

## Chapter 12

# Public Perceptions of Food Safety



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## Contents

	<i>Page</i>
INTRODUCTION .....	319
CONCERN ABOUT THE REGULATORY PROCESS .....	321
PERSONAL PERCEPTIONS OF RISK .....	323
Consumer Perceptions of Adverse Outcomes .....	324
Consumer Willingness To Pay .....	324
Consumer Perceptions of Risk Exposure .....	324
Perceptions of the Probability of Harm .....	325
IMPLICATIONS FOR CONSUMER BEHAVIOR AND WILLINGNESS TO PAY FOR IMPROVED FOOD SAFETY .....	325
IMPLICATIONS FOR NEW AGRICULTURAL TECHNOLOGIES .....	329
Food Scores .....	331
Food Labeling .....	332
SUMMARY .....	335
CHAPTER 12 REFERENCES .....	336

## Tables

<i>Table</i>	<i>Page</i>
12-1. Food Marketing Institute Consumer Food Safety Survey Responses, 1989 and 1990 ...	319
12-2. Summary of Consumer Food Safety Surveys .....	320
12-3. Specific Food Safety Concerns by Consumers .....	320
12-4. Consumer Response to New Agricultural Technologies .....	321
12-5. Consumer Confidence in Regulatory Agencies .....	322
12-6. Consumer Perceptions of the Likelihood That a Food Contains Pesticide Residues ...	325
12-7. Consumer Perceptions of the probability of Health Problems Occurring Because of Pesticide Residues in Food .....	326
12-8. Consumers Who Have Purchased Organic Produce .....	327
12-9. Frequency of Purchase of Organic Produce .....	327
12-10. Estimated Consumer Willingness To Pay To Reduce Pesticide Residues Under Specified Market Conditions .....	328
12-11. Estimated Consumer Willingness To Pay for Pesticide Residue Reductions Under No Specified Market Conditions .....	328
12-12. Consumers Indicating Purchase Intentions of Milk Produced With Bovine Somatotropin Under Specified Conditions .....	330
12-13. Consumers Indicating Purchase Intentions of Meat Produced With Porcine Somatotropin .....	331
12-14. Consumer Confidence Following Alar and Cyanide Scare .....	332

## Public Perceptions of Food Safety

### INTRODUCTION

Public acceptance or rejection of new food products produced via biotechnology will determine the commercial success of these products. Public concerns about the food products themselves and the level of confidence in the agencies responsible for ensuring the safety of the products will be of paramount importance. Consumer demand for food safety is a relatively new research topic. Most available information consists of responses to general survey questions. Extensive empirical or statistical analyses are rare, and those that exist generally focus on issues involving pesticides. Consumer food surveys have been conducted for many years, but only recently have they included questions about food safety. The Food Marketing Institute, for example, began conducting annual opinion polls on supermarket trends in 1974, but did not include questions on food safety until 1982.

Comparisons among surveys are complicated because sampling methods, wording of the questions, and response categories provided can differ widely. Thus, direct comparisons between surveys generally is not possible. And not surprisingly, surveys that ask respondents about a specific risk report higher levels of concern about that risk than surveys that merely ask respondents to list their concerns. For example, in 1989 and 1990 the Food Marketing Institute asked consumers what they felt were the greatest risks to food safety, and also asked them to identify items they considered serious from a specified list. When asked to list food safety concerns, less than 20 percent of respondents named pesticide residues, but more than 80 percent said pesticides were a serious health hazard when specifically asked. Thus, conclusions must be viewed within the context of the questions asked (table 12-1).

The lack of commonly accepted frameworks and methods used in consumer food surveys makes it nearly impossible to arrive at many definitive conclusions concerning public perceptions of food safety. What can be reasonably deduced, however, is that over time, general concern about food safety seems to have increased (table 12-2), and the types of food risks perceived to be a problem have broadened (table 12-3). Historically, food safety concerns were commonly associated with the handling, processing, and packaging of food. These concerns still remain; however, concerns over the risks associated with the way food is grown have been added (22).

Only a handful of surveys have asked people whether new agricultural technologies, specifically those derived

**Table 12-1—Food Marketing Institute Consumer Food Safety Survey Responses, 1989 and 1990**

Food safety category	Category specified		Open-ended question	
	1989	1990	1989	1990
	Percent			
Spoilage and germs . . . . .	NA	NA	36	29
Tampering . . . . .	NA	NA	20	14
Improper packaging and canning	NA	NA	17	16
Pesticide residues . . . . .	82	80	16	19
Chemicals . . . . .	NA	NA	11	16
Unsanitary handling by supermarket employees . . . . .	NA	NA	10	11
Additives (nonspecific) . . . . .	NA	NA	7	6
Preservatives . . . . .	NA	NA	7	8
Unsanitary handling by supermarket shoppers . . . . .	NA	NA	6	
Processing and preparations of foods . . . . .	NA	NA	4	3
Pollution and environmental pollution . . . . .	NA	NA	3	4
Bugs, pests, and rats . . . . .	NA	NA	3	3
Artificial coloring . . . . .	28	21	2	3
Antibiotics . . . . .	61	56	1	2
Radiation . . . . .	42	42	1	1
Other . . . . .	NA	NA	6	10
None . . . . .	NA	NA	2	6
Not sure . . . . .	NA	NA	11	12
Additives and preservatives . . . .	30	26	NA	NA
Nitrites . . . . .	44	37	NA	NA

NA = Not applicable.

**NOTE:**

These are Food Marketing Institute (FMI) surveys of 1989 and 1990. 1989 respondents were only those that in earlier questions indicated that they were not completely confident of the food supply. 1990 respondents included everyone initially surveyed. Respondents were asked "What, if anything, do you feel are the greatest threats to the safety of the food you eat" (open ended question) and "I'm going to read a list of food items that may or may not constitute a health hazard. For each one please tell me if you believe it is a serious health hazard, somewhat of a hazard, or not a hazard at all."

**SOURCE:** Food Marketing Institute, *TRENDS: Consumer Attitudes and the Market Place*, Washington, DC, 1989 and 1990.

from biotechnology, cause any food safety concerns. While a significant percentage of consumers expressed concern about the safety of new biotechnology-derived products, a comparable percentage also expressed concern about other food safety issues, such as pesticide residues (table 12-4).

It is important not to overinterpret the results of such surveys; virtually all food contaminants are perceived as potential risks to at least some degree by the majority of consumers. However, the surveys do not ask consumers, for example, how likely it is that the contaminant is at hazardous levels in the food supply, or the probability that the level of contaminants present will result in impaired health or death to them or their family. These questions are more pertinent to assessing how concerned consumers

**Table 12-2—Summary of Consumer Food Safety Surveys**

	FDA	FMI	FMI	FMI	FMI	FMI	FMI	VANR
	1980	1982	1983	1986	1988	1989	1990	1991
	Percent							
Fully confident . . . . .	47	NA	NA	58	55	23	15	10
Mostly confident . . . . .	14	89	88	34	38	58	64	56
Somewhat concerned . . . . .	28	9	11	5	5	15	18	23
Very concerned . . . . .	10	NA	NA	2	1	2	2	4
Not sure/No answer . . . . .	2	2	1	0.5	0.5	2	0.5	6

NA = Not applicable.

NOTES:

Food and Drug Administration (FDA) survey consisted of 1,570 respondents and asked "How do you feel about the safety of food and its effect on your health? Do you feel confident that your food is safe or do you worry about it, or what?" Response categories provided include fully confident, basically confident with some doubt, concerned about one or two specific problems, very worried, not sure.

SOURCE: James T. Heimbach, *Yesterday, Today and Tomorrow: consumer Perceptions of Food Safety*, Washington, DC, Division of Consumer Studies, Bureau of Foods, U.S. Food and Drug Administration, 1981.

The Food Marketing Institute (FMI) surveys of 1982 and 1983 consisted of 1,003 and 1,001 respondents, respectively, and asked the question "Please tell me whether you agree strongly, agree somewhat, disagree somewhat, or disagree strongly with the following statement—the food in supermarkets is safe to eat?" The results of the survey are presented in aggregate form such that the 89 and 88 percent somewhat confident figure includes both strongly agree and somewhat agree responses. Likewise, the percentages reported for somewhat concerned include the responses for both the disagree somewhat and disagree strongly categories.

SOURCE: Surveys conducted by Louis Harris Associates for the Food Marketing Institute, January 1982 and February 1983.

The Food Marketing Institute (FMI) surveys of 1986 and 1988 consisted of 1,004 and 1,019 respondents, respectively, and asked the question "The following are statements that people have made. For each one, please tell me how close it comes to describing you—very close, somewhat close, not very close, or not close at all—1 feel the food in supermarkets is wholesome and safe to eat."

SOURCE: Food Marketing Institute, *TRENDS: Consumer Attitudes and the Market Place*, Washington, DC, 1986 and 1966.

The Food Marketing Institute (FMI) surveys of 1969 and 1990 surveyed 1,031 and 1,005 respondents, respectively, and asked the question "How confident are you that the food in your supermarket is safe? Would you say you are completely confident, mostly confident, somewhat doubtful, or very doubtful?"

