producers in the survey used 30 different practices in addition to pesticides to control pests. Virtually all lettuce producers used some conventional nonchemical practices, such as mechanical cultivation or hand hoeing for weed control. An estimated 30 percent employed at least one other nonchemical alternative to control pests.

Growers reported some innovative approaches to pest control on vegetables, such as using a tractor-mounted sweeper to vacuum bugs off the crop. Farmers also reported using cultural methods such as crop rotation; biological methods such as releasing "beneficial" insects which prey on insect pests, planting pest-resistant crop varieties, and applying various microbial agents; and nonconventional chemical options such as applications of insecticidal soaps, placing pheromone traps to keep track of pest populations and disrupt mating insects, and pest scouting to determine treatment thresholds for the application of traditional pesticides.

Some alternative pest-control methods have become so popular that they are no longer considered "alternative," but rather are accepted as part of the conventional pest treatment relied upon by most growers. Bacillus thuringiensis (Bt, a bacterial insecticide) is one example of such a success story. The most widely used biocontrol agent, Bt accounts for an estimated 71,759 acre-treatments in lettuce in the four survey States. Because this bacteria is toxic to insect pests and not to humans or beneficial insects, Bt is an alternative to conventional chemical pesticide materials. Its use has become so widespread that it is now considered a conventional pest-control material by most farmers.

Alternative Methods Complement Pesticide Use

It is frequently asserted that adoption of alternative pest-control practices will reduce the level of chemical use in agriculture. Alternative practices are in many cases intended to substitute for chemical controls. The expected reduction in expenditures on pesticides provides the farmer with an incentive to adopt the alternative because, if yield remains constant, adoption will increase farmers' profits.

However, chemicals and alternative methods are being used to complement rather than substitute for one another in lettuce production, according to survey results.

This is particularly evident among the large farms. Large farms applied more total pounds of pesticides per acre than did smaller farms. At the same time, these farms were more likely to have adopted alternative pest-control practices.

Larger farms may be experimenting with new methods of pest control without taking the next step of reducing pesticide use. Greater cash-flow and easier access to capital among large farms may explain their tendency to innovate in this way. ■

Consumers Respond to Information About Pesticide Residues

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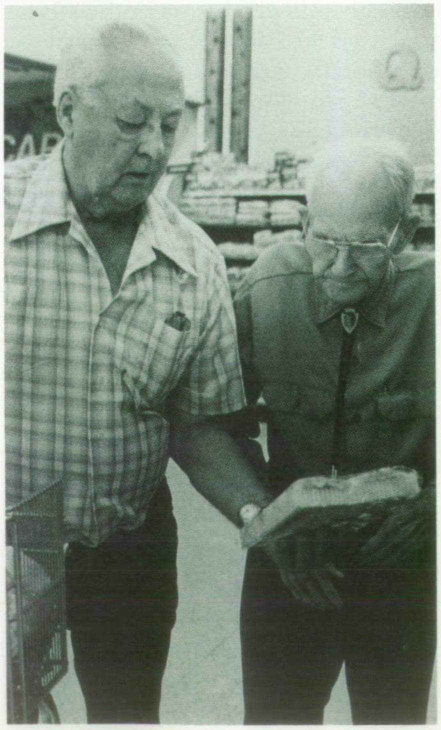
Food safety experts rank food-borne disease due to micro-organisms as the greatest health risk from the food supply. Yet for consumers, pesticide residues on fresh produce are a major food safety concern.

The Packer trade magazine reported that some consumers altered their buying habits between 1989 and 1990 because of concerns about pesticide residues on fresh produce, although changes were not dramatic. On the other hand, more than half of consumers responding to a 1989 University of Georgia survey said they maintained their purchase patterns for fresh produce, even though they perceived high risks from pesticide residues and desired some assurance of the produce's safety.

The apparent contrast between attitudes and behaviors concerning pesticide residues gives confusing signals to food marketers and regulatory policymakers.

Researchers at North Carolina State University conducted a consumer survey to gain information on how consumers trade off health risks with price. The researchers found that many consumers were willing to shift to produce that had been tested for residues after they received information about pesticide residues. But their willingness to shift depended on the price difference between the tested and untested produce and their education level.



When asked to rate the seriousness of health risks from chemicals in the food supply (which might include additives, preservatives, and pesticides), more than 60 percent of consumers surveyed expressed high levels of concern.

The author is an assistant professor in the Department of Economics at Clark University, Worcester, Massachusetts. Partial support for this research was provided under a cooperative agreement with USDA's Economic Research Service at North Carolina State University with Kerry Smith and Edmund Estes.

Table 1
Consumers Perceive Risks From Chemicals in Food

Seriousness of health risk	Respondents perceive health risk from: Chemicals in food	Commercially grown fruit & vegetables	Organically grown fruit & vegetables	Laboratory tested fruit & vegetables
	Percent of respondents			
1 (no risk)	1	1	29	6
2	2	1	24	15
3	2	5	22	23
4	4	9	7	14
5	7	16	9	18
6	8	12	4	8
7	12	17	2	5
8	19	18	2	4
9	8	9	0	2
10 (very serious risk)	37	12	1	5
Mean	7.9	6.6	2.8	4.4

Consumers Concerned About Pesticides

The researchers distributed survey questionnaires to 1,860 shoppers at 24 food stores in Raleigh, North Carolina, in September and October 1990. Roughly a third of the questionnaires were returned, and 430 respondents completed all the questions and provided consistent answers.

Sixty-eight percent of the respondents were female. The average household size for these consumers was 2.6. The average annual household income was $48,834—about a third above the national average. Education level averaged 16 years, compared with the national average of 13 years. Shoppers in the survey said they spent an average of $75 per week on groceries, including $11 on fresh fruit and vegetables for their families.

When asked to rate the seriousness of health risks from chemicals in the food supply (which might include additives, preservatives, and pesticides), more than 60 percent expressed high levels of concern.

Respondents were also asked about their perceived health risks from three types of fresh fruit and vegetables. On a scale of 1—"no health risk"—to 10—"very serious risk,"—the average ratings were 6.6 for produce grown with pesticides, 4.4 for produce tested for pesticides, and 2.8 for organically grown produce (table 1).

Consumers Respond to Risk Information

Survey respondents were asked to choose between two hypothetical produce labels. One described a produce item grown conventionally using pesticides (nontested produce). The other described produce grown the same way, but tested for pesticide residues (tested produce). Both items had similar quality features—freshness, appearance, taste, and nutritional value. But they differed with respect to price and health risks.

The labels contained information on health risks from pesticide residues. Health-risk estimates ranged from a low of 3 additional cancer cases per 50,000 consumers over their lifetimes to a high of 50 cases. Prices for the nontested produce ranged from $0.30 to $1.45 per produce unit. In the survey choices presented to each respondent, prices were increased as the probability of contracting cancer was lowered. Therefore, the health risk of the tested produce was lower and its price was higher com-

Consumers were willing to pay an average 64 cents more for produce that had been tested for pesticide residues—70 percent over the average price of 88 cents for untested produce.

Table 2
Consumers Willing To Pay More for a 33-percent Reduction in Risk

Consumer characteristics	Price premium	Number of respondents
	Dollars per unit	*Number*
Household income:		
Less than $15,000	0.83	35
$15,000-$45,000	.64	124
More than $45,000	.58	117
Number of years of formal education:		
Fewer than 16	.88	103
More than 16	.50	173
Attitude toward health:		
Sensitive	.87	200
Less sensitive	.55	76

Note: Of the 430 people who completed all the survey questions and provided consistent answers, 270 respondents who decided to purchase either tested or nontested produce were included in the calculations of price premiums.

Table 3
Consumers Willing To Pay Only Marginally More for Greater Reductions in Risk

Risk reduction	Price premium
	Dollars per unit
10 percent	0.60
33 percent	.64
50 percent	.67

pared with the risk and prices of the nontested produce.

Respondents were asked whether they would purchase either the nontested or the tested produce. To realistically represent actual choices that confront consumers in food stores, the respondents were allowed the option of buying neither type of produce item.

Forty-two percent of the respondents expressed a preference for fresh produce that was tested and certified as having less risk, even though the tested item cost 35 cents more on average. Twenty-two percent preferred to continue purchasing untested produce, given the per-unit price and health risk levels presented. Eight percent said they would buy neither type of produce, and 11 percent said they preferred organically grown. The remaining 17 percent said they did not agree with the information presented on the labels or were not able to evaluate the risk information.

The survey found that when consumers receive information about health risks, many will search for safer foods. However, changes in purchase patterns depend on the prices of tested produce and nontested produce (a substitute), the reduction in risk with tested produce, and education levels.

Price information did change consumer behavior. Each 1-percent increase in the price of the safer, tested produce reduced by 0.57 percent the likelihood of a consumer purchasing it over the nontested produce.

Risk information also mattered. Consumers appeared to revise their assessments of the risks from pesticide residues on fresh produce after comparing risk levels on the two produce labels. Consequently, a 1-percent reduction in risk associated with tested produce increased by 0.07 percent the likelihood of consumers' choosing tested produce over nontested, given the average prices for the two types of produce.

However, the relative importance of price in the decision to switch to tested produce was eight times greater than that of changing health risks.

Consumers Are Willing To Pay More for Reduced Risk

Using the choices respondents made between the tested and nontested produce, the researchers calculated how much more willing survey respondents were to pay for the reduced risk offered by the tested produce.

On average, the respondents were willing to pay 64 cents more for a produce item that had been tested in exchange for a 33-percent reduction in health risk. This amounted to a 70-percent price increase over the average price of 88 cents for untested produce. However, about 10 percent of respondents were not willing to pay more for tested produce than they were currently paying for nontested produce.

The premium consumers were willing to pay did not change much despite the increase in risk reduction (table 3). Respondents were willing to pay 60 cents more per item for a 10-percent reduction in risk, but only 67 cents more per item for a 50-percent reduction. This may mean consumers in the survey were focusing on a general concern about food safety rather than differences in the level of risk.

Consumers were not willing to pay much more for a large reduction in risk versus a small reduc-

Labeling of Pesticide Residues on Produce

With the surging popularity of fruit and vegetables has come a growing number of consumer concerns about the long-term health effects of pesticide residues on produce.

However, according to the Food and Drug Administration (FDA), pesticide residues do not pose a serious risk to food safety. In its 1991 Residue Monitoring Program, FDA found that among the domestic and imported fruit and vegetables tested for residues, 68 percent contained no pesticide residues, while 2 percent contained residues in violation of legal tolerance levels established by the U.S. Environmental Protection Agency. Yet this information has not dispelled consumers' concerns.

No Federal Regulations for Retail Labels

Present legislation pertaining to pesticide labeling requires that pesticides applied to fruit and vegetables after harvest be declared on labels on the shipping container. However, such labeling is not required once the food is removed from the shipping container and displayed for sale. There are no Federal labeling regulations regarding pesticides applied to fruit and vegetables prior to harvest.

