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Staff Papers Series

Staff Paper P89-38

October 1989

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October 3, 1989



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*The author wishes to thank Elaine Asp, Frank Busta and Jean Kinsey for their comments on an earlier version of this paper. The author remains responsible for the viewpoints expressed and for any errors.

Staff papers are published without formal review within the Department of Agricultural and Applied Economics.

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FOOD SAFETY: A GROWING CONCERN

During the last two decades, consumers have at sometime been warned about DDT, mercury and PCB's in some freshwater fish; botulism in some "Patti-melt" sandwiches, potato salad and smoked fish; sodium nitrite in bacon and many processed meats; red dye no. 2 and violet no. 1; cyclamates and saccharin; salmonella in poultry, cheese and eggs; DES (a growth hormone) in beef; aflatoxin in grain and peanuts; EDB in grain; aldicarb, captafol and other pesticide residues on produce; tainted shellfish; heptachlor (a pesticide) in some milk and poultry; and dioxin in milk cartons (Clancy, 1988, p. 6; Labuza, 1977, pp. 382-388, and Beck et al., 1989). This list represents just some of the specific food safety concerns which arose during the 1970s and 1980s. Then in early 1989 the two most widely publicized food safety incidents in recent memory occurred within a short period of each other: the case of Alar (daminozide) and apples, and the Chilean grape tampering scare, in which some imported grapes were found to be laced with cyanide.

Not surprisingly, food safety is a growing concern for many consumers. Americans have come to take a bountiful food supply for granted, but many have increasing worries about the safety of the food supply and its impact on their health. During the Chilean grape incident, one mother in Oregon became so concerned that she called the state highway patrol to ask them to stop her daughter's school bus and remove the grapes from her lunch (Beck et al., 1989, p. 16). However, anyone who thinks food safety concerns are a recent phenomena should read Upton Sinclair's

famous book, The Jungle (1906), which describes the scandalous conditions in the meatpacking industry around the turn of the century before federal meat inspection was introduced.

Everyone, including consumers, producers, processors, and politicians, would support the position that the U.S. should have an adequate, reliable, wholesome, nutritious, high quality, reasonably priced and safe food supply. No one would claim to be in favor of unsafe or unwholesome food. The controversy begins with the interpretation of these goals, including food safety, and the actions taken or not taken to achieve them.

This paper first looks at the various perspectives on food safety of consumers, producers and others. It then briefly reviews the basic food safety legislation in the U.S. and the policy formulation process. The next section discusses the two key elements required for making sound food safety decisions: estimating the risk involved and establishing an acceptable level of risk. Consumers' perceptions of the riskiness of an activity or product frequently may be quite different than the level of hazard involved and there are factors that can explain this divergence. The issue of food safety is also related to the degree of trust and confidence consumers have in the food industry and the government regulatory process. The role consumer information can and should play in food safety issues is also addressed. In the last major section, several food safety topics of particular current interest are discussed, including pesticide residues, foodborne pathogens, seafood inspection and food additives.

VARIOUS PERSPECTIVES ON FOOD SAFETY

For most consumers, food safety may be a growing, but at most times still largely latent concern. In the January 1989 Food Marketing Institute (FMI) consumer survey, people were asked how confident they were about the safety of the food in supermarkets. Twenty-three percent responded completely confident, 58% mostly confident, 15% somewhat doubtful, and only 2% very doubtful, with 2% not sure (Food Marketing Institute, 1989a, p. 52). On the other hand, when read a specific list of food safety issues, a large proportion saw several as posing a serious hazard. Table 10.1 gives the detailed response for 1989 and the percent who responded that each factor represented a serious safety hazard back to 1984, when FMI began asking this question in their annual consumer survey. The specific question was: "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" (Food Marketing Institute, 1989a, p. 54).

According to the results in table 10.1, the most worrisome food safety concern for consumers is pesticide residues, followed by antibiotic and hormone use, nitrites, irradiation, additives and preservatives, and then artificial colors. In a 1980 Louis Harris poll, 81% of the respondents felt that society was exposed to a greater risk from chemicals than 20 years earlier (Bruhn, Lane and Walton, 1988, p. 9). The greatest food safety concern of consumers "is that suspected or known cancer-causing chemicals are being used in food production and processing, with unknown long-run health risks" (Archibald and Marsh, 1988, p. 33). This helps explain why consumers rank pesticide residues as such a serious health hazard. Consumers want government to treat food safety as a high

priority issue and want the government to act to insure the safety of the food supply. In a 1983 survey of consumers in Kansas, 90% agreed that food safety should be a high government priority (Kramer, 1988, p. 148).

The hazard posed by microbial contamination, is usually quite far down on most consumers' lists of food safety concerns (Archibald et al., 1988, p. 5). Interestingly, this ranking is quite different from the priorities that food safety experts place on various issues. The professional staff of the Food and Drug Administration (FDA) considers microbiological contaminants to be the major health hazard associated with food, followed by malnutrition and diet-related factors related to degenerative diseases, environmental contaminants such as PCB's, dioxin and mercury, naturally occurring toxins in foods, pesticide residues, and then food additives (Forbes, 1988, p. 43 and Kramer and Penner, 1986, p. 21).

Some consumer advocates and some people in the food industry hold quite extreme views on either side of the food safety issue. Those in the former group feel that the government regulations are irresponsibly ignoring chemicals that pose insidious health threats (Middlekauff, 1988, p. 45). This was the position of the Natural Resources Defense Council (NRDC) regarding Alar (Beck et al., 1989, p. 16). They feel food safety regulation has been overly influenced by commercial agriculture and the food industry (Archibald and Marsh, 1988, p. 37). The government regulatory system is seen as inadequate and the agricultural and food industry as unresponsive to safety concerns, and in particular, unwilling to cut their use of toxic chemicals (Meyerhoff, 1989).

On the other side, many in the food industry complain about over-

regulation to the point where costs are increased with only marginal returns to safety. They argue that the elimination of all food-related risks is not possible, either economically or technically. They feel regulatory procedures, particularly for the approval of a new chemical, are unduly complex and time-consuming. The approval process for a new pesticide can take up to six years and for a new food additive, up to 10 years (Burbee and Kramer, 1986, pp. 19-20). And the cost to bring a new chemical to market may range from \$30 to \$50 million dollars (Archibald, Hurd and Marsh, 1988, p. 20). They feel that the hazards are exaggerated and the public's anxieties unduly inflated by the more extreme consumer advocates and the media. Public policy ends up being made more on the basis of political expediency than scientific facts (Archibald and Marsh, 1988, p. 38). Not surprisingly, given these divergent view points, food safety concerns can become highly charged public policy issues, as was the case with Alar, for example.

FOOD SAFETY REGULATION AND THE POLICY PROCESS

In the period around the turn of the century, the public's concern about the safety of the food supply was aroused by several events. In addition to Sinclair's The Jungle, Wiley's Poison Squad had a major impact (Labuza, 1977, p. 337). Harvey Wiley was Chief of the Bureau of Chemistry in the U.S. Department of Agriculture. He used a group of volunteers to test the safety of various foods which they had purchased. The testing frequently required eating the food, since today's laboratory procedures did not exist. Many problems were found. At about the same time, the New York City Health Commission found that more than 50% of the 4,000 milk

samples which it tested were adulterated. The milk was diluted by water and chalk or plaster of paris was added (Paarlberg, 1980, p. 86).