SOURCE: Food Marketing Institute, *TRENDS: Consumer Attitudes and the Market Place*, Washington, DC, 1989 and 1990.

The van Ravenswaay and Hoehn (VANRAV) survey consisted of 906 respondents and asked the question "How confident are you that the food your household eats is safe?" Response categories provided include completely confident, mostly confident, somewhat doubtful, and very doubtful.

SOURCE: Eileen O. van Ravenswaay and John P. Hoehn, "Contingent Valuation and Food Safety: The Case of Pesticide Residues in Food," Michigan State University staff paper No. 91-13, 1991.

**Table 12-3—Specific Food Safety Concerns by Consumers<sup>a</sup>**

	FMI						Mich	
	1984	1985	1986	1987	1988	1989	1990	1990
	Percent							
Pesticide residues . . . . .	77	73	75	76	75	82	80	68
Antibiotics and hormones . . .	x	x	x	61	61	67	56	53
Nitrites . . . . .	x	x		38	44	44	37	37
Irradiation . . . . .			37	43	36	42	42	36
Additives and Preservatives	32	36	33	36	29	30	26	57
Artificial colors . . . . .	26	28	26	24	21	28	21	19
Tampering . . . . .	x	x	x	x	x	x	x	71
Handling . . . . .	x	x	x	x	x	x	x	68
Improper processing . . . . .	x	x	x	x	x	x	x	67
Natural toxins and bacteria	x	x	x	x	x	x	x	50

<sup>a</sup> Respondents Indicating Serious Health Hazard

x = Not asked

NOTES:

Food Marketing Institute (FMI) surveys asked "I'm going to read a list of food items that may or may not constitute a health hazard. For each one please tell me if you believe it is a serious health hazard, somewhat of a hazard, or not a hazard at all."

SOURCE: Food Marketing Institute, *TRENDS: Consumer Attitudes and the Market Place*, Washington, DC, 1964-1990.

Michigan (Mich) survey asked "Now I'm going to read a list of factors that may or may not constitute a health hazard to food products. For each one, please tell me if you believe the item is a serious health hazard, somewhat of a health hazard, or not at all a health hazard."

SOURCE: Charles Atkin, "Consumer Attitudes About Food Issues in Michigan," Michigan Department of Agriculture, March 1990.

Table 12-4-Consumer Response to New Agricultural Technologies

	bST			pST	Transgenic organisms	
	VA	MO	WI		Percent	Vegetables and fruit
Yes .....	44	93	71	33		82
No .....	19	8	NR	67	77	NR
Don't know .....	37	5	NR	NR	NR	NR

NR = Not reported

**NOTES:**

Surveys for bovine somatotropin (bST):

Virginia (VA) survey. Because only 20 percent of respondents had heard of it, they were given descriptions of the technology and conclusions of scientists concerning safety. They were also told that it was under development and pending FDA approval. Respondents were asked if they agreed with the statement that approval of bST will make milk unsafe.

**SOURCE:** W.P. Preston, A.M. McGuirk, and G.M. Jones, "Consumer Reaction to the Introduction of Bovine Somatotropin," paper presented at the Economics of Food Safety Workshop, Alexandria, VA, June 1990.

Missouri (MO) survey. Respondents were asked if they would probably or definitely have concerns about the safety of milk.

**SOURCE:** Barbara J. Slusher, "Consumer Acceptance of Food Production Innovations-An Empirical Focus on Biotechnology and bST," paper presented at the Second International Conference on Research in the Consumer Interest, Snowbird, UT, Aug. 9-11, 1990.

Wisconsin (WI) survey. About 90 percent of the respondents were aware of bST. Respondents were asked if they have concerns that future studies might reveal that bST might harm human health.

**SOURCE:** Robin Douthitt, "Biotechnology and Consumer Choice in the Market Place: Should There Be Mandatory Product Labelling? A Case Study of Bovine Somatotropin and Wisconsin Dairy Products," paper presented at the Second International Conference on Research in the Consumer Interest, Snowbird, UT, Aug. 9-11, 1990.

Porcine somatotropin (pST) survey was conducted in 1986 in Atlanta, New York City, and Philadelphia. Respondents were given a description of PST and asked if they would eat less pork due to its use in production.

**SOURCE:** Catherine Halbrendt et al., "Public Attitudes in the Northeast Region Toward Recombinant Porcine Somatotropin," *Journal of Food Distribution Research*, February 1989, pp. 153-163.

Transgenic vegetables and fruit and poultry and meat survey was conducted in North Carolina. Respondents were asked if they would be very or somewhat concerned with eating genetically engineered products.

**SOURCE:** Thomas Hoban. "Public Attitudes Toward Bovine Somatotropin," paper presented at the 39th Annual Dairy Conference, Winston-Salem, NC, Feb. 27-28, 1990.

really are about the safety of the food supply. These types of information are needed to help define what consumers mean when they say a problem is serious. Thus, surveys that report that significant percentages of consumers view a risk as serious may create the impression that consumers see huge risks from contaminants. However, this could be an erroneous conclusion. The information needed to make that type of assessment is lacking (22).

The survey information presented suggests that consumers do have food safety concerns, but it does not provide many insights into the cause(s) of these concerns. Consumer concern could be based on a real or perceived impression that the food regulatory system is inadequate. Consumers may feel that standards for safety are too lenient, have become obsolete, or are impossible to establish because of scientific uncertainty. It is possible that consumers are satisfied with the standards, but are concerned that they are not adequately enforced.

The extent of concern expressed by consumers will be influenced by their personal perceptions of risks. Risk perceptions involve assessments of the probability that loss or harm will occur as well as assessments of the type, severity, duration, and timing of the harm. Such

perceptions are highly variable. Even if consumers do perceive risks, the question arises as to how much they are willing to pay to reduce or avoid a risk. Consumers are constantly evaluating these tradeoffs, and the willingness to pay to reduce risks is highly variable among the population. These issues must be understood in order to determine what food safety policy changes consumers might prefer (24).

## CONCERN ABOUT THE REGULATORY PROCESS

As indicated, consumers maybe concerned that safety standards are not stringent enough, or that they are not adequately enforced. Information concerning how consumers view safety standards is particularly pertinent as Congress debates possible changes in how the Environmental Protection Agency (EPA) sets pesticide residue tolerances. Unfortunately, definitive studies simply are not available.

There is limited information that consumers have decreased confidence in the institutions responsible for food safety. Once again, much of the information available comes from general consumer surveys (table 12-5). How-

**Table 12-5—Consumer Confidence in Regulatory Agencies**

	Pennsylvania		bST		PST	
	1964	1984	VA	MO	Atl	NY/Phil
	Percent					
Yes . . . . .	94	49	54	51	76.7	75
No . . . . .			NR	NR	35	31
Don't know . . . . .			NR	NR	12	18
					NR	0

NR = Not reported

**NOTES:**

Consumers in Pennsylvania were asked if they thought that the “government does an adequate job of inspection.”

**SOURCE:** Carolyn Sachs, Dorothy Blair, and Carolyn Richter, “Consumer Pesticide Concerns: A 1965 and 1984 Comparison,” *Journal of Consumer Affairs*, vol. 21, 1987, pp. 96-107.

bST (VA): Consumers in Virginia were asked if “the government will make sure milk supplies are safe and wholesome.”

**SOURCE:** W.P. Preston, A.M. McGuirk, and G.M. Jones, “Consumer Reaction to the Introduction of Bovine Somatotropin,” paper presented at the Economics of Food Safety Workshop, Alexandria, VA., June 1990.

bST (MO): Consumers in Missouri were asked if they agreed with the statement “if a government agency such as FDA or USDA says a production process is safe then it is okay to eat foods produced that way.”

**SOURCE:** Barbara J. Slusher, “consumer Acceptance of Focal Production Innovations-An Empirical Focus on Biotechnology and bST,” paper presented at the second International Conference on Research in the Consumer Interest, Snowbird, UT, Aug. 9-11, 1990.

PST (ATL): Consumers in Atlanta were asked if they would believe Federal agencies concerning the safety of pST.

**SOURCE:** W.J. Florkowski, C.L. Huang, and Brian Goggin, “Attitudes Towards Porcine Somatotropin: A Consumer Survey of the Atlanta Metropolitan Area,” The Georgia Agricultural Experiment Station, College of Agriculture, The University of Georgia Research Report 570, August 1989.

pST (NY/Phil): Consumers in New York and Philadelphia were asked if they would be inclined to believe Federal agencies concerning the safety of PST.

**SOURCE:** Catherine Halbrendt et al., “Public Attitudes in the Northeast Region Toward Recombinant Porcine Somatotropin,” *Journal of Food Distribution Research*, February 1989, pp. 153-163.

ever, these surveys provide little information about what is causing public skepticism.