In the absence of Federal regulations, State regulations have evolved. For example, Maine requires supermarkets to post notices stating if any produce sold in the store has been treated with postharvest pesticides—such as "produce in this store may have been treated with one or more postharvest treatments." Untreated produce must be labeled as such. Upon request, stores must tell customers within 48 hours which pesticides were used on specific produce items.

Retailers Respond to Consumer Concerns

In response to heightened consumer apprehension about pesticide residues, some retailers have developed private testing and certification services. The number of food retailers offering these grew from a single supermarket chain in 1987 to 14 retailers operating more than 740 grocery stores by the end of 1989.

However, retailers and growers have not been able to obtain higher prices for fruit and vegetables certified as having no detectable residues. Although growers and retailers may spend $75,000-$200,000 per year to operate residue-sampling programs, most view these as a means to document safe practices to buyers rather than as a marketing tool. Retailers do not pay price premiums to grower-shippers for residue-free produce.

Because various laboratories may use widely different testing procedures, national guidelines on laboratory performance and standards are being developed under the USDA-FDA National Laboratory Accreditation Program to promote more uniform testing.

Organic Produce an Alternative

Food retailers have also added "organic" sections to produce departments so shoppers can buy fruit and vegetables grown without synthetic chemical pesticides.

Currently, there are no national standards or definition of "organic," so consumers cannot be assured of what they are buying under such a label. For example, processed foods labeled "organic" could contain from 40 to 100 percent organically produced ingredients. Although FDA investigates intentional mislabeling, the investigations can be made only on a case-by-case basis since no legal definition of "organic" exists.

More than half the States have laws or regulations regarding organic products. Yet while there are similarities among State regulations, the lack of consistency between the different standards means farmers and processors produce and label their products differently for interstate commerce.

National standards are in the making, however. The 1990 farm bill included a provision which established procedures for developing a national program for organically grown foods. The provision requires USDA, with advice from a National Organic Standards Board, to set national minimum standards for the production, marketing, and labeling of organic foods by October 1993. (For more information on the provisions of this national program, see "Congress Mandates National Organic Food Standards" in the January-March 1991 issue of *FoodReview*.)

Although consumers often associate "organic" with "grown without synthetic chemicals," many do not realize that organically grown produce may contain small levels of pesticide residues carried by rain, fog, irrigation water, drift from spray applied elsewhere, or even from traces of chemicals used years earlier. The term "organic" focuses on production methods employed—not on guaranteeing freedom from pesticide residues.

—For further information, contact Elizabeth Frazao at (202) 219-0864.

tion partly because the probabilities of contracting cancer were evaluated to be small (15 additional cancer cases per 50,000 consumers versus 13 or 7.5 cases). Thus, respondents seemed to regard the two reductions as comparable.

Surprisingly, consumers with annual household incomes below $15,000 were willing to pay appreciably more to reduce the risk from pesticide residues than were people with higher incomes. Likewise, consumers who had not attended college were willing to pay more for risk reduction than were higher educated consumers. Perhaps more educated consumers are more skeptical about the accuracy of information on pesticide residues in food.

Prior interest in health plays a role in consumers' responses to pesticide risk information. Consumers who were more interested in their overall health were more responsive to the information on reduced risk from tested produce (table 2). They were willing to pay a higher price (87 cents per unit) for tested produce than were consumers who were less interested in their health. Consumers who were less interested were willing to pay only 55 cents more for the same reduction of risk.

Implications for Tolerance Setting and Information Programs

In setting risk standards for pesticide use, policymakers must consider that the tradeoff between risk and price depends on consumers' attitudes toward the risks, their interest in their general health, and their education levels. Differences in these risk/price tradeoffs likely result in different levels of "acceptable" risks for each consumer. Thus, a uniform tolerance level for pesticide residues in food might not accurately reflect how consumers differ in the value they place on health risks.

Consumers in this study were able to update their risk perceptions when provided with new information. Thus, information programs—such as produce labeling or instore displays—can provide consumers with more opportunities to learn about health risks. Greater understanding on the part of consumers about the relative health risks from foods may narrow the disparity between consumers' perceived high risk from pesticides and the judgement of scientists who assign pesticides a low risk.

But the communication must be effective. For example, consumers in this survey seemed to have difficulty dealing with low probabilities and distinguishing small changes in risks. Effective information programs must recognize the diversity in consumers' attitudes as well as consumers' varying abilities to understand and use information in making buying decisions.

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Food Irradiation Still Faces Hurdles

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The 1991 opening of an irradiation plant in Mulberry, Florida, has sparked renewed interest in food irradiation. Unlike the 40 or so existing gamma-irradiation plants in the United States used to sterilize disposable medical supplies and for other industrial uses, the Florida irradiator is the first to specialize in treating food.

In January 1992, Vindicator, Inc., shipped an initial 1,000 pints of irradiated strawberries to a Florida grocery store. Packaging the strawberries in a high carbon-dioxide atmosphere and irradiating them extended their shelf-life. According to the store owner, the strawberries maintained their fresh appearance and market quality for 22 days instead of the usual 3 to 5 days.

The grocery store owner said most customers were indifferent about the irradiation treatment. Most purchased the strawberries labeled "Treated by Irradiation" when the nonirradiated strawberries were more expensive. He said a small number of shoppers refused to buy the irradiated strawberries, while an equal number praised the store for offering irradiated produce. That store, and two others in Ohio and Illinios, sold irradiated strawberries and other fruit and vegetables in 1992.

As of 1991, 37 countries, including the United States, allow irradiation of specific foods. However, in only about 20 of these countries is food irradiated on a commercial basis—mostly to decontaminate small quantities of spices. Companies in a few countries also irradiate potatoes, onions, poultry, seafood, or grain. According to the American Spice Trade Association, less than 1 percent of U.S. spices are irradiated and used in processed foods. Irradiation has also been used to sterilize food for U.S. cancer patients and astronauts.

How Irradiation Works

Irradiation exposes products to ionizing radiation—gamma rays from radioactive isotopes (most commonly, cobalt-60) or machine-

Unlike most industrial irradiation facilities, this Florida plant specializes in treating food.

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produced, high-energy electrons and x-rays. Irradiated foods do not become radioactive when irradiated with FDA-approved sources. The effects of the radiation depend on the dose absorbed, measured in kilograys (kGys) (table 1).

Irradiation Offers a Variety of Benefits . . .

Irradiation sterilizes or kills insects infesting grain and produce. Low-dose irradiation also inhibits sprouting of potatoes, onions, and other root crops and can delay ripening of some tropical fruit. Higher doses can kill micro-organisms that cause spoilage in fresh foods. Thus, irradiation may replace chemical fumigants, sprout inhibitors, and postharvest fungicides. Irradiation also kills salmonellae and other micro-organisms that can contaminate meats and poultry and cause foodborne diseases, such as salmonellosis and campylobacteriosis.

Irradiation is a "cold treatment" that achieves its effects without raising the food's temperature significantly, leaving the food closer to its unprocessed state. By not using high temperatures, irradiation minimizes nutrient losses and changes in texture, color, and flavor.

. . . and Limitations

One limiting factor for irradiation is damage to the food. Irradiating fresh produce can cause softening, sensitivity to chilling, uneven ripening, and rot. Very few fruit tolerate the doses needed to control postharvest fungi. Medium doses may create off-flavors in radiation-sensitive meats. Irradiation leaves no protective residues, so proper packaging is needed to prevent recontamination by insects or micro-organisms. Meats, poultry, and fish irradiated at low or medium doses still require refrigeration.

Table 1
Food Irradiation Presents Benefits and Limitations

Suggested dose	Benefits	Limitations	Status
Kilograys			
0.05-0.15	Inhibit sprouting of root crops and elongation of asparagus	Potatoes must cure before irradiation	Approved by U.S. regulators
0.30-0.75	Sterilize insects	Reinfestation possible, insects still able to feed	Approved by U.S. regulators
0.10-0.75	Delay ripening of some fruit	Successful for limited number of fruit	Approved by U.S. regulators
0.30-0.50	Inactivate parasites in meat	Still needs refrigeration	Approved by U.S. regulators for pork only
1-2	Kill spoilage micro-organisms in fish and fungi in fruit	Recontamination possible. Still need refrigeration. Above certain doses, softening, pitting, and other problems for fruit	Not approved by U.S. regulators
1.5-3	Reduce micro-organisms causing public-health problems in meat and poultry	Recontamination possible. Still need refrigeration.	Approved by U.S. regulators for poultry only
10-30	Decontaminate spices	Recontamination possible	Approved by U.S. regulators
23-57	Sterilize food for unrefrigerated storage	Must be irradiated to minimize undesirable changes in quality	Not approved by U.S. regulators

Irradiation May Improve Food Trade

Irradiation may enhance exports or imports, provided the recipient country accepts the irradiated food. A longer shelf-life extends the geographic market for fresh products by providing extra time to reach distant markets or by allowing the use of a slower, and thus cheaper, mode of transportation.

Quarantine treatment is another use for irradiation. Such treatments help prevent the spread of plant pests to noninfested areas. For example, exports of U.S. citrus, papayas, and cherries to Japan are treated with vapor heat, are held at low temperatures (cold treatment), or are fumigated with methyl bromide. U.S. imports of many fruit are subject to similar treatment. However, methyl bromide has been found to deplete the ozone layer, and is targeted for phase out by the U.S. Environmental Protection Agency (EPA) before the end of the decade.

USDA researchers have shown irradiation to be an effective quarantine treatment in ridding Florida grapefruit of Caribbean fruit flies. But irradiation cannot be used as a quarantine treatment on grapefruit because USDA's Animal and Plant

Health Inspection Service (APHIS) has approved irradiation to treat only Hawaiian papayas for shipment to the continental United States, Guam, Puerto Rico, and the U.S. Virgin Islands.

FDA and FSIS Permit Low-Dose Irradiation

Use of irradiation on foods requires the approval of the U.S. Food and Drug Administration (FDA). USDA's Food Safety and Inspection Service (FSIS) must approve use for meats and poultry. (APHIS must approve irradiation when used as a quarantine treatment for animal and plant products.)

In the early 1960's, FDA approved low-dose irradiation for white potatoes to stop sprouting and for wheat and wheat flour to control insects. U.S. growers and food manufacturers have not used either application because less expensive and easier-to-use chemicals have been available.

In the early 1980's, FDA approved doses of 10 kGy to kill microorganisms in spices and dried-vegetable seasonings. In July 1985, FDA approved low doses (0.3 to 1.0 kGy) to sterilize trichinae in infected pork. FSIS gave its approval to irradiate pork in January 1986.