In 1906, Congress passed the Pure Food and Drug Act and the Meat Inspection Act. The former stated that the food which moved in interstate commerce was to be safe, but it was not a very effective regulation. No fines or penalties were established (Labuza, 1977, p. 338). The latter set up a federal meat inspection system. Most importantly, these laws established that the federal government has a responsibility and a legal right to insure a safe and wholesome food supply (Clancy, 1988, pp. 12-14). The Food and Drug Administration (FDA), created in 1931, was ineffective until after the passage of the Federal Food, Drug and Cosmetic Act in 1938. This law gave it the authority to fine and imprison violators (Labuza, 1977, p. 338). Originally, the FDA was located in USDA, but was transferred to the Department of Health, Education and Welfare in 1953. The Miller Pesticide Amendment, under which the pesticide residue on food is regulated, was added to the Food, Drug and Cosmetic Act in 1954.

The Poultry Inspection Act was enacted in 1957 and added that responsibility to USDA. The 1958 Food Additive Amendment placed the burden of proving an additive was safe on the company introducing it rather than the government having to prove it was unsafe (Labuza, 1977, p. 340). It also contained the well-known Delaney Clause, which will be discussed in detail later. Two other laws which have had an effect on food safety issues are the 1966 Fair Packaging and Labeling Act, which regulates advertising on packaged items, including food, and the 1971 Freedom of Information Act, which opened government actions to public

scrutiny (Labuza, 1977, p. 340). In addition to these major pieces of legislation, there are many other federal and state statutes which are relevant to various aspects of food safety regulation.

The food safety regulation system is far more complex than just the passage of laws by Congress. Specific agencies in the executive branch are given the authority to implement the law within the guidelines established by legislation. Implementation requires much more specificity though, than is contained in the legislation. A vast number of specific rules and regulations have been promulgated under the various laws by the agencies involved, principally the FDA and USDA (Labuza, 1977, p. 341). Proposed rules and regulations must be officially announced in the Federal Register, a daily record of the executive branch of government. A period of time is allowed for receiving comments concerning the proposal and frequently formal public hearings are held (Labuza, 1977, p. 341). The proposed rule or regulation may be dropped or modified before it is finalized. The complicated process of implementing and enforcing the laws passed by Congress gives the executive branch agencies and departments, and the civil servants in them, far more power and influence than most people realize.

DECIDING WHAT IS SAFE

Donald Kennedy, a past commissioner of FDA and current president of Stanford University, suggests that two elements are required for sound food safety decisions: an objective estimate of the risk involved and a policy judgement about the acceptable level of risk (Clancy, 1988, p. 15). The first is primarily a scientific issue and the second a public policy

issue. Individual consumers cannot determine their exposure to hazards in the food supply, nor can policymakers. Both must rely upon scientists to make these assessments. Sound food safety policy decisions require accurate estimates of the level of risk involved. In speaking about his experience as FDA commissioner, Donald Kennedy said that many times, decisions must be made "when the data are not as good as you would like" (Kennedy, 1988, p.13). In many cases, the toxicity information upon which policy is based is lacking or inadequate. As Kennedy (1988, p. 12) also said in reference to possibly hazardous substances, "we live in a world full of suspicion but woefully short on verification". The other fundamental food safety issue is lack of a consensus on an acceptable level of risk. How much risk, if any, are we as a society willing to accept to receive the benefits associated with the hazard?

Estimating the Risk or Hazard

We have made enormous advances in our ability to detect trace amounts of substances. With current chromatographic separation and purification procedures, plus high resolution mass spectroscopy, amounts as small as parts per trillion can be measured (Kennedy, 1988, p. 12). In fact, some would agree this very ability to detect infinitesimally small quantities has contributed to many of the dilemmas faced in food safety regulation. As Donald Kennedy said in testimony before a Senate committee, "we can detect more than we can evaluate, and measure more than we can understand" (Clancy, 1988, p. 15). Kennedy (1988, p. 12) has characterized the current methods of estimating the risk posed by a possible hazard as primitive, when compared to the advances in detection

capability.

Animal tests are the primary means used to assess the toxicity or health risks of a substance. Typically tests for acute, subacute, and chronic toxicity are conducted (Labuza, 1977, p. 370). The first step is to estimate the exposure level in terms of the consumption in a typical diet on a per unit of body weight basis, based on the amount of the substance that occurs or would occur in foods. The acute toxicity level involves giving increasingly larger doses to the test animals to determine the level at which the substance is lethal, which establishes the lethal dose. An important concept used by scientists, that most consumers are unaware of or overlook, is that virtually every substance is toxic; it is simply a matter of the dose (Middlekauff, 1988, p. 47). Familiar substances, such as salt or water, are poisonous "if taken in excess or in the wrong manner" (Sieber, 1988, p. 23). A corollary to this concept is that substances also have a minimum or threshold level below which there is no effect, either harmful or beneficial (Sieber, 1988, p. 23 and Labuza, 1977, p. 381).

The subacute tests involve giving the animals the substance daily over a period of time to study the health effects and establish the no effect dose or minimum effect dose, which is just below the level at which there are physiological effects (Labuza, 1977, p. 371). The no effect or minimum effect dose is then usually divided by a factor of either 100 or 1,000 to determine the acceptable daily intake for humans, which is in a per unit of body weight basis (Institute of Food Technologists, 1988, p. 121; Labuza, 1977, p. 371).

The chronic tests, which are how the risk of cancer is evaluated,

check for long-term harmful effects and typically involve a small number of animals over a period of years (Labuza, 1977, p. 372). The dose given is usually many times the acceptable daily intake for humans on a per unit of body weight basis. Otherwise, very large numbers of animals might have to be tested to establish results, for example, for a one-in-a-million response at low exposure. Mathematical models are used to extrapolate from the high-dose animal results to the low-exposure situation for humans (Institute of Food Technologists, 1988, p. 121).

Other animal tests are conducted for the effect of the substance on birth defects or mutations (Labuza, 1977, p. 373). The human testing of possibly hazardous substances is, of course, ethically unacceptable. Scientists can use epidemiological studies to look at samples from particular human population groups over long periods to attempt to identify health risks. However, it is always difficult in such studies to determine whether associations actually reflect causation, or are just spurious or coincidental (Middlekauff, 1988, p. 47).

There are many problems with extrapolating from the results of animal tests to humans (Clancy, 1988, p. 15). The doses given to the test animals are massive compared to the actual or expected level of human consumption (Archibald and Marsh, 1988, p. 35). In addition, a basic difficulty is that there are metabolic differences between the test animals and humans, plus other differences in chemical responsiveness may exist (Middlekauff, 1988, p. 47 and Campbell, 1988, p. 34). Thalidomide, which caused major birth defects in Europe, is a tragic example of the limitations of animal tests. At a dose level of 4 grams per kilogram of body weight per day, no birth defects were found in the tests on rats.

However, a dose level of only about 1/10,000th of that amount (a single dose of .5 milligrams per kilogram) could cause terrible birth defects when taken by women at certain stages of their pregnancy (Labuza, 1977, p. 374).

Two recent developments in risk assessment and management should be mentioned. An approach referred to as the Hazard Analysis Critical Control Point (HACCP) concept is gaining widespread use in industry to assess and control risks in products. The approach first involves determining the risks. Control points are then set up to monitor each risk area and ensure that they remain within acceptable limits. Some advocate the adoption of HACCP in public policy risk assessment and control (Bauman, 1989, p. 481).

Ames, Magaw and Gold (1987) used what they refer to as Human Exposure/Rodent Potency (HERP) index to evaluate the relative risks from a variety of chemicals which may be carcinogenic (Institute of Food Technologists, 1988, p. 123). They argue that animal test results should not be used to estimate absolute human cancer risks. The HERP values provide a relative ranking of the cancer-related risks of various chemicals based on the estimated human exposure and their carcinogenicity to rodents. The latter is based on the dose of the chemical needed to produce tumors in half of the test animals. They concluded that the risks of cancer from normal exposure to pesticide residues and food additives were minor compared to that from levels of naturally occurring carcinogens in food and the environment (Ames, Magaw and Gold, 1987).