In an empirical analysis that might shed some light on this issue, van Ravenswaay and Hoehn evaluated consumer willingness to pay for pesticide labeling in apples. Using a methodology that economists call a contingent valuation study, the authors simulated market conditions by establishing a specified set of circumstances, and then asked consumers about their purchase intentions. Values obtained using this approach are contingent on, and must be interpreted in light of, the market circumstances specified. The reliability and validity of the approach depends critically on developing clear and meaningful choice scenarios, including clear descriptions of the product and conditions under which it will be offered for sale. Vague or unfamiliar choices make it difficult for respondents to predict how they would actually act, and the answers



Photo credit: Grant Heilman, Inc.

Some consumers are concerned that food safety standards are not stringent enough, or that they are not adequately enforced.

given are likely to be a poor predictor of subsequent behavior ( 10).

The authors of the study evaluated willingness to pay for three types of product labels—no pesticide residues, no detectable pesticide residues, and no pesticide residue levels above Federal limits. Participants in the study were provided a description of pesticides and information on Federal pesticide limits. They were also informed of the circumstances under which the apples would be marketed, including the assumption that only apples would be labeled, that only one type of apple label would be available, that labeled apples would be marketed and displayed in stores as they are currently, and that the prices of substitute fruits were the prices currently prevailing at the time of the study. Consumer willingness to pay for different product labels was calculated (23).

The results indicate that on average, consumers were willing to pay 23.6 cents per pound more for apples certified and tested to have no residues above Federal limits as compared to apples with no labels. Interestingly, no statistically significant difference was found in the willingness to pay for the Federal limit label and the no detectable residue label. It was estimated that consumers were willing to pay an average of 37.5 cents per pound more for apples with the “no pesticide” label than for unlabeled apples (23).

The estimates of willingness to pay for labels provide information about how, on average, consumers value

pesticide residue reduction, and given the constraints of the methodology, the estimates represent an upper bound of willingness to pay. However, they do not tell us how many consumers would actually purchase a particular label in the market because actual purchase decisions will depend on whether or not the market conditions specified in the study prevail, and on the total price of the apples (i. e., base price of the apples plus the added price of the label) (23).

While one must be careful not to stretch the interpretation of the results too far, they do raise some interesting questions concerning how consumers feel about Federal standards and enforcement of standards. It is illegal to sell apples containing pesticide residue levels higher than Federal specifications, and as such, all apples marketed should contain residue levels that are less than the Federal limit. Yet consumers certainly demonstrated a willingness to pay for the information that the particular apple they were purchasing met Federal standards. This suggests that there is concern about the enforcement of Federal standards (23).

It is interesting that consumers were not willing to pay more for apples certified to have no detectable residues than for those that met Federal limits. Presumably, the apples with no detectable residues could have considerably lower residue levels than those that meet Federal limits. It appears that consumers are viewing these two situations as being very similar. This again suggests that consumers do not view the standards as being inadequate, but do question whether most apples actually meet the standards (23).

Consumers were willing to pay most for the “no pesticide residue” label; however, the “premium” on the “no residue” label compared to that on the “meets Federal standards” label was much lower (13.9 cents) than the premium on the “meets Federal standards” label in comparison to no label at all (23.6 cents). Intuitively one would suspect that if consumers were extremely concerned that the standards were too lax, that there would be a small willingness to pay for assurance that the standards were met, and a much larger willingness to pay for no residues (i.e., the differences should be the reverse of what they were calculated to be). It is possible that the difference between the “no residues” and the “meets Federal limit” labels are simply a reflection of people’s willingness to pay more for a sure thing rather than for something that still contains some degree of uncertainty; and that in general, consumers are not unduly concerned that standards are not appropriate.

The study also found that consumer willingness to pay for labeled apples was not explained by respondents’ risk perceptions. Respondents were willing to pay more for the labels when they perceived little risk as well as when they perceived large risks from pesticide residues. A potential explanation suggested for this finding is that the method used to elicit risk perceptions measured what people think the risks are most of the time but not the level of accuracy of that assessment. People may think the regulatory system works most of the time, but that it may break down occasionally, and consumers may be willing to pay to reduce their uncertainty about these errors. This analysis implies that it is the uncertainty about risks rather than the average perception of risk that is most important to consumers. If this is so, then it implies that policy that reduces uncertainty about risks (e.g., greater sampling and testing) rather than tougher standards may be more important in alleviating consumer concerns over food safety (22).

Clearly this study does not definitively reveal the extent of consumer concern about the process of setting standards or about the enforcement of those standards. The study does, however, present insights into the kinds of information and approaches that will be needed to begin answering those questions.

## **PERSONAL PERCEPTIONS OF RISK**

Consumer concerns about food safety will be influenced by personal perceptions of food-related risks. Risk is defined as a chance of loss or harm. The chance of occurrence can be high or low, and the potential loss or harm constituting risk can vary in type, severity, duration, and timing. A severe, lengthy, and immediate harm or loss would be viewed with greater alarm than a mild, short-term, and delayed harm or loss. This perhaps explains why consumers, in contrast to scientists and food regulatory personnel, seem to view pesticide residues as a more serious food safety risk than microbial contamination. Consumers likely associate microbial agents with an upset stomach, and possibly diarrhea, which may be inconvenient and immediate, but which is likely to be a short-term, relatively minor problem. Pesticide residues, however, are viewed as causing cancer, certainly a catastrophic illness, even though its onset may be delayed (3, 17, 23).

The concept of personal risk is further complicated by the fact that consumers can choose to take risks, or may face imposed risks (17). Risks can be avoided, but gen-

erally at some cost. If the cost of avoiding the risk is high (e.g., because there are few good substitutes available) or if a person's resources are limited, then the risk will probably cause greater distress than if the risk were easily avoided. Risks that are beyond the control of an individual may be under the control of others. If it is believed that those who do have control over risks are not seeking to minimize the risks, distrust, doubt, and suspicion could result. This may explain why some heavy smokers still become upset over any potential cancer risks associated with pesticide residues in food. Smokers choose cigarettes, but don't have much direct control over how food is produced (24).

Public understanding of risks also varies. If the probability or the type of loss involved is not clearly understood, it is more difficult for people to make decisions about whether and how to avoid a risk. A higher level of uncertainty about risks and/or the ways and costs of avoiding risks will result in a greater level of concern (24).

Thus, the possibility exists for consumers to have very different perceptions concerning food safety risks. Variation in perceptions arise primarily from four different sources. First, consumers may have different perceptions of the types, severity, duration, or timing of any adverse outcomes that may result from a risk. Second, consumers may value the same outcome differently and thus may be willing to pay different amounts to reduce the probability of that outcome occurring. Third, consumers may have different views of how likely they are to be exposed to a risk. And fourth, consumers may have a different perception of the probability that the risk will cause harm (24).

### ***Consumer Perceptions of Adverse Outcomes***

Few studies have evaluated the types of adverse outcomes consumers feel might result from food-borne risks. The little information available comes from studies that have evaluated perceived health risks associated with pesticide residues. These studies indicate that consumers do have different perceptions of the types of harm that may result from consuming pesticide residues in food. One study that compared perceptions of organic and conventional produce purchasers found that the former associated a greater number of adverse health effects with pesticide residues than did purchasers of conventional produce (6). A second study of organic produce purchasers found that these consumers considered pesticide residues responsible for a wide range of adverse health effects in addition to cancer (16). van Ravenswaay and Hoehn (22) also found that consumers differed in terms

of their perceptions of the types of harms caused by pesticide residues. Thus it seems likely that consumers do have different perceptions of the types of harm that might result from food hazards.

### ***Consumer Willingness To Pay***

The types of harm consumers associate with food safety hazards are varied, and include allergic responses, intestinal disorders, reproductive problems, cancer, and possibly death. There is little information available as to how consumers value these potential outcomes, or how much they would be willing to pay to reduce the possibility of these outcomes occurring. The limited evidence that exists for how consumers value harmful food safety outcomes is obtained from studies that have analyzed conventional and/or organic food purchases. (6, 16, 23). These studies estimated the willingness to pay to reduce the annual risk of death from pesticide residues by one in a million. The estimated willingness to pay to reduce mortality by this amount was similar in all studies and for both conventional and organic produce purchasers (6). Furthermore, this estimated willingness to pay was similar to the estimated willingness to pay to achieve a one in a million reduction in mortality due to occupational hazards, or by using seat belts and installing home fire alarms (4). Thus, it appears that the willingness to pay for a reduction in mortality is similar for many consumers and is consistent for several different potential causes of death.

### ***Consumer Perceptions of Risk Exposure***

Survey data indicate that consumers do have different perceptions of the likelihood that different food items will contain pesticide residues, and generally believe that fresh produce is more likely to have residues than processed food (table 12-6). However, in the study that evaluated conventional and organic purchasers of fresh produce, the participants did not feel that different types of fresh produce presented significantly different risks (6).