In April 1986, FDA approved doses up to 1 kGy to control insects in foods and to delay ripening and sprouting in fresh fruit and vegetables. FDA also raised the level permissible for spices and dried-vegetable seasonings to 30 kGy.

FDA's most recent regulatory action allows irradiation of poultry at doses of up to 3 kGy to control salmonellae and other pathogens in poultry. FSIS approved irradiation of poultry in September 1992 (see "Irradiation of U.S. Poultry—Benefits, Costs, and Export Potential" elsewhere in this issue).

Irradiated Foods Must Be Labeled

Government regulations require irradiated food at the retail level to be labeled "Treated with Radiation" or "Treated by Irradiation," and to bear the international logo for irradiated food.

For irradiated foods that are not packaged, such as bulk containers of fruit and vegetables, retailers must display prominently the required logo and phrase. Retailers may place the phrase and logo on the bulk container, on counter signs or cards, or on individual fruit or vegetables. Irradiated foods sold at the wholesale level must be labeled, and the caution "do not irradiate again" is required on the shipping container as well as on either the invoice or the bill of lading.

Labeling requirements apply only to whole foods that have been irradiated. Foods containing irradiated ingredients, but which are not themselves irradiated, are exempt from labeling. For example, irradiated strawberries would be required to carry the logo and phrase, but yogurt containing irradiated strawberries would not. Labeling regulations do not apply to food served in restaurants.

Irradiated foods must display this international symbol.

Surveys Show Consumers Wary . . .

Uncertainty over consumer acceptance of irradiated foods is one of the major roadblocks for the technology. A major consumer concern with irradiation is its perceived association with radioactivity and nuclear power. Several food manufacturers and retailers say they are willing to use irradiation when consumers are ready to accept the process.

In its annual consumer-attitudes survey, the Food Marketing Institute asks shoppers whether they consider irradiated foods to be a health hazard. Respondents who considered irradiated foods a serious hazard grew from 37 percent in 1986 to 42 percent over the 1989-91 period. By 1992, concern with irradiated foods as a serious hazard dropped to 35 percent. The percentage of respondents saying they were unsure about the hazard of irradiated foods grew from 18 percent in 1991 to 27 percent in 1992.

. . . But Test Marketing Demonstrates Consumer Acceptance

While opinion surveys generally find consumers wary of irradiated foods, small-scale test marketings demonstrate consumers are willing to buy irradiated produce—and even sometimes pay a premium price.

In 1984, EPA banned ethylene dibromide (EDB), one of the major pesticides used to kill insects in imported fruit and vegetables. No satisfactory alternative existed for killing fruit flies in Caribbean-grown mangoes, so Puerto Rican mangoes could not enter mainland United States.

In 1985, APHIS gave permission for a small shipment of Puerto Rican mangoes to be disinfested by irradiation and to enter the mainland United States. The mangoes were sold in the same Florida grocery that later sold the irradiated strawberries. Shoppers paid premium prices for the irradiated mangoes. And, repeat sales were common.

Two supermarkets in the Los Angeles suburbs offered irradiated Hawaiian papayas at the same price as hot-water disinfested papayas in 1986. Irradiated papayas outsold hot-water treated papayas by more than 10 to 1. (The irradiated papayas were riper because hot-water treatment requires harvesting the fruit just as it starts to ripen.)

In a more recent marketing test, Central Missouri State University researchers sold irradiated and nonirradiated apples at local roadside stands. Prices for the irradiated apples varied ($0.29, $0.39, and $0.49 per pound), while the nonirradiated apples were priced at a constant $0.39 per pound. Some bought the irradiated apples out of curiosity or because they thought irradiated apples tasted better and could last longer. Most buyers responded to price, purchasing whichever apples were cheaper.

Food Irradiation Opponents Vocal

Opponents of food irradiation may be fueling consumer apprehension about irradiation. One anti-food-irradiation group sponsored radio spots in Florida implying that irradiated fruit and vegetables might kill anyone who eats them.

Opponents object to the use of a technology dependent on a radioactive material for environmental and worker safety reasons. Some have threatened boycotts against manufacturers and retailers who handle irradiated foods. They assert that the long-term safety of eating irradiated food has not been proven and question whether irradiation lessens the nutritional value of the treated food.

Irradiated Foods Not Easily Detectable Without Labels

The lack of reliable post-irradiation techniques for detecting irradiated foods may be adding to public mistrust of the process. Several types of dosimeters exist for determining the amount of radiation a food receives while in the irradiation chamber. But once the food leaves the chamber, the reduction of bacteria is the only easily discernible difference between some irradiated and nonirradiated foods.

Scientists are working on a variety of post-irradiation testing methods to determine if a product has been irradiated and at what dose. The most promising tests are for products containing fatty acids, bone, or chitin, such as poultry or shrimp. However, these screening methods are still in the development or verification stage.

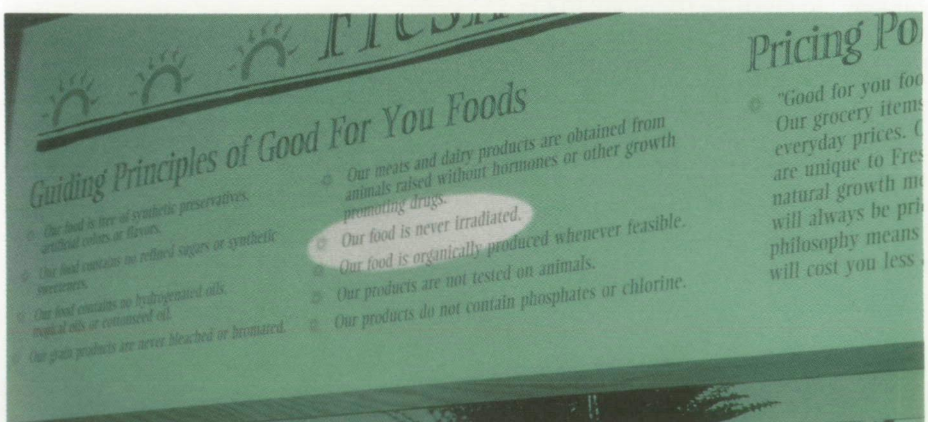
Public Concern Sparks Restrictive Actions

Maine and New York prohibit the sale of irradiated foods, with the exception of spices and sterilized food for hospital patients with compromised immunity. Officials of these two States have said the action was in response to lobbying by citizen groups and not the result of scientific evidence questioning the safety of food irradiation.

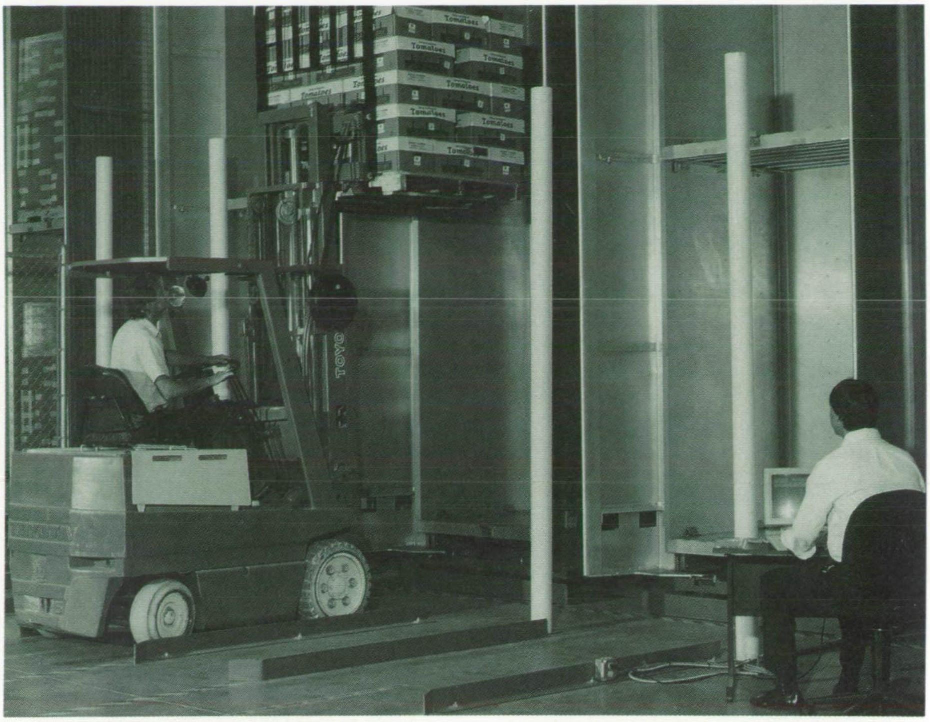
In the past, legislatures in other States—including Alaska, California, Massachusetts, New Hampshire, and Pennsylvania—had introduced resolutions or legislation that would ban or restrict the irradiation of foods. But, these proposals were not passed.

Costs Also Limit Use

Irradiation is capital-intensive. USDA's Economic Research Service (ERS) estimated that building an irradiator designed to treat one type of food (single-purpose facility) in 1988 would have required a minimum initial investment of $3 million. Sam Whitney, president of the Vindicator irradiator, reports



Consumer acceptance is one of the main roadblocks for the technology.



Irradiating produce to control insects is more costly than chemical fumigation. An irradiator must treat 50 million pounds of food a year to bring costs down to 1-3 cents per pound.

that his first plant, which can treat a variety of foods, cost $7.8 million to build and load with cobalt-60—the radiation source. Duplicate facilities would cost somewhat less.

ERS found that an irradiator must treat 50 million pounds of food a year to bring treatment costs down to 1-3 cents per pound. (For additional cost information, see "Irradiation's Potential for Preserving Food," *National Food Review,* Spring 1986.) Firms that do not have the volumes to justify building their own irradiator as part of their packing or processing plant will either have to join with other firms and build a freestanding, centrally located irradiator or use the services of a contract irradiator.

The president of Vindicator reports that irradiating the strawberries for the Miami store added 30 cents to the cost of a dozen pints—or about 3 cents per pound. In addition to the irradiation cost, with a freestanding or contract irradiator there is also the expense of transportation.

Irradiation must compete with existing preservatives and fumigants by providing either a superior or a lower cost treatment. Preliminary comparisons show irradiation to be more costly than chemical treatments. ERS estimates that irradiating produce for insect control runs 1-4 cents per pound, higher than the reported 0.3-2.3 cents per pound for chemical fumigation.

Irradiation Faces Competition From Other New Technologies

Food scientists continue to develop and refine alternative methods to extend shelf-life and improve food quality. For example, USDA and Israeli researchers have copatented three new yeast strains that have proven effective against certain postharvest rots that strike citrus fruit, grapes, apples, pears, and tomatoes. A private company is developing these yeasts for commercial use.