In the future, alternative methods, such as cell and tissue culture and computer modeling, may reduce the need to rely on animal tests. Gary

Flamm, director of the FDA Office of Toxicology Science, "predicted that large animal tests for carcinogenicity will be all but passé in the next 10 to 15 years" (Science, 1987, p. 252). With research advances, scientists will be able to identify "biomarkers" for cancer potential that will require the use of smaller groups of animals for shorter periods of time.

Establishing an Acceptable Risk Standard

As Sandra Archibald (1988, p. 39) states, "food safety is governed by a patchwork of safety standards defined in a multitude of laws, that have evolved over time to meet a variety of needs". The risk standard in effect is related to how a substance enters the food supply, rather than strictly to the health risk it presents. Figure 10.1 presents the major risk standards currently in use, from the zero tolerance, zero risk principle of the Delaney Clause to the risk benefit approach of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). In fact, one of the major criticisms of the current system of food safety regulation is the inconsistency of the risk standards applied (Archibald, 1988, p. 39).

Delaney was a congressman whose wife died of cancer, who quite understandably, took a particular interest in cancer-related health and safety issues (Vento, 1989). The Delaney Clause was contained in the Food Additive Amendment of 1958 to the Food, Drug and Cosmetic Act (Labuza, 1977, p. 338). It states that "no additive shall be deemed to be safe if it is found to induce cancer when ingested by man or animal, or if it is found, after tests which are appropriate for the evaluation of the safety of food additives, to induce cancer in man or animal--" (Institute

of Food Technologists, 1988, p. 121).

The Delaney Clause applied specifically to food additives. Much of the controversy relates to judging the appropriateness of a test, since most of the evidence of carcinogenicity comes from animal tests. The concept of zero tolerance appeals to much of the public. Many consumers object to the presence of even very small amounts of hazardous substances in food (Kennedy, 1988, p. 9). Although it may be naive, they do not see why any hazardous substance should be in food. In a survey of Kansas consumers, 63% felt that the government should try to eliminate all health risk from the food supply, and 70% agreed that the government should not allow carcinogenic chemicals in food (Kramer, 1988, p. 148).

The Delaney standard of zero tolerance has become less workable as the ability to detect minute quantities of a substance has increased. When the Delaney Clause was enacted in 1958, laboratory equipment could detect 100 parts per billion of a substance, which meant that any amount less than that was, for practical purposes, equal to zero since it could not be measured. The increased detection capability, to as little as parts per trillion, has created a policy dilemma. One part per trillion is the equivalent of a single grain of sugar in an Olympic-size swimming pool (Institute of Food Technologists, 1988, p. 123). The detection limitations of the past implicitly set a *de minimis* standard because infinitesimally small traces of a substance could not be measured (Hazlett, 1988, p. 29). However, explicitly setting such a standard is more complicated.

The term "*de minimis*" comes from the legal argument: *de minimum non curat lex*, which is Latin for "the law does not concern itself with

trifles". This legal concept suggests that very small amounts or very small risks can be ignored, and courts should be reluctant to apply a statute literally to enforce pointless results (Institute of Food Technologists, 1989, p. 125 and Dardis, 1988, p. 310). A de minimis standard is used in the California Birth Defects Prevention Act (SB 950). The EPA announced it intends to use a de minimis standard to register pesticides with a low level cancer risk, after being urged to do so by a National Academy of Science panel (Archibald, 1988, p. 40 and Dardis, 1988, p. 310). And the FDA appears to be moving in the direction of a de minimis standard and away from a zero-tolerance concept (Archibald, 1988, p. 40). The de minimis standard currently being applied is one in one million, which means the hazard should not cause more than one additional death per one million people over their lifetimes (Kennedy, 1988, p. 12).

Under California's recent Safe Drinking Water and Toxic Enforcement Act, better known as Proposition 65, a no-significant risk standard of one additional death per 100,000 people over their lifetimes was adopted (Archibald, 1988, p. 40). The complexity of applying the de minimis or the no significant risk standard should not be underestimated. They require estimating exposure to a hazardous substance and extrapolating to human response from animal test results (Kennedy, 1988, p. 11). Clearly the degree of uncertainty which surrounds such dose-response estimates will typically be considerable. The level of risk is also likely to vary across individuals because it depends on exposure and is influenced by differences in a person's genetic predisposition to cancer or sensitivity to other hazardous substances (Archibald et al., 1988, p. 5-6). De minimis and no significant risk are applied as actuarial risk standards.

A risk/benefit approach is mandated by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which regulates pesticide residue on fresh agricultural products. This approach allows the environmental and health risks to be offset by the economic benefits (Archibald, 1988, p. 39). The justification for a risk/benefit standard is that pesticides are supposedly essential to ensuring an adequate food supply and some residue is unavoidable (Archibald, 1988, p. 40).

More generally, a risk/benefit approach focuses on balancing the risks and benefits to society from an activity or substance (Dardis, 1988, p. 309). Some find this approach ethically unappealing or unacceptable, since the major risks typically involve human health and life. Placing a value on life can seem unethical. There is also usually a lack of necessary data to carry out rigorous quantitative analyses of risks and benefits (Archibald, 1988a, p. 3). In addition, the people bearing the greatest risks are frequently different from those receiving the greatest benefits. For example, the greatest risk from the use of pesticides on produce falls on agricultural laborers.

The cost/benefit approach is related to the risk/benefit approach, but is somewhat different, in that it compares the benefits to society from reducing the risk to the costs of its reduction (Dardis, 1988, p. 310). Again though, this involves placing a value on reduced pain and suffering, and the saving of human lives. A risk/benefit or cost/benefit approach does introduce the important concept of trade-offs. Greater safety is not free. Producing more of it will require reducing something else. In some cases, the costs of giving up a possibly hazardous product or activity would seem to be quite minor, whereas at other times, they may

be substantial. Alar would appear to be an example of the former, since completely discontinuing its use should have only a minor effect on the quantity and quality of the apple crop (Rosewicz, 1989). Alar acts as a growth regulator which helped to keep apples from falling off the tree and increased storability (Begley and Hager, 1989, p. 20).

Consumers themselves seem to want to apply a risk/benefit criteria in cases where the benefits are obvious and substantial. For example, most of us choose to drive or ride in automobiles, although we know that tens of thousands are killed and seriously injured in car accidents every year. However, the automobile gives us a mobility which is valued very highly. When the FDA moved to ban saccharin in 1977 because it was linked to urinary bladder cancer, the public outcry caused Congress to pass legislation putting a moratorium on the ban and instead requiring a warning label on food containing saccharin (Institute of Food Technologists, 1988, p. 125). Many consumers, particularly diabetics and those with weight problems, saw a significant benefit to the availability of saccharin, one of the few low-calorie sweeteners on the market at that time.

In the final analysis, the amount of risk society will tolerate is decided by the political policy process (Archibald, 1988, p. 41). As Donald Kennedy (1988, p. 9) states, "we decide as a matter of public policy how much risk we are prepared to tolerate". The politics of public policymaking is the means by which risks and benefits are ultimately balanced in our system of government. Major food safety decisions must remain political because costs and benefits cannot be measured precisely and entail value judgments.