Exposure to risk also depends on the cost and ability to avoid the risk. The 1989 scare over Alar in apples presents a good example. Alar was reported as posing a small additional risk of cancer particularly in children. Because there are many good substitutes for apples, consumers could easily avoid any potential risks from Alar simply by purchasing other types of fruit regardless of whether or not they believed the purported risks to be significant. Thus exposure to a risk will depend on how easily that risk can be avoided, and will vary for different individuals and food safety hazards.



**Table 12-6—Consumer Perceptions of Likelihood That a Food Contains Pesticide Residues**

	USDA	van Ravenswaay
	Percent	
Fresh fruits and vegetables . . . . .	88	5.8
Apples . . . . .	NA	5.5
Lettuce . . . . .	NA	5.4
Tomatoes . . . . .	NA	5.2
Oranges . . . . .	NA	4.8
Frozen fruits and vegetables . . . . .	32	NA
Canned fruits and vegetables . . . . .	28	NA
Processed fruits and vegetables (frozen and canned) . . . . .	NA	4.1
Fruit/vegetable juices . . . . .	NA	4.1
Dried foods (flour, cereals, rice) . . . . .	46	NA
Cereals, flour and uncooked grains . . . . .	NA	3.8
Bread and baked goods . . . . .	NA	3.8
Meat and poultry . . . . .	41	NA
Fresh fish . . . . .	NA	4.3
Fresh meat . . . . .	NA	4.2
Dairy products . . . . .	NA	3.1

NA = Not applicable.

**NOTES:**

**USDA survey (1974):** An in-person interview with homemakers in 2,503 households. Asked the question "Which of the types of food listed, if any, do you believe could carry traces of chemicals to kill insects and other pests?" Percentages reported are the number of respondents indicating the possibility.

**SOURCE:** Judith Lea Jones and Jon P. Weimer, "Food Safety: Homemakers' Attitudes and Practices," U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 360, January 1977.

**van Ravenswaay and Hoehn survey (vanRav) (1990):** Number of respondents was 906. Asked the question "What do you think the chances are that there are any pesticide residues in each of the following types of food that you might buy when you do the grocery shopping?" Respondents were asked to assign scores ranging from 0 (0 = percent chance) to 10 (91 to 100-percent chance). Scores reported are the average scores for each category.

**SOURCE:** Eileen O. van Ravenswaay and John P. Hoehn, "Contingent Valuation Safety: The Case of Pesticide Residues in Food," Michigan State University staff paper No. 91-13, 1991.

### *Perceptions of the Probability of Harm*

Evidence exists that different consumers view the probability of harm occurring very differently. The Ham-mitt study of organic and conventional food purchasers found that organic food consumers had a significantly higher estimation of the likelihood of developing cancer

or other health problems than did consumers of conventional foods. This study found that organic consumers estimated that the additional risk of dying from consuming conventional produce for 1 year was 8.5 in 10,000. Conventional food purchasers estimated the additional risk of dying from consuming conventional produce for 1 year was 8 in 10,000,000. Thus, organic consumers perceive the probability of dying as being three orders of magnitude higher than conventional produce consumers. Similarly in the Rae study, organic produce purchasers estimated the additional lifetime chance of getting cancer if only organic food was eaten was 1 in 4, as compared to 1 in 2 if conventional food was eaten.

The van Ravenswaay and Hoehn study also examined consumer perceptions concerning the probability of harm. This study asked consumers to estimate the probability that current levels of pesticide residues will cause health problems to someone in your household (table 12-7). The perceptions of how likely pesticide residues are to cause health problems vary widely. When compared to worst case estimates of the cancer risks associated with pesticide residues,<sup>1</sup> at least half of the respondents perceived the health risks to their household as being less, approximately 30 percent view the risks as being the same, and about 15 percent consider the risks to be much higher. At least a quarter of the population perceives the risks associated with pesticide residues to be very serious, while another quarter believes them to not be serious at all. These two polar positions imply that there may be very different preferences for changes in food safety policy among consumers (24).

## **IMPLICATIONS FOR CONSUMER BEHAVIOR AND WILLINGNESS TO PAY FOR IMPROVED FOOD SAFETY**

The food safety surveys discussed above indicate that at least 80 percent of consumers consider pesticide residues to be a "serious" hazard; however, while data are

<sup>1</sup>The worst-case scenarios of lifetime additional cancer risks for an average household are estimated at 3.8 per 1,000 by the Environmental Protection Agency (EPA) and 1.6 per 100 by the National Research Council (NRC). These scenarios are based on lifetime additional cancer risks for an average household of 2.7 persons. For EPA, the worst-case estimate is that there would be 6,000 extra cases of cancer per year or a rate of 2 in 100,000. Assuming a 70-year lifespan and a linear dose-response function, this would be a lifetime risk of 1.4 in 1,000 persons. For a household of 2.7 persons, the household risk would be 3.8 per 1,000. Similarly, the NRC worst-case estimate of extra lifetime cancer risk from pesticide residues in food is 5.8 in 1,000. For a household of 2.7 persons, the household risks would be 1.6 in 100. The worst-case estimates and study results are not completely comparable because the worst-case scenarios looked only at cancer risks, as compared to the broader issue of health problems examined in the study. U.S. Environmental Protection Agency, "Unfinished Business: A Comparative Assessment of Environmental Problems," 1987 and National Research Council, Board on Agriculture, Committee on Scientific and Regulatory Issues Underlying Pesticide Use Patterns and Agricultural Innovation, *Regulating Pesticides In Food*, National Academy Press, Washington, DC, 1987.

**Table 12-7—Consumer Perceptions of the Probability of Health Problems Occurring Because of Pesticide Residues in Food**

	Percent
No chance . . . . .	4.1
1 in a million . . . . .	19.5
1 in 100,000 . . . . .	16.4
1 in 10,000 . . . . .	13.4
1 in 1,000 . . . . .	15.6
1 in 100 . . . . .	12.1
1 in 10 . . . . .	5.1
1 in . . . . .	3.2
1 in 2 . . . . .	1.0
Certain to happen . . . . .	4.4
No answer . . . . .	5.2

**NOTE:**

The study asked the question "What do you think the chances are that someone in your household will have health problems someday because of the current level of pesticide residues in their food?"

**SOURCE:** Eileen O. van Ravenswaay and John P. Hoehn, "Contingent Valuation and Food Safety: The Case of Pesticide Residues in Food," Michigan State University staff paper No. 91-13, 1991.

skimpy, it would appear that no more than 5 to 10 percent of consumers could be classified as purchasers of organic foods (tables 12-8 and 12-9).

Given that so many consumers seem to be concerned about pesticide residues, why do so few buy organic produce? Several factors are undoubtedly involved. Organic produce may not be available in the supermarkets where consumers regularly shop. Even if available, the choice of varieties may be limited or the organic produce maybe marketed or advertised differently from conventional produce. Another explanation may be the lack of national definitions and standards for organic produce, leaving consumers unsure about what they are actually purchasing. However, cost and quality factors also play a critical role in consumer purchasing decisions. Consumers are constantly faced with tradeoffs. For food safety concerns, a major consideration is how much it will cost to avoid or reduce perceived risks.

Because food safety is a public good required by law, consumers face few actual food safety choices in the marketplace. Consequently there are few opportunities to observe the choices and tradeoffs consumers actually make. Even if these tradeoffs could be observed, actual

market choices still may not reflect willingness to pay for safety, because safety is a characteristic embodied in goods and not a separate good itself. Methodologies have been developed to overcome some of these problems so that estimates of consumer willingness to pay to reduce food risks can be made.<sup>2</sup> These estimates tell us how consumers value the food safety benefits of regulatory control, and what tradeoffs they are willing to make between food safety and income.

Four studies have attempted to estimate willingness to pay for reduced pesticides based on data of actual purchases or purchase intentions under specified market conditions (table 12-10). Three studies asked consumers how much they would generally be willing to pay to reduce pesticide residues without specifying market conditions (table 12-1 1). The results from the different approaches are relatively consistent with each other, and suggest that many consumers are willing to pay to reduce risks from pesticide residues, however, not all are willing to pay the same amount. Approximately one-quarter to one-third of the consumers surveyed indicate that they are unwilling to pay anything. About 5 to 10 percent of consumers, primarily those who now purchase organic foods, appear to be willing to pay premiums of up to 50 percent over conventional foods. In between are the majority who may be willing to pay 5 to 10 percent more for reduced pesticide residues (22).

Estimates of willingness to pay for reduced pesticide residues indicate what consumers may be willing to pay to reduce pesticide residues, but do not indicate whether or not consumers will actually purchase a product in the marketplace. Many factors affect the final purchase decision, including the perception of risk, total product price (price of product plus willingness to pay for added risk reduction), quality, and other factors associated with the product, such as environmental concerns, small farm issues, etc. (24).

Total price of a product will affect the quantities of the product purchased regardless of the willingness to pay for safety. For example, in the study that evaluated the willingness to pay for labeled apples, given a total price of apples of \$0.79 per pound, the probability of purchase was 0.59 for no-label apples, 0.69 for Federal-limit apples, and 0.74 for no-residue apples. As total

<sup>2</sup> TWO methods are commonly used to estimate **willingness** to pay. One method seeks to **reveal preferences for characteristics of goods based on** examining how changes in that characteristic affect purchases of the good (a method that economists call the hedonic approach). The other method simulates the market and ascertains purchase intentions under specified circumstances (the contingent valuation method discussed previously). A third method is to simply ask consumers how much they would pay for a product improvement without describing the specific market setting or quantities involved (10).