New developments in packaging—such as shrink-wrapping and modified-atmosphere storage—can also extend shelf-life. For example, Fresh Western Marketing Inc. in Salinas, California, uses a breathable plastic patch to regulate the rate at which oxygen and carbon dioxide enter and leave the packaged fruit and vegetables. The company uses this controlled-atmosphere packaging to sustain the quality and to more than double the shelf-lives of a variety of fresh fruit and vegetables, including asparagus, broccoli, cauliflower, lettuce, snowpeas, tomatoes, and berries.

This process and other packaging technologies may achieve the shelf-life extension that irradiation offers at a lower cost and a higher degree of public acceptance.

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Irradiation of U.S. Poultry—Benefits, Costs, and Export Potential

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Along with the potential to give perishable food products a longer shelf-life and to substitute for chemical fumigants, irradiation may offer consumers safer poultry by destroying microbial pathogens which cause foodborne illnesses.

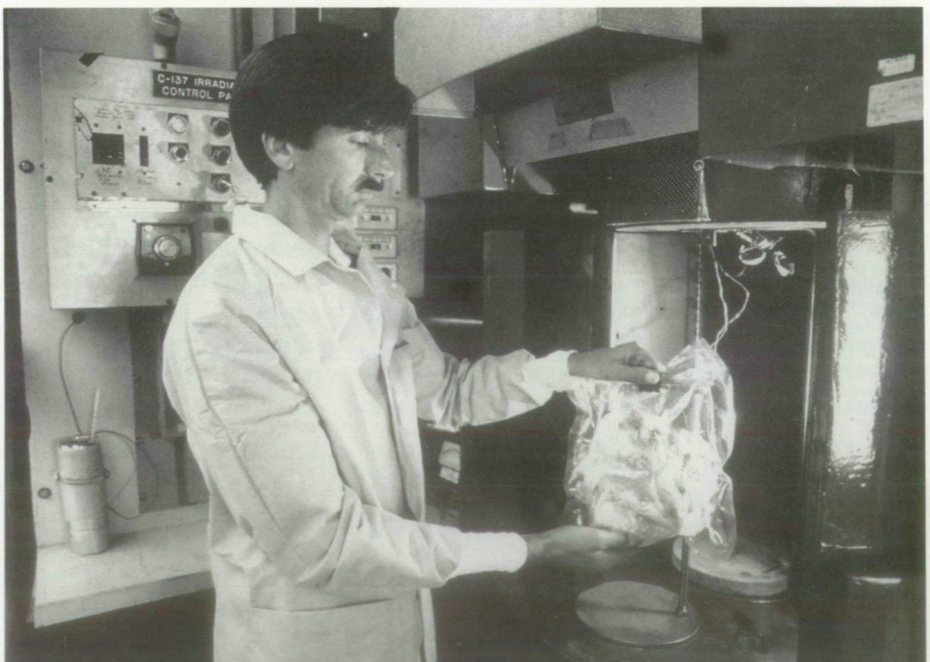
Last fall, USDA's Food Safety and Inspection Service (FSIS) approved irradiation of uncooked poultry to control bacteria that cause diseases, such as salmonellosis and campylobacteriosis. Each year, about 4 million Americans contract these diseases primarily from foods, and suffer a variety of symptoms ranging from diarrhea and vomiting to blood poisoning. These diseases can be especially serious for the very young, the elderly, and people with compromised immune systems.

Although irradiation of poultry could reduce the number of foodborne illnesses caused by eating undercooked or improperly handled chicken or turkey, producers will not use the technology until they believe that consumers will buy irradiated poultry.

But, poultry producers' interest in irradiation is mixed. The National Broiler Council says it is neutral toward irradiation—that commercial viability depends on consumer acceptance. The National Turkey Federation favors experimentation with irradiation to determine public acceptance. The USA Poultry and Egg Export Council favors offering irradiated poultry products in export markets.

Poultry Irradiation Approved To Combat Foodborne Disease

On September 21, 1992, FSIS published a final rule which allows irradiation of fresh or frozen uncooked poultry and mechanically separated poultry products to kill micro-organisms that cause dis-



USDA chemist Bill Obermeyer places a plastic bag containing chicken into position for irradiation—now approved for poultry to reduce spoilage and illness caused by bacteria.

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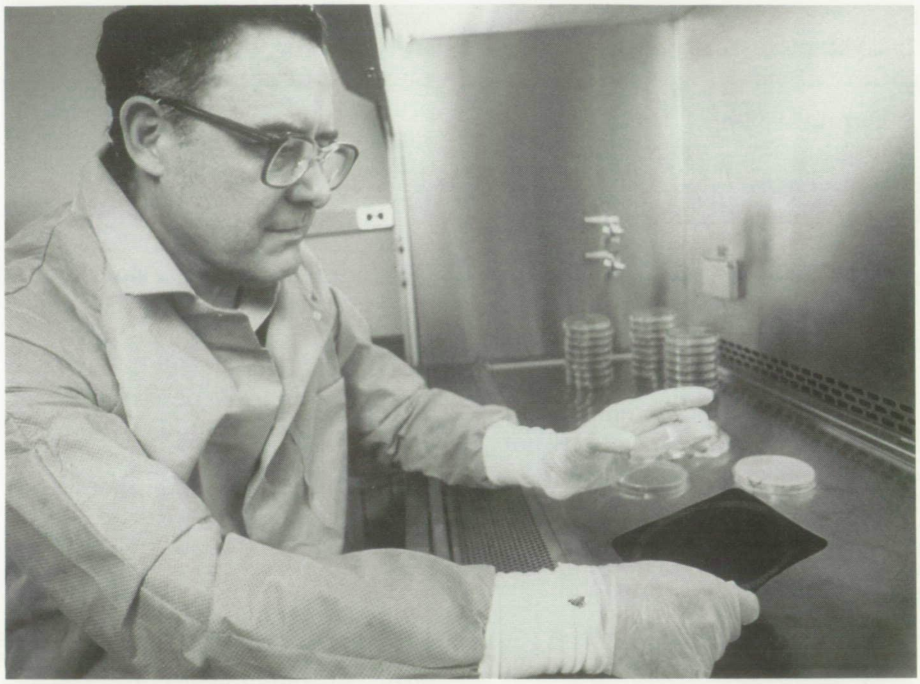
eases, such as salmonellosis, campylobacteriosis, and listeriosis. The U.S. Food and Drug Administration (FDA) had approved irradiation of uncooked poultry in May 1990. Now that both FDA and FSIS have issued final approvals, irradiation may be used on poultry.

FSIS' rule would allow the use of FDA-approved ionizing radiation sources to treat poultry at a dose of 1.5-3.0 kilograys (kGy). (Ionizing radiation is radiation with sufficient energy to remove electrons from atoms, thereby creating ions.) Products that may be irradiated include fresh or frozen uncooked whole carcasses and parts, including ground, boneless, and skinless poultry, as well as mechanically separated poultry products. Cooked, cured, or poultry products with added ingredients may not be irradiated.

To reduce the possibility of recontamination, poultry must be packaged for sale prior to irradiation. Such packaging must be approved by FDA, which last amended the list of packaging materials approved for use during irradiation in 1989. Newer combination materials, such as pads that absorb poultry juices and water, would need approval. The packaging material must allow oxygen—but not moisture or micro-organisms—to enter and leave the package.

Labels for irradiated poultry must display the international radiation logo in green along with the statement "Treated with Radiation" or "Treated by Irradiation." The labels would also carry the handling statement "Keep Refrigerated" or "Keep Frozen" as appropriate. Statements about the purpose of irradiation, such as "Irradiated to control foodborne disease," may be included, as long as FSIS rules that the information is not false or misleading.

FSIS must approve a poultry packing plant's or irradiation plant's quality-control program before the plant will be permitted to irradiate poultry. Quality controls include facility licensing by appropriate Federal and State agencies, radiation processing and safety training for plant supervisors, procedures and equipment for measuring the amount of radiation absorbed by the products, and appropriate handling and sanitation practices.



USDA microbiologist Donald Thayer uses various growth media to replicate Salmonella—the primary bacterium contaminating poultry.

Foodborne Illnesses Are Costly

Salmonellosis and campylobacteriosis are the two human diseases most frequently associated with chicken consumption. (This article focuses primarily on chicken, because Americans consume four times as much chicken as turkey.)

These two diseases cause symptoms and illnesses ranging from a day or two of mild diarrhea and vomiting to hospitalization for dehydration and diarrhea, blood poisoning, or sometimes even death. The severity of the symptoms depends, in part, on how many bacteria are consumed and how well the body can fight off the bacteria. Therefore, the most vulnerable are people with weak immune systems, such as some of the elderly and patients with cancer, AIDS, or other diseases treated with immunosupressing drugs.

People place themselves at risk of contracting these foodborne illnesses by eating undercooked poultry and by improperly handling uncooked poultry. Risks of contamination can be reduced by cooking the poultry thoroughly; washing all surfaces and utensils touched by raw poultry in hot, soapy water before reusing; refrigerating leftovers promptly in small containers; and thawing frozen raw poultry in the refrigerator—not at room temperature.

Salmonellosis

Centers for Disease Control (CDC) researchers estimate that 2 million cases of salmonellosis occur each year—96 percent of which are caused by food—and that 1,000 to 2,000 end in death. Most cases go unreported.

During 1983-87, 170 salmonellosis outbreaks with identifiable causes were reported to the CDC (each of these afflicted, on average, 84 people). Eaten as a separate item, chicken was identified by the CDC as the cause of 15 of these outbreaks.

Salmonellosis outbreaks are increasingly caused by combination food dishes (which may or may not contain chicken), such as poultry, fish, or egg salads; Chinese or Mexican dishes; or casseroles. During 1983-87, 80 of the 170 salmonellosis outbreaks were attributed to such combination food dishes.

Researchers with USDA's Economic Research Service (ERS) assumed that 30 percent, or 24 of the outbreaks from mixed foods, were caused by chicken. Using this assumption, chicken could have been responsible for 39 of the 170 salmonellosis outbreaks, or 23 percent. ERS researchers assumed chicken was responsible for the same percentage of unreported cases. Therefore, chicken is estimated to have been responsible for 23 percent of the 2 million cases of salmonellosis estimated by the CDC.

ERS estimates medical costs and productivity losses due to food-caused salmonellosis are $1.1 billion to $1.6 billion each year. Using the assumptions explained above, $260 million to $363 million of these estimated costs were attributable to chicken. Medical costs include expenses for doctor visits, medicine, and hospital care. Productivity losses refer to earnings lost from work due to illness or death.

These estimated medical and lost productivity costs do not include pain and suffering, the value of lost leisure time due to illness, or the time consumers take for preventive actions, such as cleaning hands and utensils after handling raw chicken. Costs would increase even more if chronic complications of salmonellosis, such as arthritis and colitis, could be estimated.