The political process can be frustrating. There is frequently a long lag between the initial awareness of a problem and the implementation of a policy. The political process is far more responsive to a crisis or exposé, as demonstrated by the Alar issue, than it is to problems that are not the focus of media and public attention (Clancy, 1988, p. 12). A political policy decision is typically the result of compromise, which reflects the impact of various special interest groups in relation to their political influence. The protection of consumers is but one factor influencing policy decisions concerning food safety issues (Kennedy, 1988, p. 10).

PERCEPTIONS OF RISK

There is, in many cases, a wide divergence between people's perception of the riskiness of a certain activity or product and the actual statistical probability of injury or harm. Our feelings about flying and driving provide a good example. Flying provokes outright fear for some of us and mild anxiety in many more, but most of us give very little thought to the dangers of driving. However, the fatality rate per 100 million passenger miles for travel by scheduled airlines is less than one-tenth the similar automobile fatality rate (Wade, 1989 and U.S. Dept. of Commerce, 1989). The adage about the most dangerous part of an airline trip being the drive to and from the airport is basically true, but most of us do not feel that way. A similar gap exists between the perception of risk and the actual hazard involved with many food safety concerns. Understanding what factors heighten or reduce the public's perception of risk is important.

Why are some actions or products perceived as being so much more dangerous than they actually are, whereas the reverse holds true for others? Table 10.2 lays out some of the factors which typically are related to people finding a particular risk either more or less acceptable. Lowrance, who wrote a widely referenced book on this subject, differentiated between the scientific measurement of risk, which is objective, and the judging of safety or perception of risk, which is subjective (Lowrance, 1976, pp. 75-76, Dardis, 1988, p. 308 and Slovic, 1987).

Factors on the left-hand side of the table are related to people perceiving less of a threat from a particular statistical probability of risk, whereas those on the right side are associated with a heightened sense of danger. The willingness of people to bear a risk is also influenced by their perceptions of the benefits of the activity or product. The lower the perceived benefits, the lower is the tolerance for the resulting risk (van Ravenswaay, 1988, p. 99 and Slovic, 1989, p. 282).

A close examination of the factors in table 10.2 related to an increased sense of risk can help us understand why the public reacted so strongly to the Alar issue (Rosewicz, 1989 and Beck et al., 1989). First, the consumption of apples and apple products with Alar residue was definitely involuntary. The effect was delayed, since the risk involved the possibility of cancer which would occur years later. There were lots of alternatives. Consumers could quite easily reduce their consumption of apples and apple products, or give up eating them altogether. There is more of an attitude of "grin and bear it" if the risk involves something with no alternatives, that is viewed as essential, or related to earning a

living. There was considerable disagreement about the risk posed by Alar. The Natural Resources Defense Council said it was high. The apple industry claimed Alar posed no hazard and apples treated with the chemical were completely safe. The Environmental Protection Agency (EPA) said Alar might pose a risk but not a sufficient one to warrant action to immediately ban it. Consumers, in most cases, worry more about such uncertain and involuntary risks that are known but voluntarily accepted (Slovin, 1987). In the latter case, the individual's sense of control, naive though it may be, makes the risk more acceptable.

Furthermore, the claims against Alar involved the most dread disease of all, cancer, and the NRDC claimed that because of their relatively high consumption of apple products, the risk was greater for children. Children are an especially sensitive group since parents, in particular, and the larger society, rightly have a strong protective feeling toward them. When a food safety issue brought together apples, cancer and children, a strong public reaction should have been expected. In addition, the public's willingness to accept any risks proposed by Alar was very low, because they perceived its benefits as being very minor.

The attention the media gives to a safety-related issue has a strong impact on the public's perception of the risk involved (van Ravenswaay, 1988, p. 97). One of the reasons that most people are more anxious about flying than they are about driving is that airline disasters are major news stories. On the other hand, the typical automobile fatality is usually reported in a short story in the back of the newspaper and not covered on television at all. Likewise, the Alar issue and the grape tampering incident received extensive coverage in the media. Each in its

turn was for several days a front page newspaper story and was covered at the top or near the top of both national and local television news programs. With such saturation coverage, the intensity of the public concern generated should not have been surprising.

THE ISSUE OF CONFIDENCE AND TRUST

Food safety issues are related to the level of trust and confidence consumers have in the food industry and in the ability of the government regulatory process to protect them. Food safety is in many respects a credence attribute, which must be accepted on trust, since the consumers cannot evaluate most hazards themselves. There has been an erosion in the public's confidence in both the food industry's and government's ability to insure the safety of the food supply (Kennedy, 1988, pp. 17-18, and The Kiplinger Agriculture Letter, June 2, 1989). An increasing number of consumers feel the federal government is failing to regulate the food supply to keep it safe (Burros, 1989).

The technical and regulatory complexity of many food safety issues makes them difficult to explain to consumers. In addition, the credibility of experts has declined and the public has less faith in their risk assessments. This loss of public confidence makes it more difficult for government and industry to deal with specific food safety issues. Both need to work to regain the public's trust. The public's concern about food safety issues and loss of confidence in the government's ability to deal with the issue is giving rise to some private initiatives. Some supermarkets in California and other states, for example, have begun to do their own testing for chemical residues on fresh produce (McCarthy,

1988).

When asked in the 1989 Food Marketing Institute consumer trends survey what source they would turn to for more information about food safety, 22% said government, 21% said consumer organizations and 15% said magazines. However, only 8% said food retailers and supermarkets, 5% doctors and other medical professionals. Likewise, just 5% said food manufacturers (Food Marketing Institute, 1989a, p. 62). A 1983 survey of Kansas consumers found that the level of confidence was highest for food safety information received from university professors and consumer spokespersons, followed by family or friends and government spokespersons, with food product spokespersons and popular media personalities ranked lowest. Some 38.1% of consumers had either a lot or a high level of confidence in university professors, 36.6% in consumer spokespersons, 31.2% family or friends, 21.6% government spokespersons, but only 14% in popular media personalities and 12.9% in food product spokespersons (Kramer, 1988, p. 164).

Such widely publicized issues as Alar and grape tampering have an impact not just on the public's attitude toward the specific product, but increase consumer concern about food safety in general. The Food Marketing Institute's (FMI, 1989a) annual survey of food consumers was taken in January 1989. In response to the question, "How confident are you that the food in the supermarket is safe?", 81% responded completely or mostly confident. The Alar issue then hit in late February and the grape tampering episode in early March. FMI (1989b) did a follow-up survey and asked the same question again in mid-April. Those completely or mostly confident in the safety of the food supply had fallen 14

percentage points, to 67%. By late April, when surveyed once again, the figure had recovered to 73%.

Major food safety incidents can also damage public confidence in the food industry and government if handled improperly. The apple producers initial reaction was to take out full-page newspaper advertisements saying that Alar posed no health danger. They misread the depth of the public concern and came across as stonewalling and not being sufficiently concerned about a serious issue. The EPA's response perplexed many and eroded the public's confidence in government's role as a safety watchdog. The spokesperson for the EPA said that although Alar was considered unsafe and announced the agency's intention to ban it, that process could take at least 18 months. The EPA said Alar was not sufficiently dangerous to require immediate action (Beck et al., 1989, p. 18). However, a typical consumer cannot see why an unsafe product should not be withdrawn immediately, as Alar eventually was.

The producer's response to a food safety issue can be very important for not only limiting or regaining any lost sales, but also for maintaining credibility with the public (van Ravenswaay and Smith, 1986, p. 15). Disputing the seriousness of the problem, as was the initial reaction of the apple producers to the Alar issue, may only serve to focus public attention on the issue, heighten the level of uncertainty, and harm the credibility of the industry. When a major food safety issue arises, the public wants to know that the seriousness of the problem has been recognized and appropriate action has been taken. One of the most damaging effects on credibility occurs when statements are made which later have to be retracted (van Ravenswaay and Smith, 1986, p. 16).