**Table 12-8—Consumers Who Have Purchased Organic Produce**

	Fresh Trend	California	Michigan
	Percent		
Yes . . . . .	11	62	45
No . . . . .	89	38	48
Don't know . . . . .	0	0	7

**NOTES:**

Fresh Trend Survey, October 1989, asked 1,260 households nationally if they sought or bought organically grown produce in previous 12 months.

**SOURCE:** The *Packer Focus: Fresh Trends 1990*, B. Jones and T. Zind (ads.), Vance Publishing Corp., Lindolnshire, IL, 1990, pp. 37-69.

California survey, California counties of Marin, Sacramento, and San Diego, August 1989, asked 946 households if they purchase organic products,

**SOURCE:** Desmond Jolly, "Consumer Willingness to Pay Price Premiums for Organic Apples and Peaches," Department of Agricultural Economics, University of California, Davis, March 1989.

Michigan survey was 600 households, 1990, and asked if they had ever purchased organically grown foods,

**SOURCE:** Charles Atkin, "Consumer Attitudes About Food Issues in Michigan," Michigan Department of Agriculture, March 1990.

price of apples increased, the probabilities of apple purchase decreased in all three scenarios (23).

Quality of the product is a major concern to purchasers of organic products. Organic products frequently have more pest damage than conventional products. Three studies have looked at how pest damage affects consumer purchases. The study that estimated consumer willingness to pay for pesticide labels in apples also estimated the amount of pest damage that would be acceptable under different label scenarios (22, 23, 24). This study presented consumers with photographs portraying apples that varied only in terms of pest damage. Four levels of damage were presented ranging from no damage to dam-

age of 24 percent of the surface area of the side of the apple shown in photo. Respondents were asked what their purchases would be under different labeling conditions and prices. It was estimated that when the "meets Federal limits" label was available, consumers were willing to accept damage in lieu of paying a higher price. The maximum level of damage acceptable under these conditions was estimated to be 7.5 percent of the surface area on the apple shown in the photo. For the "no pesticide residue" level, acceptable levels of pest damage was 11.9 percent of the surface area of the apple in the photo. Since the surface area of a real apple would be larger, the acceptable level of damage is small.

In another study, Bunn et al. (1) presented consumers in California with three photographs of oranges. One photo presented a perfect orange, one presented an orange with 10 percent of the surface area scarred as the result of insect damage, and one presented an orange with 20-percent scarring. Seventy-eight percent of the respondents said they were less willing to buy the orange with 10-percent scarring than the perfect orange, and 87 percent were less willing to buy the orange with 20-percent scarring. When informed that the damaged oranges were grown with 50 percent less pesticide, 63 percent of respondents indicated that they were more willing to buy the orange with 10-percent scarring than the perfect orange, and 58 percent indicated they were more willing to buy the orange with 20-percent scarring.

A survey in Georgia found that 62 percent of consumers were unwilling to accept cosmetic damage to obtain pesticide-free fresh produce and 88 percent were unwilling to accept insect damage (11, 12).

Overall, these studies suggest that consumers are generally willing to accept a small amount of pest damage if they also feel that risks are reduced. However, the amount of damage acceptable is not likely to be very high (24).

Hammitt (6) found that organic-produce purchasers perceived higher risks from conventional produce than organic produce and are willing to pay higher prices for reduced pesticides (i. e., organic foods) than are conventional produce purchasers. The Van-Ravenswaay and Hoehn study that examined willingness to pay for labels, however, found that there is no strong correlation between willingness to pay and risk perception (23). This study found that consumers are willing to pay more for labels whether or not they perceived high or low risks resulting from pesticide residues. This finding suggests that even consumers that do not feel that low levels of pesticide residues pose significant risks, may have some

**Table 12-9—Frequency of Purchase of Organic Produce**

	California	Michigan
	Percent	
Total purchasing organic produce. . . . .	62	45
16-30 times/month . . . . .	2	NA
5-15 times/month . . . . .	9	NA
1-4 times/month . . . . .	23	NA
less than once/month . . . . .	28	NA
very often . . . . .	NA	7
occasionally . . . . .	<b>NA</b>	<b>23</b>
seldom . . . . .	NA	15

NA = Not applicable

**NOTE:** Times/month is the number of times that any organic foal was purchased.

**SOURCES:** Desmond Jolly, Howard Schutz, Jagit Johal, and Kathy Diaz Knauf, "Marketing Organic Foods in California," Sustainable Agricultural Research in Education Program, University of California, Davis, CA, August 1989; Charles Atkin, "Consumer Attitudes About Food Issues in Michigan," Michigan Department of Agriculture, March 1990.

**Table 12-10—Estimated Consumer Willingness To Pay To Reduce Pesticide Residues Under Specified Market Conditions**

	Hammitt	Rae	Jolly	vanRav
	Percent willing to pay above conventional food prices			
Organic consumers . . . . .	50	49	NA	NA
Peaches . . . . .	NA	NA	69	NA
Apples . . . . .	NA	NA	37	NA
Conventional consumers . . . . .	5	NA	NA	NA
Labeled apples. . . . .	NA	NA	NA	47

NA = Nonapplicable

**NOTES:**

The Hammitt study assumes that conventional and organic versions of products differ only in terms of risk, a very strong assumption. Data was collected from shoppers patronizing two food cooperatives, one health food market, and two supermarkets in West Los Angeles and Santa Monica, CA, 1985. Estimates were based on focus group studies involving two groups each of organic and conventional produce purchasers. The values reported are the median willingness to increase expenditures over conventional produce prices to avoid a one part per million of residues. The actual observed premiums paid in the market were 45 percent higher for organic produce.

SOURCE: James Hammitt, "Organic Carrots: Consumer Willingness to Pay to Reduce Food Borne Risks," The RAND Corp., R-3447-EPA, 1986.

The Rae study was conducted in 1987 at four Bread and Circus stores in Boston. Organic produce purchasers were asked if they would be willing to support a referendum requiring EPA to eliminate the use of most pesticides if they knew it would increase the cost of food by X (20,40,50,60,80) percent.

SOURCE: Douglas Rae, "Risks of Consuming Pesticide and Fungicide Additives: Perceptions and Behavior of Organic Food Consumers," Final Report to the U.S. Environmental Protection Agency Benefits Staff, 1987.

The Jolly study involved organic fruit purchasers in Marin, Sacramento, and San Diego, CA counties in August, 1989. The estimated willingness to pay for organic apples and peaches was based on the price of conventional apples of \$0.68/lb and of conventional peaches of \$0.49/lb.

SOURCE: Desmond Jolly, "Consumer Willingness to Pay Price Premiums for Organic Apples and Peaches," Department of Agricultural Economics, University of California, March, 1989.

The van Ravenswaay and Hoehn study was a 1990 nationwide survey. The estimate reported is for the percent increase consumers were willing to pay for apples with no label and those certified and labeled to contain no pesticide residues, given a conventional apple price of 79 cents/pound, and given that only apples (and not other produce) were labeled (thus it represents an upper bound).

SOURCE: Eileen O. van Ravenswaay and John P. Hoehn, "Willingness to Pay for Reducing Pesticide Residues in Food: Results of a Nationwide Survey," Michigan State University staff paper No. 91-18, 1991.

**Table 12-1 I—Estimated Consumer Willingness To Pay for Pesticide Residue Reductions Under No Specified Market Conditions**

	Atlanta	Georgia	Michigan
	Percent willing to pay above conventional food prices		
No . . . . .	34	26	29
Yes . . . . .	66	45	66
Don't know . . . . .	0	29	5
How much more			
50/0 . . . . .	56	24	23
10% . . . . .	10	15	23
0.10% . . . . .	NA	6	17
Don't know . . . . .	NA	NA	5

NA = Not asked

**NOTES:**

The Atlanta survey was administered to 313 shoppers at 9 supermarkets in Atlanta, Georgia suburbs in 1988. The survey asked if the shoppers were willing to pay more for certified pesticide-free fresh produce.

SOURCE: Stephen L. Ott and Arlyn Maligaya, "An Analysis of Consumer Attitudes Toward Pesticide Use and the Potential Market for Pesticide Residue-Free Fresh Produce," Paper Presented at the Southern Agricultural Economics Meetings, Nashville, TN, January, 1989.

The Georgia survey involved 389 members of the Georgia Consumer Panel maintained by the Department of Agricultural Economics at the Georgia Experiment Station in 1989. The survey asked the respondents if they were willing to pay more for certified pesticide-free fresh produce.

SOURCE: Stephen L. Ott, C.L. Huang, and S.K. Misra, "(Consumer Risk Perceptions About Pesticide Use in Fresh Produce Production," Paper Presented at the Economics of Food Safety Workshop, Alexandria, VA, June 1990.