Campylobacteriosis

The CDC estimates that 2.1 million campylobacteriosis cases occur each year, of which 120-360 result in death. A 1984 study by the Seattle-King County Health Department found that 48 percent of the cases in that area could be traced to chicken consumption or cross-contamination of other foods by raw chicken. If this percentage is applied to the 2.1 million cases nationally, the medical costs and productivity losses due to campylobacteriosis caused by chicken would be $390-$452 million per year.

Irradiation Prevents Diseases

Irradiating chicken with doses of 1.5-3 kGy will greatly reduce the potential for foodborne illnesses. For example, Dutch researchers estimate that irradiation at 2.5 kGy will leave 93 percent of chicken packages free from *Salmonella*. According to USDA scientists, in the remaining 7 percent of packages, *Salmonella* levels would be reduced by 99.9 percent, the *Salmonella* would be injured and their growth would be reduced, and the remaining *Salmonella* would be more susceptible to heat reduction. This same dose would kill 100 percent of *Campylobacter*.

Irradiation kills other pathogens that sometimes contaminate chicken, such as *Listeria*. However, *Listeria* was not included in the benefit/cost analysis because the percentage of human illnesses associated with chicken could not be determined. Therefore, the public health benefits are underestimated somewhat.

Irradiation Costs Pennies Per Pound

In 1988, ERS estimated the costs of irradiating chicken at a dose of 2.5 kGy in hypothetical irradiators of various sizes. Estimated 1991 operating and annualized investment costs range from 1 to 1.5 cents per pound, depending on irradiator size (table 1).

At the time of the study, there were no U.S. irradiators built specifically to irradiate fresh poultry. The investment and operating costs for irradiating chicken were based on information from commercial plants using irradiation mostly to sterilize medical supplies and equipment.

The irradiators were assumed to use radioactive cobalt-60 as their radiation source. For some applications, an irradiator could use high-energy electrons or x-rays as the radiation source, such as one in France which treats mechanically deboned chicken (see box).

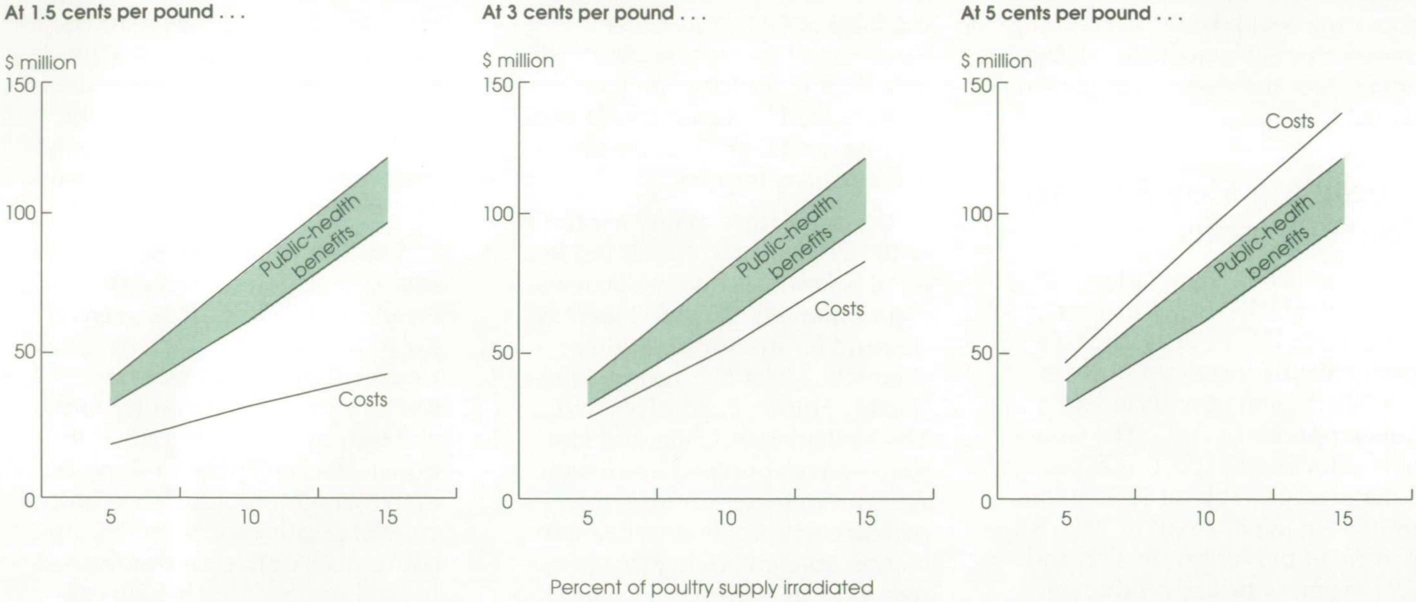
The irradiators in table 1 reflect the processing capacities of medium and large U.S. chicken pack-

Table 1
Costs of Irradiating Chicken Decrease as Plant Size Increases[1]

Annual amount of chicken irradiated	Initial investment	Treatment cost
Million pounds	*Million dollars*	*Cents per pound*
52	2.6	1.50
104	4.4	1.30
208	7.5	1.02
416	14.5	.99

[1]Assumes cobalt-60 irradiator integrated into packing plant.

Figure 1
Public-Health Benefits Can Outweigh the Costs of Irradiating Chicken



ing plants. Irradiators treating smaller volumes would have higher treatment costs per pound.

These costs are for the treatment alone and do not include the expense of a possible educational campaign to acquaint consumers with irradiation, research efforts needed to support industry petitions to FSIS or FDA, or disposal of the cobalt-60 when its radioactivity is too low to be useful for processing. In addition to the costs incurred by the company, various Federal and State government agencies must commit resources for license approval and other forms of inspection.

The irradiators in table 1 were assumed to be physically integrated into existing chicken packing plants, which eliminates the need to build additional refrigerated storage space, loading docks, and offices.

However, an irradiator does not have to be located in the packing plant. Contractors handling a variety of products could do the job instead. For instance, Sam Whitney, president of Vindicator, Inc., a contract irradiator specializing in treating food, said their charge to irradiate poultry at a dose of 1.5-3 kGy will be 3 cents per pound. Customers must pay for transportation.

Public-Health Benefits Can Exceed Costs

Irradiated poultry will enter the marketplace very slowly for many reasons, including uncertainty over consumers' interest in purchasing irradiated chicken and the lack of approved facilities to irradiate the products.

ERS has estimated and compared the public-health benefits with the irradiation treatment costs if 5, 10, and 15 percent of U.S. chicken were irradiated (fig. 1).

If 5 percent of the 18.5 billion pounds of chicken consumed in the United States in 1991 were irradiated, between $31.6 million and $39.5 million would have been saved in terms of reduced medical costs and lost productivity from salmonellosis and campylobacteriosis illnesses and deaths. If 10 percent of the chicken were irradiated, between $63.2 million and $79 million would have been saved. If 15 percent of the chicken were irradiated, public-health protection benefits would have been $94.8 million to $118.5 million.

Assuming a cost of 1.5 cents per pound for an irradiator integrated into a chicken packing plant, irradiating 5 percent of the chicken consumed in 1991 would cost $13.9 million. Irradiating 10 percent of the chicken supply would cost $27.8 million, and irradiating 15 percent would cost $41.6 million. In these three examples, the estimated benefits to public health are more than double the estimated costs, thus yielding positive net benefits.

Higher costs for irradiation lessen the net benefits. For example, a charge of 3 cents per pound (Mr. Whitney's estimated charge at the contract irradiator) for the irradiation treatment yields smaller, but still positive, net benefits under these assumptions. However, a charge of 5 cents per pound would raise the irradiation treatment costs above the health benefits, resulting in negative net benefits for all three amounts of the chicken supply irradiated.

Irradiation May Expand Poultry Exports

Exports are a small but growing part of the U.S. poultry market. Since 1985, U.S. poultry meat exports steadily increased from below 500 million pounds to 1.4 billion pounds by 1991. The value of poultry meat exports is expected to have reached about $930 million in 1992. In the first half of 1992, 6.4 percent of broiler production and 3.0 percent of turkey production was exported.

Some countries are increasing testing requirements for bacteria in imported foods. In 1991, Indonesia began enforcing a zero-tolerance standard for *Salmonella* on poultry, which has largely excluded U.S. exports to that growing market. Greece also has insisted that chicken be free of *Salmonella*, but does not apply that standard to U.S. turkey. Such tests may be used in other countries to reject poultry imports.

U.S. producers' ability to offer irradiated poultry with reduced levels of *Salmonella* could open new export markets, provided there is demand for irradiated poultry products. Major U.S. competitors—notably France, Brazil, Thailand, The Netherlands, Chile, and Hungary—have approved irradiation. As firms in these countries gain experience with commercializing irradiation, foreign poultry producers may gain an edge over U.S. producers in offering irradiated poultry.

Irradiating poultry with doses of 1.5-3 kGy and using proper refrigeration doubles the current shelf-life of about a week. This may make it possible to ship some products now frozen as fresh. Exports could expand because fresh poultry is preferred in some markets, such as Hong Kong. Poultry products with reduced bacteria counts would have an advantage in the Middle East and other hot-weather regions where spoilage is more of a problem.

Swedish companies produce *Salmonella*-free poultry through a variety of controls in each segment of the broiler industry, including heat treatment of chicken feed, strict sanitary controls on poultry farms, and testing of breeding stock and grown chickens prior to shipment to the slaughterhouse. If any chickens test positive for *Salmonella*, the entire stock or flock is condemned. In addition, Sweden has surveillance programs to determine the food source of infection for patients hospitalized with salmonellosis.

These controls, however, come at a price as chicken is consider-

Table 2
Among Countries Permitting Irradiation of Poultry, the Former Soviet Union Is the Largest Importer of U.S. Poultry

Country	Poultry products approved for irradiation	Imports of U.S. broiler meat, 1991
		Million pounds
Bangladesh	Chicken	*
Brazil	Poultry	.13
Chile	Chicken	.55
France	Poultry (ground, chopped, or cut), mechanically deboned poultry meat, egg whites (liquid, dried, or frozen)	6.14
Hungary	Frozen chicken	.09
Israel	Poultry and poultry sections	*
Netherlands	Poultry	6.99
South Africa	Chicken	.80
Syrian Arab Republic	Chicken	.01
Thailand	Chicken	.04
United Kingdom	Poultry	7.10
Former Soviet Union	Poultry, eviscerated	183.09
Yugoslavia	Fresh poultry, egg powder	5.22
Total		210.16

* No U.S. poultry meat imports.

Machine-Produced Radiation Used on Poultry in France

Alternatives to cobalt-60 as the radiation source include high-energy electrons or x-rays.