The quick, decisive action by Johnson and Johnson to the Tylenol tampering incident in 1982 is held up as an example of the way to respond so as to retain public trust. The product was quickly removed from store shelves, a refund was offered to consumers who returned the product, and a new, more tamper-proof product was designed and manufactured before it was reintroduced to the market. Of course, it is far easier for a corporation headed by a single chief executive officer to respond in such a decisive fashion than it is for a numerous and disparate group of producers, as was the case with Alar. The FDA did respond with some of the same quickness and decisiveness in the grape tampering incident as did Johnson and Johnson. The prompt action taken to warn the public and address the problem probably helped to maintain, and maybe even enhanced, the credibility of the FDA and the public's confidence and trust in government food safety efforts.

CONSUMER INFORMATION AS A REMEDY

Some would argue that the best approach to food safety issues is simply to provide the relevant information to consumers and allow them to make their own decisions concerning behavior and products (Clancy, 1988, p. 16). However, others would argue that, whereas consumer information has an important role to play in food safety issues, it is most certainly not a panacea. When consumers were asked who they most rely on to insure the safety of the food they buy, 41% answered themselves, whereas only 20% said government, 14% food manufacturers, 10% food retailers and 8% consumer organizations (Food Marketing Institute, 1989, p. 59).

Relying on well-informed consumers to make their own food safety

decisions is appealing for several reasons. This approach appeals to the American concept of freedom of choice. Some see government intervention in terms of health and safety regulations as moving in the direction of impinging on individual liberty (Dardis, 1988, p. 303-304). Although both smoking and drinking impose extremely high health and economic costs on individuals and society, government is not likely to ban either cigarettes or alcoholic beverages.

The second argument supporting the information approach relates to economic efficiency. Because individuals differ in their attitudes towards risk and their willingness to pay to reduce risk, the imposition of a single level of safety by government regulation will be inefficient. It is more efficient to allow consumers to adjust their own behavior and product purchases in terms of their own risk preferences (Dardis, 1988, p. 304). With government actions, there is also some evidence that consumers engage in offsetting behavior. Some of the impact of improved automobile and highway safety, for example, has been offset by people driving less carefully (Dardis, 1988, p. 304).

However, a purely informational approach would require large amounts of time for consumers to become adequately informed, most likely more time than most people would be willing to commit (Clancy, 1988, p. 16). Since time is a scarce resource with an opportunity cost, then the information approach can be seen as imposing large costs on consumers, which are also inefficient. The issue of information overload is also relevant. The increasing use of warning labels on products, for example, may carry a danger of overkill with consumers no longer paying attention to them (Waldman, 1989, p. 40-41). This problem has been referred to as the "cry

wolf" dilemma, which is an analogy to the fable in which the little boy sounds a false warning several times and is then ignored when the threat is real. The warning label for saccharin probably goes virtually unnoticed by most of us, when we consume a diet soft drink or other product which contains that sweetener.

Furthermore, the technical expertise necessary to evaluate many food safety issues is simply beyond the level of the typical consumer. If the experts and the regulators cannot decide what to do about a complex food safety issue, is it reasonable to expect the average consumer to be able to make a decision (Clancy, 1988, p. 75). In the case of a regulation which bans a product, the government regulators can be viewed as assuming consumers would not use the product if they were fully informed (Zellner, 1988, p. 63). Consumers can view a ban as information about the product's risks to their health. It reduces their decision costs.

The strict information approach also tends to discriminate against certain vulnerable groups, such as some of the elderly, the less educated, and people who are not literate or do not understand English, who would have particular difficulties evaluating the information. The safety-related message might also be distorted by the impact of special interest groups (Clancy, 1988, p. 75). The consumer can, as in the case of Alar, receive several conflicting messages concerning the safety of a food product or substance. For all these reasons, consumer information by itself has an important, yet limited role to play as a remedy for food safety concerns. It is in the interest of individual consumers and society to delegate safety assessments and regulation to government agencies and expect them to act judiciously. Safety is partly a public

good which can best be ensured by government action.

To whatever extent consumers are expected to make their own food safety decisions, they need reliable information. However, such information frequently is difficult to provide because the scientific evidence may be insufficient to determine the level of risk, there may be conflicting claims, and complex laboratory findings are difficult to translate into easily understood terms (Burbee and Kramer, 1986, p. 18). Consumers want two major types of information. One type describes the product, its ingredients, nutrient composition, chemicals used in the product's production, and the type of packaging material. The other type would inform the consumer of any potential risks associated with the product's consumption. They would like to know the nature of the hazard and its probability (Burbee and Kramer, 1986, p. 18). Current laws and regulations do a better, although far from complete job of providing consumers with the descriptive type of information. Only rarely, for example in the case of saccharin, is any type of risk assessment information provided.

CURRENT FOOD SAFETY ISSUES

There are several major food safety issues of considerable current interest which are worth discussing in some detail. These include pesticide residues, microbiological contamination, seafood safety and food additives. Pesticide residues are the top-rated safety worry of consumers, as shown in table 10.1, whereas microbial contamination is the highest priority concern among professional scientists involved with food safety issues. Some of the unsanitary practices reported in the seafood

industry are appalling and reflect an inadequate inspection system for seafood. Food additives remain a major issue, although they are not currently as controversial a topic as in the 1970s. In addition, there are several other important topics which will be discussed briefly.

Pesticide Residues

Pesticide residues have become a major food safety concern for many consumers. In a national survey of adults taken by Newsweek magazine in early 1989, 38% said they "are more worried that the food they eat may be contaminated by pesticides or other toxic chemicals" (Begley and Hager, 1989, p. 22). Seventy-three percent thought fewer pesticides and chemicals should be used even if higher prices resulted. About 50,000 pesticide products that contain more than 600 chemical ingredients are in current use (Beck et al., 1989, p. 18 and Vento, 1989). However, a very small number of these account for most of the total pounds of pesticides used (Stimmann, 1988, p. 38). The EPA ranked pesticide residues as the third worst environmental cancer risk, after occupational exposure to chemicals and indoor radon (Nazario, 1989, p. B1 and Vento, 1989).

However, even given this, the consensus among scientific experts seems to be that pesticide residues pose a fairly low cancer risk, particularly relative to the major risk factors such as smoking, and that the overall health hazard for consumers from pesticides used in accordance with good agricultural practices is small (Berg, 1987, O'Beirne, 1988, p. 183, Begley, Hager and Howard, 1989, Passell, 1989, Begley and Hager, 1989, p. 20 and 23, and Nazario, 1989). The FDA found no residue at all on 57% of 14,492 food samples taken in 1988 and less than 1% had illegally

high residues (Begley and Hager, 1989, p. 20). In addition, the FDA conducts a total dietary study as a final check on the safety of the food supply. Over 200 food items that would be included in a typical American's diet are purchased. The items are then prepared as they might be for a normal home-cooked meal (washed, peeled, baked, etc.), and then analyzed for chemical residues. The findings have consistently been within the government safety guidelines (Beck et al., 1989, p. 19).

In fact, the more serious health hazard associated with pesticides is probably faced by farmers and agricultural laborers (Benbrook, 1988, p. 31). There were 1,065 confirmed cases of pesticide-related occupational illnesses in California in 1986 (Stimmann, 1988, p. 43). Ground water contamination is another serious problem (Stimmann, 1988, p. 43).