The Michigan survey was a telephone survey of 600 households in Michigan in 1990. The survey asked respondents what they would be willing to pay for food products grown without the use of pesticides and/or chemicals.

SOURCE: Charles Atkin, "Consumer Attitudes About Food Issues in Michigan," Michigan Department of Agriculture, March 1990.

questions about the certainty of that perception or that the apples they are consuming may contain much higher levels of pesticides than anticipated. Thus, it would appear that consumers are willing to pay more for additional information on which to base purchase decisions.

Consumers may be willing to purchase organic foods for reasons unrelated to their perceived risks from pesticide residues. For example, purchasers of organic produce generally indicated that they bought organic products primarily for their family's health, although some consumers indicated that they bought organic products due to political or ecological concerns, concerns about small farms, and because they thought organic food was more nutritious and tasted better (6, 8, 9, 16).

## **IMPLICATIONS FOR NEW AGRICULTURAL TECHNOLOGIES**

Unlike the development of some technologies that enhance food safety, such as refrigeration, the benefits of many biotechnology products may not be obvious to the consumer or may accrue to someone other than the consumer. For example, genetically modified enzymes may allow a food company to produce a food product at a reduced cost, but unless that reduced cost of production results in a noticeable price reduction to consumers, the benefits of the technology will not be obvious to them. Consumers may only see real or perceived increases in risk without any offsetting benefits resulting from biotechnology. If important changes in the food supply are to be introduced, industry and government regulators will have to demonstrate that risks are not going to be increased, or that there are consumer benefits that offset any added risks (14).

Risks that are uncontrollable, invisible, unfamiliar, not well understood, or involuntary will also elicit greater public concern than those that are readily identified and potentially avoided by individuals. Risks that may have catastrophic effects, affect particular groups such as children, or involve particularly dreaded diseases such as cancer will cause the most alarm. Consumers often differentiate between risks of natural and synthetic origin (21), although this distinction may not be based on any sound scientific rationale.

Industry and government regulators can help alleviate consumer fears by explaining what steps are taken to reduce any risks that exist. Additionally, offering choices to consumers can help diminish fears. Organic foods are

an example. As noted, many consumers indicate that they are not willing to pay substantially higher prices for pesticide-free foods (e.g., one-quarter to one-third of consumers indicate they are unwilling to pay any price, while nearly two-thirds of consumers indicate a willingness to pay 5 percent and possibly 10 percent higher food prices). About 5 to 10 percent of consumers appear willing to pay premiums of up to 50 percent over conventional foods to reduce pesticide residues (23). Development of an organic foods market, even if prices are higher, provides consumers who can afford these prices with a choice concerning the amount of pesticide residues they are exposed to. A similar scenario may be possible with food products produced with biotechnology. Niche markets of biotechnology-free food products could be developed to satisfy those consumers whose concerns are so great that they are willing to pay potentially higher food prices to avoid biotechnology, without burdening all consumers with these potentially higher food prices.

The lack of standard frameworks and methods to analyze how consumers think about food risks, how those perceptions are affected by new information, and the tradeoffs consumers are willing to make to reduce risks, makes it difficult to assess how consumers will react to new biotechnology products. Assessments are further complicated by the fact that few consumers have heard of many of the technologies. Furthermore, of the few surveys available, the purchase scenarios given to consumers were generally ambiguous about the conditions under which the consumer would know if the product had been produced with biotechnology, what the price would be, and how the quality characteristics of the product would be affected (tables 12-12 and 12-13).

Definitive conclusions concerning how consumer purchases will be affected by the use of biotechnology in food products cannot be reached, but a few tentative conclusions are suggested by these studies. At least one-quarter of the respondents are resistant to the idea of using milk or pork produced with the use of somatotropin. However, the data also indicate that consumers revise their perceptions in light of new information regarding risks. For example, learning that the government had approved the safety of bovine somatotropin (bST) substantially reduced the percentage of consumers who said they would not purchase bST-produced milk. Price and quality characteristics also affect consumer purchase intentions. With knowledge that the price of bST- and porcine somatotropin (pST)-produced products is less than that of conventional products, a greater percentage of consumers said they would increase purchases of milk and pork produced with bST and pST. Learning that pST

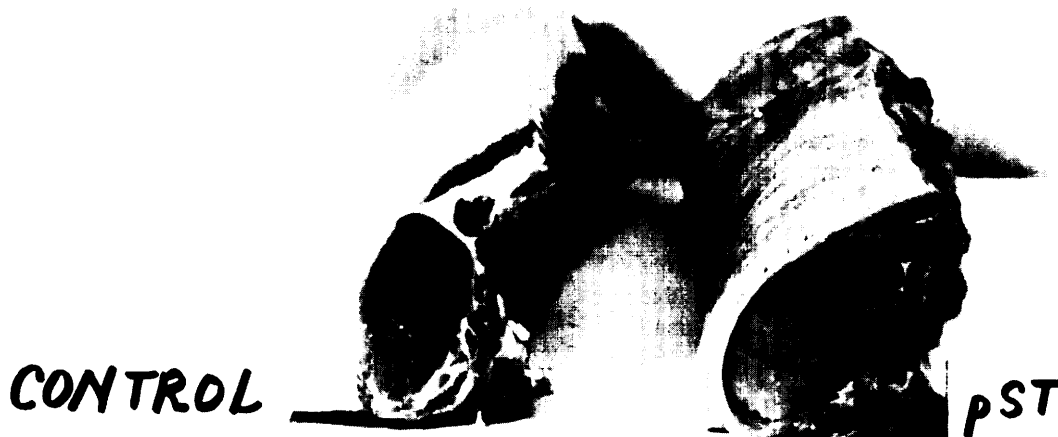


Photo credit: Terry Etherton, Pennsylvania State University

At least 50 percent of consumers surveyed are willing to pay higher prices for pST produced pork if it is leaner.

**Table 12-12—Consumers Indicating Purchase Intentions of Milk Produced With Bovine Somatotropin Under Specified Conditions**

	Virginia			Missouri		Wisconsin
	10¢ price decrease	40¢ price decrease	No price change	bST	FDA approved	No price change
	Percent					
No change in amount purchased . . . . .	79	72	82	NA	NA	NA
Reduce or stop purchases . . . . .	16	15	16	NA	NA	NA
Increase purchases . . . . .	4	11	NA	NA	NA	NA
Probably would purchase milk . . . . .	NA	NA	NA	28	49	NA
Probably would not purchase milk . . . . .	NA	NA	NA	44	28	NA
Don't know . . . . .	2	2	2	28	23	NR
Prefer milk not treated with bST . . . . .	NA	NA	NA	NA	NA	77

NA = Not applicable.

**NOTES:**

The Virginia study asked consumers about their purchase intentions of milk after bST was approved. Consumers were not told whether all milk or only some would be produced with bST or whether consumers would be able to identify that milk produced with bST.

SOURCE: W.P. Preston, A.M. McGuirk, and G.M. Jones, "Consumer Reaction to the Introduction of Bovine Somatotropin," paper presented at the Economics of Food Safety Workshop, Alexandria, VA, June 1990.

The Missouri study asked consumers if they would purchase milk produced with bST. They were then asked if they would purchase milk produced with bST if bST is approved by FDA. No price scenarios were given nor was it indicated whether consumers would be able to identify milk produced with bST.

SOURCE: Barbara J. Slusher, "Consumer Acceptance of Food Production Innovations—An Empirical Focus on Biotechnology and bST," paper presented at the Second International Conference on Research in the Consumer Interest, Snowbird, UT, Aug. 9-11, 1990.

The Wisconsin study asked consumers if they would prefer milk from untreated herds if milk from bST treated herds were labeled and there was no price difference.

SOURCE: Robin Douthitt, "Biotechnology and Consumer Choice in the Market Place: Should There Be Mandatory Product Labeling? A Case Study of Bovine Somatotropin and Wisconsin Dairy Products," presented at the Second International Conference on Research in the Consumer Interest, Snowbird, UT, Aug. 9-11, 1990.

makes pork significantly leaner resulted in more consumers indicating that they would increase purchases of pork produced with pST.