A French food processing company uses high-energy electrons to reduce *Salmonella* in mechanically deboned poultry. The company uses the irradiated poultry in a variety of processed foods, such as sauces, gravies, and soups. The mechanically deboned poultry is made into 2-1/4-inch-thick cakes, which are then packaged, deep-frozen, and carried on a conveyor through a stream of high-energy electrons.

High-energy electrons and x-rays are produced by electron accelerator machines powered by electricity. With this technology, no radioactive materials are shipped or disposed of.

However, electrons at the maximum energy levels allowed by FDA cannot penetrate more than 1-3 inches, depending on the food's density, when irradiated from one side. Therefore, electrons could be used only with thin packages or if the *Salmonella* contamination were just on the surface.

Although x-rays have the same penetrating ability as cobalt-60, producing x-ray power is very inefficient. No industrial accelerator presently operates in the x-ray mode for a significant portion of time.

For further information on electron accelerators' potential for treating food, see R.M. Morrison's *An Economic Analysis of Electron Accelerators and Cobalt-60 for Irradiating Food,* TB-1762. USDA, ERS, June 1989.

ably more expensive in Sweden than in the United States. In June 1992, the retail price of whole broilers in Stockholm was $3.55 per pound, compared with $0.87 in Washington, DC.

Swedish companies are selling chicken with "*Salmonella*-free" labels in Sweden and Denmark. Denmark is examining ways to change their production and inspection systems to meet this competition. Norway is producing chicken that seems to be free of *Campylobacter*, although no label declarations appear on chicken packages.

Irradiation might provide an alternative product with safety features at a cheaper cost. It will be interesting to see if European customers will accept this product.

Exports of irradiated poultry would require approval by the importing country. Currently, 13 countries permit irradiation of chicken or poultry (table 2), and 11 import U.S. poultry. In 1991, about 15 percent of U.S. broiler meat exports went to these countries, a large portion of which went to the former Soviet Union. However, the four largest U.S. export customers—Japan, Hong Kong, Mexico, and Canada—have not approved irradiation of poultry (they receive about 60 percent of U.S. poultry exports).

Alternatives to Irradiation Explored

Other techniques may offer some public benefits as well. For example, FSIS has just approved (on a case-by-case basis) a trisodium phosphate (TSP) wash for poultry that reduces *Salmonella.* (Whether TSP is also effective in reducing *Campylobacter* is being investigated.)

USDA is working on farm-management strategies to control *Salmonella enteritidis* in eggs, which may also reduce Salmonella levels in chicken.

Poultry producers will compare the costs and benefits of irradiation with alternative techniques to reduce *Salmonella* contamination.

Marketplace Will Decide Use

Potential niche markets might include supermarkets serving individuals at high risk from foodborne illnesses and foodservice operations in nursing homes.

But whether irradiated chicken and turkey have a place in the U.S. poultry marketing system depends on actions by consumers, producers, and marketers. Poultry processors and marketers will decide whether to use irradiation based on a variety of factors, including the cost of irradiation and consumers' acceptance of this technology and interest in its benefits.

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The National School Lunch Program Serves 24 Million Daily

Masao Matsumoto
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The National School Lunch Program ranks behind the Food Stamp Program as the Federal Government's largest food assistance program. On an average school day in fiscal 1992, the program served 24.5 million lunches to children in 92,300 schools and residential child care institutions.

In fiscal 1992, the Federal Government provided $3.8 billion to schools participating in the program. Commodities worth $752.4 million were also distributed. Student payments and State and local funds contribute an approximately equal amount to cover the rest of the cost of the lunches.

Congress established the National School Lunch Program in 1946 to safeguard the health of American children by encouraging consumption of nutritious foods and to provide an outlet for surplus commodities by encouraging domestic consumption through noncommercial channels.

USDA's Food and Nutrition Service (FNS) administers the National School Lunch Program nationwide. All public schools and nonprofit private schools are eligible to participate. State agencies administer the programs in public schools. Other institutions and local school districts prepare and serve the meals. Participating schools are required to serve nutritious lunches that meet USDA guidelines which specify servings, quantities, and types of foods. A typical lunch includes a serving of a protein-rich food, fruit and/or vegetable, bread, and milk. Schools adjust the portion sizes according to children's ages.

In June 1992, the National School Lunch Program operated in 92,300 schools and residential child-care institutions, with a total enrollment of 42.7 million students—about 90 percent of all children in kindergarten through grade 12.

The author is an agricultural economist in the Commodity Economics Division, Economic Research Service, USDA.

Low-Income Children Receive Free Lunches

The Federal Government reimburses States based on the number and type (free, reduced-price, or full-price) of lunches served. All children attending participating schools are eligible to receive a school lunch, but the price they pay depends on their family income.

Eligibility to receive a free or reduced-price lunch is based on the Office of Management and Budget's (OMB) poverty guidelines, which are modified yearly.

For the 1992-93 school year, a child from a family of four with an annual income of $18,135 or less is eligible for a free lunch. A child from a family of four whose annual income is between $18,136 and $25,808 is eligible for reduced-price lunches. Children whose family income exceeds these Federal income limits must pay full price.

Participation Rates Stable

In June 1992, the National School Lunch Program operated in 92,300 schools and residential child-care institutions, with a total enrollment of 42.7 million students—about 90 percent of all children in kindergarten through grade 12. About 58 percent of the students attending participating schools ate in the school lunch program.

About 4.1 billion lunches were served during the 1991-92 school year: 1.88 billion free (45.9 percent), 284 million reduced-price (6.9 percent), and 1.93 billion full price (47.2 percent). The proportion of all lunches served free or at reduced prices has remained relatively stable over time, although free and reduced-price participation tends to increase in economic downturns.

On an average school day in fiscal 1992, 24.5 million children participated in the National School Lunch Program (table 1). The number of students served has fluctuated at around 24 million since 1986.

Table 1
Participation in the National School Lunch Program Has Remained Steady Since 1979

Fiscal year	Full price	Reduced price	Free	Total
		Million children		
1979	15.3	1.7	10.0	27.0
1980	14.7	1.9	10.0	26.6
1981	13.3	1.9	10.6	25.8
1982	11.5	1.6	9.8	22.9
1983	11.2	1.5	10.3	23.0
1984	11.5	1.5	10.3	23.3
1985	12.1	1.6	9.9	23.6
1986	12.2	1.6	10.0	23.8
1987	12.4	1.6	10.0	24.0
1988	12.8	1.6	9.8	24.2
1989	12.8	1.6	9.7	24.1
1990	12.6	1.7	9.9	24.2
1991	12.1	1.8	10.3	24.2
1992	11.7	1.7	11.1	24.5

Federal Payments Up 10 Percent

Federal cash reimbursements to State agencies for the program in fiscal 1991 totaled $3.5 billion, a 9.8-percent increase from 1990 (table 2). State agencies are reimbursed on a per meal basis. The reimbursement rates are revised each year to reflect changes in the consumer price index (CPI) series for food away from home.

For the 1992-93 school year, States will be reimbursed $1.695 for each free lunch served, $1.295 for each reduced-price lunch, and

Table 2
Federal Payments to the National School Lunch Program Have Grown Steadily

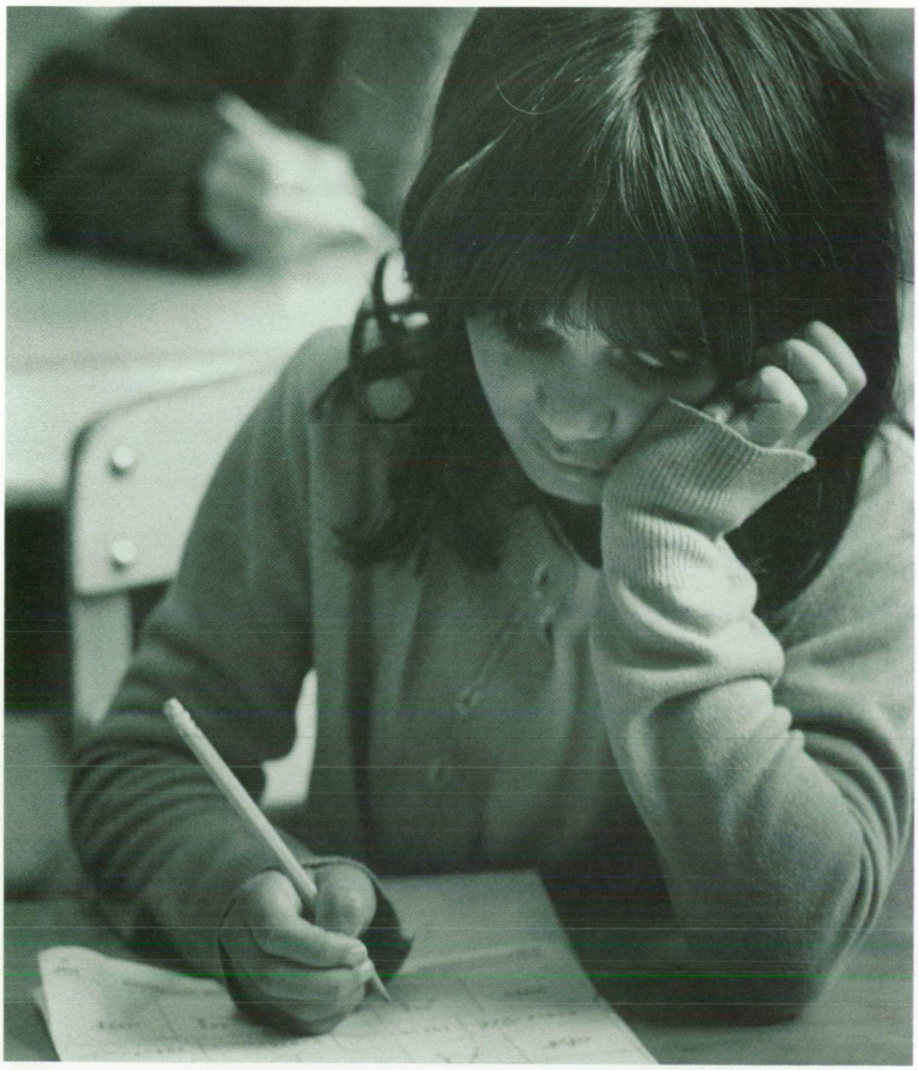
Fiscal year	Cash payments	Value of commodities: Entitlement	Value of commodities: Bonus	Total
		Million dollars		
1979	1,991.1	675.3	69.6	2,736.0
1980	2,296.0	772.5	132.0	3,200.5
1981	2,397.2	578.9	316.3	3,292.4
1982	2,191.3	426.2	339.9	2,957.4
1983	2,405.9	433.4	339.9	3,179.2
1984	2,506.1	445.8	384.1	3,336.0
1985	2,578.4	456.0	345.2	3,379.6
1986	2,714.5	445.7	372.6	3,532.8
1987	2,797.1	448.5	439.6	3,685.2
1988	2,917.4	466.3	348.6	3,732.3
1989	3,004.9	474.5	291.2	3,770.6
1990	3,210.2	446.1	153.8	3,830.1
1991	3,524.9	584.3	101.9	4,211.1
1992	3,837.7	636.8	115.6	4,509.1

$0.1625 for each full-price lunch. Local school districts also will receive an additional 2 cents per lunch when they serve 60 percent or more free and reduced-price lunches.