The EPA is responsible for setting the permissible tolerance levels for pesticide residues. The monitoring and enforcement of those levels is under the authority of the FDA (Kennedy, 1988, p. 14 and Beck et al., 1989, p. 18). Many of the pesticide chemicals which were already on the market when EPA was first given the responsibility to regulate them under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in 1972 would not meet the standards applied to new pesticides. An amendment to the FIFRA required the EPA to re-evaluate old pesticides. However, the re-evaluation process has been extremely slow. In 1988, Congress directed the EPA to complete the re-evaluations by 1997 (Beck et al., 1989, p. 18 and Vento, 1989).

One of the criticisms of the regulations has been the inconsistency in the treatment of old and new pesticides. Getting approval for a new pesticide is a time-consuming and costly process for a chemical company.

Frequently though, newer pesticides are far safer than the older ones which are on the market. On the other hand, removing an old pesticide from the market is typically a lengthy process for the government. Public hearings are usually required and there may be legal challenges which can delay action (Benbrook, 1988, p. 30 and Beck et al., 1989, p. 18).

Charles Benbrook of the National Academy of Sciences has characterized the situation as, "new pesticides are guilty until proven innocent and old pesticides are innocent until proven guilty" (Benbrook, 1988, p. 30).

Partly in response to these concerns, the EPA has drafted a legislative proposal for Congressional action which would streamline the procedure to remove a pesticide from the market by eliminating the judicial appeals process (Minneapolis Star Tribune, July 20, 1989).

Other major criticisms of the EPA's evaluation of the safety of pesticides includes the failure to examine the additive or cumulative effect when several chemicals are used on a crop. In addition, the EPA only evaluates the active ingredients in a pesticide, but not the inert ingredients used to dilute and stabilize the active agents, which may also be toxic (Nazario, 1989).

The adoption of integrated pest management techniques by farmers holds out the hope that the use of pesticides could be sharply reduced (Shabecoff, 1989, p. E6). The possibility of using bio-technology to develop pest resistant crop varieties adds to this hope. Realistically though, if consumers want a reduction in the use of pesticides, they will need to abandon their demand for blemish-free produce. A recent survey by the Georgia Experiment Station found that although 50% of consumers wanted pesticides banned, less than 20% said they would accept produce with

insect damage (Minneapolis Star Tribune, June 14, 1989).

Many people are shocked when they first learn about the FDA "food defect action levels" which set limits for such things as insect parts and eggs, and rodent hairs and excreta in food products. A one-pound box of macaroni, for example, can contain up to nine rodent hair fragments (Minneapolis Star Tribune, April 21, 1989). The FDA says these defect levels pose no health hazard and most of the foreign matter is microscopic, so it is unnoticed. Such natural defects unavoidably get into foods as they are raised, harvested, stored and processed. The alternative to setting such defect levels would be to use more pesticides.

Microbiological Food Contamination

Since foods are naturally perishable, in the absence of preservation, they tend to become contaminated by bacteria, yeasts, molds, and viruses which in many cases cause illness and even death (Zellner, 1988, p. 55). The occurrence of foodborne illness in the U.S. is vastly underreported (Wolf and Lechowich, 1989, p. 468). In many cases, the victims do not associate their symptoms with the food they recently ate and assume they are suffering from some type of flu. Most recover in a few days without seeing a doctor.

However, the seriousness of the health problem posed by microbial food contamination should not be underestimated. Because most of the cases go unreported, there is a wide range of estimates of the number of cases of foodborne illness. Estimates range from several million to over 200 million cases per year in the U.S. (Forbes, 1988, p. 43, Roberts, 1989, p. 471, Roberts and van Ravenswaay, 1989, p. 1, and Wolf and

Lechowich, 1989, p. 468). The number of deaths from food contamination are estimated at 9,000 to 12,000 per year (Forbes, 1988, p. 43, Roberts and van Ravenswaay, 1989, p. 1). The costs to society in terms of health care costs and lost productivity from such illness were recently estimated to be \$4.8 billion per year (Roberts, 1989).

Foodborne bacteria can cause two basic types of illness: infections and intoxications. The former is caused by consuming a foodborne microorganism which then infects the human body. The latter results from eating something which contains a toxin that was produced by microorganisms growing in the food (Wolf and Lechowich, 1989, p. 469). Salmonellae, Staphylococcus aureus and Clostridium perfringens are the microorganisms currently responsible for the largest number of foodborne illnesses in the U.S. (Wolf and Lechowich, 1989, p. 469).

Salmonella, which is the name given to a group of almost 2,000 related bacteria strains, is the most widespread food contamination problem. Some 37% of the confirmed cases of foodborne illness reported between 1977 and 1982 were caused by Salmonella species (Wolf and Lechowich, 1989, p. 469). Salmonellosis is an infection and its severity depends on the number of bacteria ingested. The symptoms for people who become infected are similar to the flu and may include diarrhea, an upset stomach, fever and headache. The symptoms usually last from three to five days.

The Department of Agriculture estimates that about one-third of the chickens headed for consumer tables are contaminated by Salmonellae (Roberts and van Ravenswaay, 1989, p. 5). Some critics argue that the contamination rate is even higher and that the majority of birds are

contaminated when they leave some of the processing plants which do not follow careful sanitary procedures (Kendall, 1989). The Salmonella bacteria are in the fecal matter of the chickens and can be easily spread through the slaughter, evisceration and washing processes.

Salmonellae are not only a problem in poultry. The source of an outbreak of salmonellosis in Minnesota in the summer of 1989 was determined to be mozzarella cheese (Slovut, 1989). Consumers have also been warned not to eat foods which contain uncooked eggs, such as home-made mayonnaise, eggnog, cookie dough and desserts containing uncooked eggs, because the bacteria have been found inside unbroken eggs.

Staphylococcus aureus is considered the second most common cause of foodborne illness. When the bacteria reproduce in sufficiently large numbers in a food product, enough toxin is produced to cause a reaction when consumed. The illness usually occurs within a few hours and typically involves chills, abdominal cramps, nausea, vomiting and weakness. The bacteria are commonly present in the nose, throat, hair and skin of many healthy persons. It is spread by unsanitary food handling, and improper refrigeration permits its growth. The most frequent problems occur with cooked protein foods which are handled after cooking. Some common examples are tuna, chicken, ham and potato salads (Wolf and Lechowich, 1989, p. 469 and Labuza, 1977). Clostridium perfringens is another microorganism common in the environment. Outbreaks of illness, which have diarrhea as the major symptom, are connected with improper food preparation and storage. Protein foods are again the most common source of contamination (Wolf and Lechowich, 1989, p. 469).

The bacteria Clostridium botulinum produces a toxin which causes

botulism, which is a very serious disease. The majority of botulism outbreaks have been traced to home-processed foods, particularly underprocessed home-canned low acid foods, such as certain vegetables. Recently, unusual products such as oil-packed garlic have been implicated in outbreaks. The botulinum toxin is one of the most poisonous substances known. An amount of botulinum toxin equal to an aspirin tablet would be enough to kill the entire population of a city the size of Los Angeles (Sieber, 1988, p. 30).

Campylobacter jejuni, Listeria monocytogenes, Escherichia coli O157:H7, and Shigella have been referred to as the "emerging pathogens" because they are increasingly the source of foodborne illnesses (Food Chemical News, 28 August 1989, p. 3). Campylobacter contamination may now be the leading cause of diarrhea in the U.S. (Food Chemical News, 28 August 1989, p. 3). The most serious outbreak of listeriosis occurred in 1985 when 142 persons became ill from the contaminated cheese from a plant in California. Half were mothers and their infants and the mortality rate was 30% (Wolf and Lechowich, 1989, p. 470). Yersinia enterocolitica and four species of Vibrio are other sources of foodborne illness. Some microbiological food contamination is also related to long-term health risks. Aflatoxin is a toxin produced by a mold that may grow on some foods, such as corn and peanuts. Aflatoxin is a potent carcinogen in animal tests and tolerance levels have been set to limit exposure to it (Institute of Food Technologists, 1988, p. 122).