When asked if they are willing to pay more to purchase leaner pork produced with pST, 32 percent of consumers

surveyed in Atlanta said they would pay 5 to 10 cents/lb extra, and 21 percent would pay even more. About half of the consumers surveyed in New York and Philadelphia indicated that they are willing to pay higher prices for pST produced pork if it is leaner. In contrast, of the consumers in Wisconsin who said that they prefer

**Table 12-13—Consumers Indicating Purchase Intentions of Meat Produced With Porcine Somatotropin**

	Atlanta <sup>1</sup>	New York/ Philadelphia	Atlanta/Chicago/Los Angeles/ New York/Philadelphia <sup>2</sup>
<b>Question: Would you eat less pork if PST were used? (no price or quality information provided)</b>			
Less likely . . . . .	1570	22%	NR
More likely/yes . . . . .	1290	230/.	330/0
No change/no . . . . .	420/0	550/0	670/.
Don't know . . . . .	300/0	NR	NR
<b>Question: Would you eat more pork if pST were used and the pork is leaner?</b>			
	Atlanta	New York/ Philadelphia	Atlanta/Chicago/Los Angeles/ New York/Philadelphia
Less likely . . . . .	14%	22%	NR
More likely/yes . . . . .	27%	320/0	46%
No change/no . . . . .	40%	460/0	NR
Don't know . . . . .	19%	NR	NR
<b>Question: Would you eat more pork if PST were used and the pork was cheaper?</b>			
	Atlanta	New York/ Philadelphia	Atlanta/Chicago/Los Angeles/ New York/Philadelphia
Less likely . . . . .	17%	240/.	NR
More likely/yes . . . . .	21%	19%	44%
No change/no . . . . .	43%	57%	NR
Don't know . . . . .	19%	NR	NR

NR = Not reported

**SOURCES:**

<sup>1</sup>W.J. Florowski, C.L. Huang, and Brian Goggin, "Attitudes Towards Porcine Somatotropin: A Consumer Survey of the Atlanta Metropolitan Area," The Georgia Agricultural Experiment Station, College of Agriculture, The University of Georgia Research Report 570, August 1989.

<sup>2</sup>Catherine Halbrendt et al., "Public Attitudes in the Northeast Region Toward Recombinant Porcine Somatotropin," *Journal of Food Distribution Research*, February 1989, pp. 153-183.

<sup>3</sup>Catherine Halbrendt et al., "Socioeconomic Determinants of Attitudes Toward the Use of Bioengineered Products in Food Production," Department of Food and Resource Economics, University of Delaware, 1990.

milk that is not produced using bST, 67 percent said they are willing to pay at least 5 cents more per half gallon to obtain bST-free milk.

Perhaps the feature that stands out the most in these surveys is the large number of consumers who are unfamiliar with these new technologies. Given this lack of familiarity, there is a great deal of consumer uncertainty. The greatest awareness of a new technology was for technologies that had generated controversy and media coverage in a region. Thus, 80 percent of the consumers in Wisconsin were aware of bST, while fewer than 20 percent of those surveyed in Virginia had heard of it. This implies that consumer perceptions concerning these new technologies will be affected by media coverage and controversy. The Alar scare of 1989 provides another example of how consumer perceptions can be affected by media attention. The significance of media attention and controversy is substantial given that some opponents

of biotechnology have demonstrated a willingness to exploit food safety issues in their attempts to stop biotechnology.

### ***Food Scares***

Food scares can affect consumer food demand and shake the public confidence in regulatory institutions. In early 1989, reports<sup>3</sup> highly critical of the use of Alar (a growth regulator) in apples, followed by an alert of potential cyanide poisoning in imported grapes, lead to significant public fears over the safety of the food supply (table 12-14). Nearly a year later, the level of confidence had not recovered to previous levels.

One study isolated the effects of the Alar controversy on apple purchases by determining what the purchases would have been in the absence of the controversy (23). This difference provides an estimate of the willingness to pay for the removal of Alar. The study found that

<sup>3</sup>The public interest group Natural Resources Defense Council (NRDC) (18) and the television program *60 Minutes* concurrently released reports.

**Table 12-14—Consumer Confidence Following Alar and Cyanide Scare**

	FMI				CPQ			
	Jan. 1989	Apr. 1989	Apr. 1989	June 1989	Aug. 1989	Jan. 1990	Jan. 1989	Mar. 1989
	Percent							
Completely confident . . . . .	NA	NA	NA	NA	NA	NA	25	21
Mostly confident . . . . .	81	67	73	65	67	79	56	49
Somewhat doubtful . . . . .	15	24	19	27	24	18	14	23
Very doubtful . . . . .	2	7	6	6	6	2	4	6
Not sure . . . . .	2	2	2	2	3	0	NA	NA

NA = Not applicable.

**NOTES:**

The Food Marketing Institute (FMI) surveys were conducted in January, the second week of April, the fourth week of April, June, and August of 1989 and in January, 1990. Respondents numbered greater than 1,000 in each survey. The question asked was "How confident are you that the food in your supermarket is safe?" Response categories provided were completely or mostly confident, somewhat doubtful, very doubtful, not sure.

**SOURCE:** Food Marketing Institute, *Consumer Confidence in Food Safety, an Update*, Sept. 28, 1989 and Food Marketing Institute, "Trends: Consumer Attitudes and the Market Place," 1989 and 1990.

The Center for Produce Quality (CPQ) surveys were conducted in January and March of 1989 and consisted of 1,008 and 1,004 respondents, respectively. The question asked was "How confident are you that fruits and vegetables available to consumers are safe to eat?" Response categories provided were very, somewhat, not very, and not at all.

**SOURCE:** Center for Produce Quality, "Tracking Survey to Identify Changes in Consumer Concern about Pesticide Residues on Fresh Fruits and Vegetables," Produce Marketing Association, Newark, DE, April 1989.

consumers were willing to pay 21 cents per pound (a 27-percent increase) more for Alar-free fresh apples in 1989. On an annual basis and based on the average annual per-person consumption of fresh apples, this finding implies that the average consumer is willing to pay about \$2.35 per year to avoid the risks of Alar. Estimates of consumer willingness to pay for a one in a million reduction in annual mortality risks were approximately the same as those calculated for other risks such as occupational hazards, seat belt use, etc. Thus consumers react to Alar in much the same way as they do to other risks, and the estimated willingness to pay to reduce Alar gives an indication of what consumers may be willing to pay to reduce pesticide risks given an unusual situation when the risks of pesticides were probably perceived to be well above what people normally believe them to be (23).

### ***Food Labeling***

Labels can be used to provide consumer information, and indeed, that is the primary purpose generally attributed to them. Labels as well as brands, however, are also used by the food industry to differentiate their products and to establish market niches. Labels are most frequently used for this purpose when the product is technically complex, when nutritional and food safety attributes are enhanced by processing or combining of ingredients, when advertising is important in establishing and maintaining the value of the product, and when convenience, packaging, and style are important to establishing the image of a product. When characteristics such



Photo credit: DNAP

Freshworld, a joint venture between DNA Plant Technology and DuPont, has been marketing VegiSnax brand carrot and celery sticks produced by plant tissue culture technology.

as these are important, sellers use advertising and new product introductions to distinguish their products rather than price rivalry.

Labels may also play a role in defining public values (i.e., the choice and emphasis of information contained in labels reflects those nutritional and safety attributes considered important). Debates over the types of information that should be contained in food labels provide a forum to reach expert consensus concerning important nutrition and safety issues. Information provided on food



labels is regulated by several Federal and State agencies, and this regulation provides some public surveillance over food safety and nutrition claims (13).

Consumer surveys indicate that consumers prefer that foods derived from biotechnology be labeled as such (2, 15, 19). Consumers also prefer that foods containing pesticide residues are labeled, but studies show that even though consumers prefer labeling, they are not willing to pay significantly higher prices to get labeling. If consumers react to biotechnology products in a similar manner, then it may be reasonable to expect that they also will be unwilling to pay significantly higher prices for those labels. In general, the costs of labeling will play a significant role in consumer demand for labels. Labeling costs are born by the food industry itself (e.g., the actual costs of implementing the label), and by society as a whole (e.g., in the form of potentially higher food prices, higher taxes, fewer food choices, and a changed food industry structure).

Implementing a label change can be expensive for the food industry. Costs include administrative costs and the actual printing costs of the label itself. The cost of any analytical assays necessary to support the information contained on the label (e.g., verification of cholesterol content) and any marketing costs incurred as a result of the label change (e.g., if the label change resulted in the reformulation of a food product) must also be included in the label's cost. Additionally, any losses incurred as a result of a firm having a large inventory of products with the old label must be included (5).

Administrative costs will vary by firm size, the scope of the label change, the significance of the change, and the length of time allowed for the labeling change to occur. The scope of the labeling change can be limited (e.g., inclusion of a saccharin warning statement), or it may be comprehensive (e.g., major changes in nutrition labeling). Additionally, the number of products, firms, and industries affected will influence whether the scope of the label change is major or relatively minor. The significance of a label change can be measured, in part, by the impact it will have on the functionality of the product (e.g., the label change causes a reformulation of the product that affects the taste, texture, smell, and appearance) and on consumer perceptions of the product (5).

Analytical costs are a function of the analytical test being performed and the number of products affected. Analytical testing is the step that most frequently concerns small companies faced with a mandated label change. Large companies generally maintain their own analytical databases or contract with independent analytical testing

companies to obtain lowest cost. Small companies usually produce only a few products and are often not equipped to perform analytical testing in-house (5).

Marketing costs are similar to analytical costs in that they are a function of the market test performed and the number of products tested. Firms do not regularly initiate market testing in response to labeling changes, unless a mandated label change results in a reformulation of the product that affects the characteristics of, or the public perception of the product. If major reformulations are needed as a result of a mandated label change, firms may choose to discontinue the product altogether (5).