Commodities worth $752.4 million were also distributed to schools in fiscal 1992. About $636.8 million in commodities, worth 14 cents per meal, were provided as an entitlement—based on the needs and preferences of the recipient schools.

The remaining $115.6 million worth of food was distributed as bonus commodities, which are provided to schools when USDA surplus inventories permit. For example, during the 1980's, when dairy products were in surplus, USDA provided to the National School Lunch Program nearly $1 billion worth of bonus commodities annually, including cheese, butter, and dry milk.

Bonus commodities are secured by USDA's Commodity Credit Corporation (CCC) or Agricultural Marketing Service (AMS) and donated to FNS for distribution. Schools may obtain as much of some bonus commodities as they can use without waste; others are offered on a limited basis.



Participation in the National School Lunch Program improves the nutritional status of school-age children, especially those from low-income households.

Program's Benefits Widespread

The National School Lunch Program benefits the national agricultural economy as well as the nutritional well-being of participating children.

The University of North Carolina found that participation in the National School Lunch Program improves nutritional status of school-age children, especially those from low-income households. For example, children ages 12 to 18 years receiving free or reduced-price lunches obtained an average of 728 more calories daily than did nonparticipating children of a similar income level. Children in the same age group eating full-price lunches ate 169 more calories daily than did children of the same income level who did not eat a school-prepared lunch.

According to an FNS study, lunchtime consumption of all nutrients by older participating children increased, except vitamin C. For children ages 6 to 11 years, the results were similar, but less consistent. Low-income children eligible for free or reduced-price lunches who participated daily obtained slightly more protein, calcium, riboflavin, phosphorus, and vitamins A and B6, but less magnesium and vitamin C than did nonparticipants of similar income.

The National School Lunch Program also expands the market for agricultural commodities. USDA's Economic Research Service found that demand rose significantly for red meats, poultry, and milk due to Federal commodity donations and purchases by participating schools. Demand for fruit, vegetables, and eggs also rose, but by a smaller level.

The program also provides an outlet for surplus commodities. It helps relieve temporary or chronic surpluses by purchasing large quantities for distribution to schools and other institutions. ■

Domestic Food Assistance...At a Glance

In fiscal 1992, the Federal Government spent $31.6 billion for food assistance benefits, 16.6 percent over the amount spent in fiscal 1991. The $4.5-billion increase was almost entirely due to additions to the Food Stamp Program ($3.5 billion), the National School Lunch Program ($378 million, including commodities), the Special Supplemental Food Program for Women, Infants, and Children (known as WIC, $265 million), and the Child Care Food Program ($163 million).

These are the largest domestic food assistance programs and are most responsive to the needy in times of economic distress. The recent recession, along with the accompanying unemployment, and adjustments for inflation, increased participation and program costs. By providing the needy with more buying power, these programs increase consumer purchasing and provide a stimulus toward economic recovery.

Participation in the Food Stamp Program rose from 22.6 million in fiscal 1991 to 25.4 million a year later. This caused a 20.5-percent increase in benefit costs and raised the total outlays from $18.8 billion in fiscal 1991 to $22.4 billion in fiscal 1992.

Participation in the National School Lunch Program increased from 24.2 million children during 1991 to 24.5 million in 1992. Students receiving free lunches increased from 10.3 million to 11.1 million per day from 1991 to 1992, while participation in paid lunches declined by 450,000.

The WIC program had an 11.5-percent increase in total costs and a 10.6-percent increase in participation in 1992 over that in 1991. Unlike entitlement programs, such as the Food Stamp Program and the National School Lunch Program in which program costs increase as more Americans qualify to receive assistance, the WIC program is limited to annual appropriations.

Smaller programs have also increased. Total costs for the School Breakfast and the Child Care and Summer Food Programs increased by 14 and 16 percent, respectively. Food donation programs, such as the Commodity Supplemental Program and the Charitable Institutions Program, increased by over 10 percent.

—For more information on domestic food assistance, call Masao Matsumoto at (202) 219-0864.

Food Stamps, School Lunches, and WIC Account for Most of the Rise in Food Assistance in Fiscal 1992[1]

Program	1990	1991	FY 1991 quarters*				FY 1992 quarters*			
			I	II	III	IV	I	II	III	IV
			Million dollars							
Family food:										
Food stamps	17,339	20,891	4,100	4,309	4,426	4,503	5,086	5,209	5,246	5,349
Puerto Rico[2]	967	1,006	242	242	242	242	251	251	251	251
Food distribution:										
Indian reservations	49	45	12	13	12	12	11	12	11	11
Schools[3]	700	755	220	265	116	99	222	269	118	145
Other[4]	179	205	46	43	45	45	53	52	51	48
TEFAP[5]	207	189	45	43	74	44	37	49	53	50
Cash-in-lieu of commodities[6]	156	173	38	38	40	40	42	43	44	44
Child nutrition:[7]										
School lunch	3,525	3,838	1,065	1,078	876	506	1,166	1,225	922	526
School breakfast	685	783	204	205	172	105	234	243	192	114
Child care and summer food	983	1,146	202	212	251	318	231	252	289	373
Special milk	20	20	5	5	5	4	5	6	5	4
WIC[8]	2,296	2,561	520	560	581	635	596	646	638	680
Total*	27,106	31,611	6,699	7,013	6,840	6,553	7,937	8,257	7,820	7,596

* May not add to annual total due to rounding. [1]Administrative costs are excluded unless noted. [2]Puerto Rico transferred from the Food Stamp Program to a substitute Nutrition Assistance Program on July 1, 1982. Data represent appropriated amounts. [3]National School Lunch, Child Care Food, and Summer Food Service Programs, and schools receiving only commodities. [4]Commodity Supplemental Food Program and Elderly Feeding Pilot Projects, excluding bonus commodities and donations to charitable institutions. [5]The Emergency Food Assistance Program. [6]Child nutrition programs and Nutrition Program for the Elderly. [7]Cash expenditures. [8]Special Supplemental Food Program for mothers, infants, and children—includes administrative costs.
Source: USDA's Food and Nutrition Service, Program Information Division.

Food and Nutrition Legislation

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From February 1 through October 23, 1992, many bills affecting food safety, quality, nutrition, and assistance were introduced in the House and the Senate. Some are described below.

Appropriations for Agriculture

H.R. 5487—Jamie L. Whitten (MS)

Signed into law (P.L. 102-341) on August 14, 1992, this bill provides appropriations for farm and food programs in fiscal 1993. The new budget authority is $60.5 billion, an $8-billion increase over fiscal 1992.

More than $38 billion will go to domestic food programs. Food stamp funding rose $5 billion to $28 billion. However, this figure is only a projected outlay. Because it is an entitlement program, the cost is determined by the number of people who qualify and actually receive benefits.

Appropriations for the Women, Infants, and Children Special Supplemental Food Program (WIC) also rose. WIC's funding for fiscal 1993 is $2.86 billion, $260 million over fiscal 1992.

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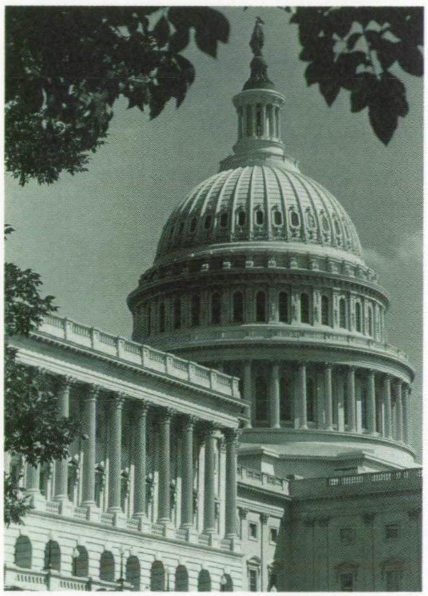

Domestic Food and Nutrition Assistance

H.R. 4150—Robert H. Michel (IL)

This broad piece of legislation amends food stamp and child nutrition programs.

The food stamp amendments would require the parent of a minor child with an absent parent to cooperate with State child-support enforcement agencies in order to participate in the food stamp program. Federal cost-sharing would be retained and made permanent.

Amendments to the National School Lunch Act would increase cash subsidies for reduced-price meals. Amendments to the Child Nutrition Act of 1966 would increase cash subsidies for reduced-price meals in the School Breakfast Program. These amendments also provide for additional research funds to determine WIC's effect on children.

H.R. 4822—Dale E. Kildee (MI)

The Every Fifth Child Act would phase in appropriations for the WIC and Head Start Programs toward full funding.

At present funding levels, WIC serves only 55 percent of those who are eligible, and Head Start programs reach only one in three eligible children. If this bill is approved, WIC should be fully funded by 1996 and Head Start Programs should be fully funded through 1998.

The bill acknowledges Congress's findings that: every fifth child in the United States lives in poverty; every 35 seconds, on average, an infant is born into poverty in the United States; children, who account for 15 percent of all homeless people, are the fast growing segment of the homeless population; and, in the last decade, childhood poverty increased 21 percent.

H.R. 5218—William E. Dannemeyer (CA)

The Women and Children First Act of 1992 would address the food, housing, and income needs of families, women, and children.

The act establishes eligibility criteria (which include income requirements, asset requirements, identification requirements, job training or education requirements, employment status, and registration with State employment offices) for households to receive benefits.

Cash payments would be made available to eligible households of any participating State (one which enters into an agreement with the Department of Health and Human Services to provide benefits that meet the terms of the act).

The act would terminate certain public assistance programs by repealing legislation—including the Food Stamp Act of 1977, the National School Lunch Act, and the Child Nutrition Act of 1966.

H.R. 5439—Charles Hatcher (GA)

The Food Stamp Quality Control System Amendments of 1992 would provide a program that enhances payment accuracy. The program would reward States with low payment errors and penalize those with poor rates after this year. Rewards would consist of enhanced administrative funding. Penalties would require States with high error rates to share the cost of payment errors.

Provisions of this act would become effective only if the costs are fully offset each fiscal year. No agricultural price-support or income-support program administered through USDA's Commodity Credit Corporation could be reduced to achieve such offset.

S. 2761—Patrick J. Leahy (VT)

The WIC Farmers' Market Nutrition Act of 1992 would allow WIC recipients to use their benefits to buy fresh, nutritious unprepared foods at farmers markets.