The fact that the average consumer is probably unfamiliar with many of these reinforces the argument that the public is not sufficiently informed about microbiological food contamination as a food safety issue.

The problem may be worsening because of changing food supply and consumption patterns (Forbes, 1988, p. 44). Two examples are the increased consumption of raw seafood at sushi bars and the greater consumption of imported foods, which may be processed under less sanitary conditions than domestically. A particular concern is the increasing popularity of fresh prepared foods, at deli counters for example, and fresh refrigerated foods (Freedman, 1988). Both must be treated with the necessary care to avoid contamination.

Most incidents of foodborne illness could be prevented. The Center for Disease Control (CDC) has estimated that some 94% of the cases of foodborne disease in the U.S. are due to lax sanitary practices in the home or in food service establishments (Labuza, 1977, p. 253). Douglas Archer, director of FDA's microbiology division, has said that consumers, not the food industry, are to blame for most cases of foodborne illness (Puze, 1989). Proper cooking and refrigeration would prevent most such illnesses. For example, cooking thoroughly at high enough temperatures kills the Salmonella bacteria in meat or poultry. In addition, proper sanitary food preparation procedures need to be followed to prevent cross-contamination to other foods from contaminated countertops, cutting boards, knives and other utensils, and even hands (Kendall, 1989).

An increasing number of consumers are ignorant of, or overlook, the basic procedures which must be followed in home food preparation to minimize the risks of foodborne illness. A survey found that 32% of consumers let cooked chicken cool to room temperature before refrigerating, which is not advised (Kramer and Penner, 1986, p. 21). This problem is related to the general decline in cooking skills and food

preparation knowledge that has occurred. Consumer education is clearly an important part of addressing the problem of foodborne illnesses.

Seafood Inspection

Currently, there is no mandatory federal inspection program for fish and other seafood as there is for meat and poultry. About 75% of the seafood in the U.S. is not inspected (Ingersoll, 1988). Some of the documented stories about the practices of unscrupulous fishermen and processors in the industry are shocking. A recent Wall Street Journal article described the harvesting of shellfish from water contaminated with sewage:

"Oyster bootleggers usually wait for nightfall before they get down and dirty in the bayous of west Florida. They slip into sewage-polluted waters that are off-limits to shellfish harvesting They call it 'hogging'" (Ingersoll, 1989).

Another Wall Street Journal article documented the totally unsanitary practices in one Port Bolivar, Texas seafood packing plant:

"Inside, the toilet doesn't work and the rusty equipment can't be sanitized because the plant doesn't have hot water. Flies swarm through holes in the ceiling, cockroaches flee into the bowed walls, and workers haul trash and cooked crab meat around on the same cart" (Ingersoll, 1988).

According to the Center for Disease Control, there were 171 cases of foodborne illness for every billion pounds of seafood eaten in the U.S., as opposed to 102 cases for poultry and 57 for beef and veal (Ingersoll, 1989). Much of the credit for originally focusing attention on what she called the "great American fish scandal" belongs to Ellen Haas of Public Voice for Food and Health Policy, a consumer advocacy organization

(Ingersoll, 1988). A voluntary Commerce Department program inspected only 11% of the seafood in 1987 and the Food and Drug Administration inspects only a tiny portion of the seafood imported into the U.S. (Ingersoll, 1988). To keep the issue in perspective, the major problems exist in only a very small portion of the \$30-billion-a-year seafood industry (Ingersoll, 1989).

Seafood consumption in 1988 fell to 15 pounds per person, down from 15.4 in 1987, which represented the first decline since 1982 (Manges, 1989). This drop is certainly partly in response to rising prices, but may also be partially attributable to safety concerns. At this point, sufficient attention has been focused on the problem so that Congress will probably pass a law which sets up a comprehensive, mandatory seafood inspection program.

Food Additives

Food additives are substances added to foods in minor amounts, either intentionally to improve nutrition, quality, or shelf-life, or unintentionally as a result of production, processing, storage or packaging (Labuza, 1977, p. 378 and Sieber, 1988, p. 28). Over the years, many of the major food safety controversies involved additives, such as DES (diethylstilbestrol), a synthetic growth hormone fed to cattle; cyclamates and saccharin, both synthetic sweeteners; two food dyes, violet no. 1 and red no. 2, and sodium nitrite, a preservative used on cured meat, such as ham and hot dogs (Labuza, 1977, pp. 382-388). Perhaps the current major issue concerning food additives is the Delaney Clause itself, which has already been discussed in some detail.

Many additives have been designated as Generally Recognized as Safe (GRAS). This category includes substances which are nontoxic when "used in the food supply under normal manufacturing processes" (Labuza, 1977, p. 367). The GRAS list was originally composed in 1958 when the Food Additive Amendment was passed. However, it has since been modified and the FDA has felt it necessary to test many of the additives that were on the original GRAS list (Labuza, 1977, pp. 367-368). As a result of this testing, some compounds have been banned. One of the GRAS categories that is being tested, for example, is synthetic chemicals in long use in the food supply prior to 1958. Additives not on the GRAS list, which are non-carcinogenic, are evaluated on a risk/benefit basis and placed in the regulated food additives category, for which the amounts that can be used are specified (Labuza, 1977, p. 368).

An important fact which is frequently overlooked is that foods may contain naturally-occurring substances which are toxic. For example, raw cabbage, lettuce and spinach contain a small amount of 3'4-dibenzopyrene, which has been linked to gastric cancer (Labuza, 1977, p. 391). Comfrey herb teas contain symphytine, a known carcinogen. Barbecuing fat-containing meats produces benzopyrene, which is a suspected carcinogen. If the natural food supply contains risks, some might argue why should food safety standards for additives be particularly strict. The objection is that if a normal diet poses some risk from low exposure to naturally-occurring substances, then additives which may be toxic should be tightly controlled so as not to unnecessarily add to the body's burden (Institute of Food Technologists, 1976, p. 122).

Other Current Issues

There are several other food safety issues which should at least be briefly mentioned. These include the current meat and poultry inspection system and its proposed revision, food tampering and adulteration, safety related issues concerning food imports and exports, the level of funding and staffing of the federal regulatory agencies, and the relationship between federal and state regulatory activity. There are also consumer food safety concerns regarding food irradiation and bio-technology which, however, will not be discussed in this paper.

Insuring the safety and overall quality of meat and poultry is the responsibility of the Food Safety Inspection Service of the Department of Agriculture. The inspection system has become overburdened and outdated. Inspectors have been expected to examine every meat or poultry carcass (Sachs, 1989, p. 32). However, that inspection has usually been very cursory, relying on the inspector's sight and smell, with only a few seconds to make each evaluation (Ingersoll, 1989 and Vento, 1989). Only occasional spot tests have been conducted for bacterial and chemical contamination. A 1985 National Academy of Science report recommended the establishment of a traceback system, monitoring critical points, and checking more for higher risk problems, such as Salmonella (National Academy of Science, 1985).