Printing costs are a function of the printing process, the frequency with which the label must be redesigned, the complexity of the label changes, the length of time needed to implement the change, and the number of units in stock that must be changed. Label changes range from minor one-color changes to completely redesigned labels requiring extensive artwork, photography, stripping, and engraving (5).

The primary inventory cost associated with a label change is the inventory loss of old labels (i.e., products with old labels may have to be disposed of). Many variables influence the probability and magnitude of inventory losses for a particular firm, including the average size of the inventory containing the old label, the length of the compliance period allowed for mandated label changes, the significance of the change, the size of the firm, and the type of the label (i.e., if it's a label that is added after the product is packaged, or if it is a significant part of the packaging itself). Shorter compliance periods may not be as significant for products that have short shelf lives and rapid market turnover, in contrast to products that sell more slowly in the market (5).

Mandatory changes in food labels can affect product formulation. Proponents of mandatory labeling of certain ingredients (e.g., pesticide residues) push for such labeling in the hopes that rather than stating that their product contains such an ingredient, a food processor will redesign their product so that the ingredient is not used at all. Indeed, this is one of the primary goals of Proposition 65 in California. Proposition 65 contains provisions that consumers be warned about potential exposure to certain carcinogens or reproductive toxins. Proponents hope that such labels will result in the reformulation or discontinuation of products containing ingredients requiring labels (13). Some groups have proposed that any food product that contains ingredients produced with biotechnology should be required by law to state this fact on the label (7). Many opponents of biotech-

nology hope that by requiring biotechnology labeling, food producers will avoid the use of biotechnology.

Such avoidance, in the absence of banning all agricultural biotechnology products, may be difficult to achieve. Biotechnology is not like pesticides, which are limited in number and whose residues in food, at least in theory, can be analytically verified. The numbers of genes that could be manipulated and the types of food products that could be produced using biotechnology are enormous, and at present, it is not clear if it is even theoretically possible to develop a generic assay to determine if biotechnology has been used to produce a food ingredient.

Thus, the only mechanism of verification may be intense monitoring of every step (i.e., from farm to dinner table) in the food production process. Such monitoring may be feasible in some food industries where a significant amount of vertical integration already exists (e. g., some fruits and vegetables, and poultry). For food industries that are highly decentralized (e.g., grains and oilseeds), monitoring requirements may provide significant incentives for the vertical integration of these industries. Generally, small farmers do not fare well in food industries that are highly vertically integrated. Thus, a mandatory labeling program could result in significant structural changes in agricultural production.

The record keeping and oversight needed to monitor all aspects of food production will be expensive for the food industry. Additionally, mandatory labeling programs will require State or Federal oversight, the maintenance of which will require a reallocation of personnel and tax dollars. Given that the food industry involves over two million farmers alone, in addition to millions of food haulers, processors, and retailers, effective oversight of a mandatory labeling law for all biotechnology products used in foods will not be easy to accomplish, and significant potential for abuse of the labeling requirements can exist.

Regulated voluntary labeling is an alternative to mandatory labeling of all food products containing biotechnology-derived food products. Such a policy could provide for the establishment of niche markets for biotechnology-free products. This would provide a choice to consumers who are substantially concerned about the use of biotechnology in food without unduly burdening consumers

who are indifferent to the use of biotechnology in food production. As with mandatory labeling, voluntary labeling programs would require industry monitoring of the entire food production process; however, with a voluntary program, the number of firms involved could be substantially fewer than with a mandatory program (choices of food products available also may be limited). Administration of such a program would be more manageable as compared to a mandatory program, although considerable difficulties would still exist. Industry can compensate costs incurred by charging higher prices for labeled food items (i.e., similar to organic foods).

Federal or State resources will still be required to establish guidelines, provide certification or permits for participants, and to provide oversight, but these inputs will be lower than they would be under a mandatory program. Additionally, while a voluntary program is also likely to provide incentives for vertical integration, because the number of participants may be considerably less than with a mandatory program, the extent of the impact on the structure of the agricultural industry would likely be less. A regulated voluntary program would substantially shift the cost of the program to those who are most concerned about biotechnology food products, rather than requiring all of society to pay the higher prices likely to occur with a mandatory labeling program.

Alternatively, the status quo can be maintained concerning labels, with all labeling at the discretion of the food industry—hence, completely voluntary. Unlike the regulated voluntary labeling program, Federal or State regulatory agencies would not establish guidelines other than those currently in existence for food products, would not establish a certification or permit procedure, and would not conduct oversight procedures specific to biotechnology. Enforcement would be limited to the same misbranding (see ch. 10) provisions that currently exist for food products. The cost of such a program would be minimal, and it is likely that producers will limit the biotechnology information provided to consumers.

The need for information concerning biotechnology in food could be eliminated, of course, by banning the use of biotechnology in agriculture. Such a step is not without consequences, however, and even if enacted, is no guarantee that biotechnology will not be used in the food products eaten by U.S. consumers. Banning biotechnol-

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<sup>4</sup>Firms are vertically integrated when they control two or more levels of the production-marketing system for a product. For example, a vertically integrated fruit industry could control the conditions under which the fruit is produced (i.e., varieties grown and inputs used in production) and the manner and price in which the fruit is distributed and marketed. Control of the two levels may be exercised by contractual arrangements with producers or by ownership.

ogy would greatly diminish the competitive position of U.S. agriculture, which could result in significant social costs. Some products may have significant cost advantages to farmers and processors, and if such products are available elsewhere in the world, the development of a black market trade in such products cannot be ruled out. Additionally, the United States is by no means the only country developing biotechnology for use in the food and agricultural industries. The United States annually imports billions of dollars worth of food products and seeds. Given that it may not be possible to develop verification procedures for biotechnology-derived imported foods, it is not clear how one will be able to control the importation of genetically modified food products short of banning the importation of all imported food products.

In short, contrary to the claims of proponents for mandatory labeling of biotechnology food products, such a regulation is not likely to be very low cost (7). Indeed a recent study conducted by the Wisconsin Department of Agriculture concerning a mandatory labeling program for fluid milk only (milk products such as cheese, ice cream, and yogurt were not included) produced with bovine somatotropin (bST) found that such a policy would be difficult and costly for Wisconsin to implement, and would require considerable changes in modes of operation for milk producers, haulers, processors, and distributors. Considerable funding and personnel would be needed to oversee the program. No assay methodology currently is available to detect bST in milk, making effective enforcement extremely difficult. Additionally, even if Wisconsin adopted labeling, it would be nearly impossible to control milk imported from other States. A regulated voluntary control mechanism would have some of the same problems, but they were likely to be on a smaller scale, and therefore more manageable and less costly (20).

The argument for mandatory labeling is that the consumer has the right to know whether or not biotechnology was used in the production of the food, and presumes that a high level of consumer concern will persist indefinitely. This is a possibility. It is also possible that consumers will be concerned when these products are first introduced, but as they become more familiar with the products, anxieties may decrease and the demand for labels may decline. Mandatory labeling could not accommodate this scenario; a regulated voluntary program would be more flexible in this respect.

Although a small subset of the population undoubtedly will be willing to pay higher prices to avoid products produced with biotechnology, most people will not, if

they react to biotechnology as they do to pesticide residues.

## SUMMARY

Attempts to study food safety issues are relatively new and do not share a standard methodology. No definitive answers to questions about public perceptions of food safety are available, but some tentative conclusions can be reached. For example, there appears to be increasing and broadening concern about food safety issues, and a general skepticism about the ability of public institutions to maintain food safety. It is not clear whether the public feels that Federal agencies establish inadequate standards of safety or inadequately enforce the standards, although some research suggests that enforcement might be the major concern. Consumer perceptions of the harm that will come from food safety risks vary extensively. While most consumers value the same harm or loss similarly, they have widely divergent views of the types of harm that might occur as a result of food safety risks, and differ significantly in their views of the probability that the risk will result in harm to them.

Because of these differences in perceptions, consumers may not be equally willing to pay for food safety precautions. For example, perhaps as many as one-third of consumers surveyed are unwilling to spend any amount to reduce risks from pesticide residues, while 5 to 10 percent of consumers surveyed appear willing to pay premiums of up to 50 percent over conventional food prices to reduce the risks of pesticides. The majority of the consumers appear willing to pay a premium of 5 to 10 percent to reduce pesticide residues. There is also evidence that consumers do consider new information about risks and change their perceptions accordingly. Additionally, when considering how much consumers are willing to pay to accept or reduce a risk, other factors, such as total product price and quality are also important decision variables. Thus, it is too early to determine how consumers will perceive food products derived from biotechnology, but it is likely that the same factors that influence their perception of the safety of conventional foods will also influence their acceptance of foods produced with new technologies. That is, the extent of safety concerns about new technologies will depend on how the potential risk is perceived, how much confidence consumers have in government food safety guarantees, how costly it is to avoid the technology, and what benefits consumers perceive will accrue to them from eating or not eating biotechnology-derived food products.

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