The act grants funds to State WIC programs designed to provide resources to persons who are nutritionally at risk. This program would award grants, subject to the availability of appropriated funds. States must submit plans for the establishment or maintenance of such programs, as long as the programs provide State, local, or private funds equal to at least 30 percent of program's total cost.

H.R. 6143—Barbara Collins (MI)

The Transportation of Produce Act of 1992 attempts to encourage and assist producers, processors, and other handlers of agricultural commodities to donate edible—but "unmarketable"— commodities to food banks, soup kitchens, and homeless shelters. Commodities eligible for donation are fit for human consumption but are unmarketable because of grade, size, and quality restrictions imposed by marketing orders.

USDA may enter into agreements with producers, processors, and other commodity handlers offering to make such donations. In return for the donations, USDA could pay all or part of the harvesting costs if the commodity would likely not be harvested without the agreement and if volunteers are not available for harvesting.

USDA and the Department of Transportation would enter into contracts with persons to collect, store, and distribute commodities made available under the program.

Local governments may nominate food banks, soup kitchens, and homeless shelters to receive commodities. Those nominations, along with the listed donations, would be compiled into a State plan for review by USDA.

Food Safety and Health

H.R. 4764—E (Kika) de la Garza (TX)

The Minor Crop Protection Assistance Act of 1992 would amend pesticide-use provisions in the Federal Insecticide, Fungicide, and Rodenticide Act. Congress found that many of the uses of crop-protection chemicals for fruit, nuts, vegetables, ornaments, and other specialty crops are "minor uses," in that the potential return on the cost of producing data necessary to support the registration of such chemicals is not sufficient. Also, while limited use of some crop-protection chemicals on major crops is necessary for integrated pest-management programs in small areas with unusual pest problems, this small-scale use means economic incentives may be insufficient to support the costs of registration and continued availability.

The act allows minor use of pesticides (when total area treated with a particular pesticide is less than 300,000 acres) under certain circumstances. Production of crops protected by the chemicals is important to preserve the public health of American citizens, to ensure a varied and healthy diet, and to support a viable domestic economy.

The act permits waiver of data requirements to ensure that certain minor-use chemicals critical to the protection of various crops continue to be available. Applicable data requirements may be waived if the Environmental Protection Agency (EPA) determines that adequate data are available from other sources to permit the determination of the risk presented by the minor use of the pesticide. Any such risks must not have an unreasonable adverse effect on the environment.

The bill also provides for the registration of pesticides for minor use.

S. 2884—Thad Cochran (MS)

The Fish Safety Act of 1992 would expand meat-inspection programs to include fish and fish products. States would be assisted in implementing the inspection and sampling program.

The act would ensure the wholesomeness and safety of all fish and fish products in the United States through a comprehensive safety program. Included would be: (1) a mandatory health-based program for the inspection of fish and fish products, which must be properly labeled and packaged; (2) establishment and enforcement of safety and wholesomeness standards; (3) monitoring and evaluating product safety risks; (4) scientific assessment of consumer health risks attributed to the consumption of adulterated products; (5) consumer education programs; and (6) proper labeling, processing, handling, packaging, and storing of products.

Food Labeling

Section 343 of the Food, Drug, and Cosmetic Act defines the conditions by which a food shall be deemed to be misbranded. Several bills under consideration would amend section 343.

H.R. 5401—Gerald D. Kleczka (WI)

Amendments to the Federal Food, Drug, and Cosmetic Act would require that foods derived from plant varieties developed by genetic modification be labeled to identify their derivation. "Modification" means an alteration in the composition of food that results from adding, deleting, or changing hereditary traits.

H.R. 5613—Patricia Schroeder (CO)

Amendments to the Federal Food, Drug, and Cosmetic Act would require ingredient labeling for malt beverages, wine, and distilled spirits.

Labels must disclose the alcohol content by volume, the number of servings it contains to the nearest quarter drink, ingredients, calories per container and per drink, and the common or usual name of each ingredient (including additives).

The label would also be required to bear the following statement: "If you or someone you know has a drinking problem, a call may be made to... (reference to a toll-free phone number providing assistance for problem drinkers)."

The required information would be located in a conspicuous place on the label, be displayed horizontally, be easily legible when the container is held in the usual way, and be offset by borders.

Funds would be authorized to establish and operate the toll-free phone number for problem drinkers.

S. 2835—Orrin G. Hatch (UT)

The Health Freedom Act of 1992 adds provisions regarding the composition and labeling of dietary supplements to the Federal Food, Drug, and Cosmetic Act. The bill defines a dietary supplement as an article that includes—and is intended to supplement the diet with—a vitamin, mineral, herb, or other similar nutritional substance.

Under the terms of the bill, a dietary supplement would not be considered a drug solely because of the potency of a substance. Also, a substance in a dietary supplement would not be considered a food additive if the substance is identified on the label as a substance to supplement the diet.

The act would allow a dietary supplement to be described as such in labeling or advertising, which may include a health claim. Such claims may characterize the relationship of the dietary supplement (or one or more of the substances provided by the supplement, or the absence of the substances provided by the supplement) to a disease or health-related condition. Such claims must be truthful and not misleading, and be backed by scientific evidence.

S. 2968—Howard M. Metzenbaum (OH)

The Nutrition Advertising Coordination Act of 1992 would amend the Federal Food, Drug, and Cosmetic Act to prevent misleading advertising of the health benefits of foods. Foods would be considered misbranded if the advertisement makes a claim, expressly or by implication, unless the claim is in accordance with regulations issued by the Department of Health and Human Services.

Foreign Food and Nutrition Assistance

H.R 4168—Robert G. Torricelli (NJ)

The Cuban Democracy Act of 1992 would provide for sanctions against countries assisting Cuba and would prohibit certain transactions between U.S. firms and Cuba until Cuba takes certain steps toward democracy and respect for human rights.

The U.S. Trade Representative would negotiate with Cuba's trading partners to restrict trade and credit relations with Cuba in a manner consistent with U.S. policy.

The act would prohibit restrictions on the export to Cuba of medicines for humanitarian purposes. Food, medicine, and medical supplies for humanitarian purposes would be made available to Cuba under the Foreign Assistance Act of 1961 and the Agricultural Trade Development and Assistance Act of 1954, if the President certifies that the Government of Cuba: (1) has made a commitment to hold free and fair elections for a new government within 6 months, and is proceeding to implement that decision; (2) has made a commitment to respect, and is respecting, human rights and basic democratic freedoms; and (3) is not providing weapons or funds to any group in any other country that seeks the violent overthrow of the government of such country.

H.R. 4547—Dante B. Fascell (FL)

The Freedom Support Act of 1992 sets forth U.S. policy with respect to assistance to the independent states of the former Soviet Union (excluding Estonia, Latvia, and Lithuania). The assistance is conditional on the termination of those states' military and technical assistance, subsidies, and other forms of assistance to Cuba.

The act would amend the Food for Progress Act of 1985 by considering the independent states as emerging democracies. Then they would qualify to receive agricultural commodities under this act.

The act also would amend the Agricultural Development and Trade Act of 1990 to expand the availability of export credit guarantees to emerging democracies if the guarantees will promote exports of U.S. agricultural commodities.

An independent state's ability to service debt under the export credit guarantee program of the Agricultural Trade Act of 1978 must be considered along with: (1) the major economic reforms occurring there; (2) the substantial enhancement in its international financial standing resulting from such reforms; and (3) the contribution that credit guarantees can make in promoting U.S. agricultural exports. ■

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U.S. Department of Agriculture
Economic Research Service

ERS SUMMARY OF REPORT

Production Costs for Ethanol to Drop as New Technology Comes On-Line

Number 7, February 1993

Contact: Neil Hohmann (202) 219-0428

The fuel ethanol industry is poised to adopt a wide range of technologies that would reduce costs at every stage of the production process. Adoption of improved enzymes, fermenter designs, membrane filtration, and other innovations in the next 5 years is expected in new ethanol plants constructed to meet new demand resulting from Clean Air Act stipulations for cleaner burning fuel. A new report, *Emerging Technologies in Ethanol Production*, examines the likelihood of near- and long-term cost reductions in producing ethanol, as well as the potential of biomass (agricultural residues, municipal and yard waste, energy crops like switchgrass) to supplement corn as an ethanol feedstock.

Ethanol Industry Expands, Reducing Costs

The use of ethanol as a fuel for vehicles in the United States grew from insignificance in 1977 to nearly 900 million gallons in 1991. The ethanol industry emerged through a combination of government incentives and new technologies, which enabled large-scale production of ethanol from domestic resources, particularly corn. Growing consumer acceptance of ethanol-blended fuels, incentives to gasoline blenders, and falling costs of production (from $1.35-$1.45 per gallon in 1980 to less than $1.25 per gallon in 1992) were responsible for the jump in ethanol production.

The construction of new ethanol production plants and the adoption of new technologies at existing plants is likely to lead to further cost reductions (5-7 cents per gallon over the next 5 years). Improved yeasts, which tolerate high concentrations of ethanol, can lower energy costs. A system of membranes can recycle enzymes and capture high-value coproducts at many steps in the production process.

Longer term technologies would save approximately 9-15 cents per gallon over present costs. Energy and feedstock savings will result from technology that can convert some of the nonstarch portions of corn to ethanol. Development of microorganisms that speed the process will contribute to long-term savings. Development of markets for coproducts of ethanol production will create additional savings. Cost savings may be less for smaller plants that serve niche markets, or in older plants that must replace inefficient equipment.

Ethanol From Biomass Reduces Costs and Environmental Waste

Biomass can also be converted to ethanol, although commercial-scale ventures are limited by current technology. While biomass requires more handling and sorting before conversion, those costs may be offset by the abundance of biomass relative to corn. Although the production of ethanol from biomass is presently constrained by technological difficulties, new developments in this decade may allow ethanol to be produced from biomass at or below the cost of corn-derived ethanol.

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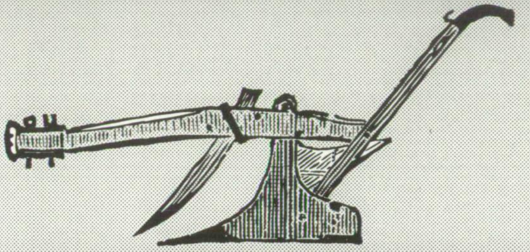

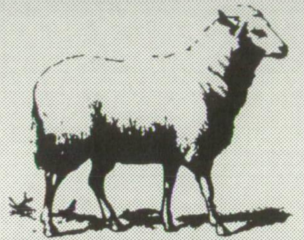

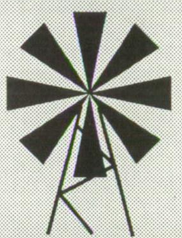

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