The Department of Agriculture has proposed a major revision of the inspection system, which would rely heavily on self-inspection by the industry and sharply cut the number of federal inspectors (Ingersoll, 1989). A Hazard Analysis Critical Control Point (HACCP) approach would be implemented (Food Chemical News, 28 August 1989). Government inspectors

would visit plants with good records only occasionally and concentrate on those with chronic problems. This proposal has been met with considerable controversy. Critics are particularly concerned about the pressures that plant employees checking quality-control might face to overlook questionable practices or product (Ingersoll, 1989).

Food tampering and adulteration are rare, but particularly disturbing, food safety issues. The most well-known tampering incident is, of course, the Chilean grape episode. Many packaged foods are now sold in tamper-resistant containers. However, most of these are probably not tamper-proof and protecting many food products from tampering, such as fresh meat and produce, is far more problematic. Tampering, which is really a form of terrorism, is as difficult to prevent as other terrorist acts when the perpetrators do not care if innocent people are harmed.

The two most well-known recent incidents of food adulteration in the U.S. involved infant apple juice and orange juice. In each case, the food processing company purposefully substituted cheaper ingredients for the apple or orange juice and thus engaged in fraud. However, in both cases the substitute ingredients, such as beet juice, were completely safe. Perhaps the worst adulteration incident in recent history occurred in Spain in 1981. Nearly 700 people were killed and thousands more were injured when rapeseed oil tainted with aniline dye and intended for industrial use was sold as cheap olive oil for human consumption (Minneapolis Star Tribune, May 21, 1989).

Assuring the safety of imported foods should be a high priority concern. Fruit and vegetable imports have increased sharply in recent years. Between 1980 and 1986, the value of fruit imports tripled and

vegetable imports doubled, according to a General Accounting Office (GAO) study (Minneapolis Star Tribune, June 29, 1988). In addition, about 7% of the U.S. meat supply is imported, which includes some 40% of the ground beef sold in this country (Phelps, 1987). The use of agricultural chemicals and drugs elsewhere is regulated by each country's own laws and may not be ones accepted here. Food imported into this country is subject to our regulations concerning chemical residues (United Fresh Fruit and Vegetable Association, 1989, p. 11).

The GAO found the violation rate for imports is substantially higher than for domestic products (Minneapolis Star Tribune, June 29, 1988). Moreover, detailed up-to-date information about the chemicals and drugs used overseas is lacking and if a substance is not used here, it typically is not tested for (Phelps, 1987, p. 87). The personnel inspecting imported food products are also spread too thinly to do an adequate job, which relates to the general under-funding of food inspection activities. In many ways, it is no small wonder that the couple of Chilean grapes injected with cyanide were found at all.

A related issue, which is likely to become increasingly important, is the relationship between food safety regulations and international trade policy. The U.S. claimed the European Economic Community's January 1989 ban on beef imports containing growth hormones was a pseudo-safety issue and, in fact, enacted as a non-tariff barrier to trade (Runge, 1989, p. 1). Americans may, however, underestimate the sincerity of the European's safety concerns regarding growth hormones. They had already been banned in Europe for European producers (Krissoff, 1989, pp. 34-35).

A rather unglamorous, but quite crucial food safety issue, is the

level of funding and staffing of the government regulatory agencies, particularly the FDA and USDA's Food Safety Inspection Service (FSIS). For food safety laws to be effective, they must be backed up by the necessary funding for these agencies to carry out their regulatory responsibilities. There is reason to believe that a lack of funding is undercutting the effectiveness of the FDA and FSIS. The number of FSIS meat and poultry inspectors was cut from 8,400 to 7,200 between 1979 and 1989. They are responsible for over 6,000 meat and poultry processing plants in the U.S. (Ingersoll, 1989).

The FDA, which only had a budget of about \$50 million in 1989 and has only some 1,000 inspectors, suffered a 15% reduction in its field staff since 1980 (Beck et al., 1989, p. 18; Vento, 1989). In addition to its food inspection responsibilities, the FDA is also responsible for drugs, medical devices and radiation emitting products like microwaves. The pesticide staff at the EPA has also been reduced since 1980 (Nazario, 1989). Frank Young, the FDA Commissioner, was quoted as saying to a Senate committee, "If you want me to do this job, give me the resources. It is a cruel joke to pass over 20 bills requiring more work and then decrease the resources" (Beck et al., 1989, p. 18).

Jurisdiction over the regulation of food safety and quality is shared by the federal and state governments (Caswell, 1988, p. 129). The federal government has broad powers under the Constitution to regulate goods that move in interstate commerce. In areas of regulation where Congress has passed legislation, federal law can typically preempt state action by stating that intent. Where federal regulation and preemption do not exist, states have the right to take action under their general

police powers to protect the health and safety of their citizens (Caswell, 1988, pp. 129-130). When federal laws are perceived to be inadequate, there is pressure for states to step in with their own regulations, as happened with Proposition 65 in California, for example.

A patchwork of different state-by-state food safety regulations would fragment the national food marketing system, reduce efficiency from economies of scale and lead to higher food costs. To avoid this possibility, the federal government must not abdicate its responsibility to provide leadership on food safety issues and to take action to address major concerns. Most of the important food safety issues are best addressed at the national level, rather than state by state.

REFERENCES

- Ames, B.N., R. Magaw, and L.S. Gold. "Ranking of Possible Carcinogenic Hazards", Science, 236, 17 April 1987, pp. 271-279.
- Archibald, Sandra O. "Introduction" (pp.1-4) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.
- Archibald, Sandra O. "Next Steps: Looking for Compromise", (pp.39-44) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.
- Archibald, Sandra O., Christine Bruhn, Sylvia Lane and Robin Marsh. "Perspectives of Consumer Advocates", (pp.5-8) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.
- Archibald, Sandra O., Brian Hurd, and Robin Marsh. "Perspectives of Chemical Manufacturers", (pp.19-23) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.
- Archibald, Sandra O. and Robin Marsh. "Focusing the Policy Debate", (pp.33-38) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.
- Bauman, Howard E. "Risk Assessment - Use and Abuse", Cereal Foods World, 34:6, June 1989, pp. 480-481.
- Beck, Melinda, et al. "Warning! Your Food, Nutritious and Delicious, May be Hazardous to Your Health", Newsweek, March 27, 1989, pp.16-19.
- Begley, Sharon and Mary Hager. "A Guide to the Grocery", Newsweek, March 27, 1989, pp.20-23.
- Begley, Sharon, Mary Hager and Judy Howard. "Dangers in the Vegetable Patch", Newsweek, January 30, 1989, pp.74-75.
- Benbrook, Charles M. "Critical Issues Related to Pesticide Regulation", (pp.29-32) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Berg, Steve. "Standards for Pesticide Traces in Food Urged", Minneapolis Star Tribune, May 21, 1989, p.3A.
- Bruhn, Christine, Sylvia Lane and Laura Walton. "Perspectives of Consumers", (pp.9-13) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.

- Burbee, Clark R. and Carol S. Kramer. "Food Safety Issues for the Eighties", National Food Review, U.S. Department of Agriculture, Economic Research Service, NFR-33, Spring 1986.
- Burros, Marian. "Food Safety Raises Concerns", The Minneapolis Star Tribune, March 18, 1989, p.1E.
- Campbell, T. Colin. "Food Quality as Measured by Changes in Buying Behavior Required for Chronic Disease Reduction", (pp.33-35) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Caswell, Julie A. "Federal Preemption, State Regulation, and Food Safety and Quality: Major Research Issues", (pp.129-137) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Clancy, Katherine L. "Overview of Current Food Safety and Quality Issues and Policies", pp.1-26 in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Dardis, Rachel. "Risk Regulation and Consumer Welfare", The Journal of Consumer Affairs, 22:2 (Winter 1988): pp.303-318.
- Food Chemical News, 31:26, August 28, 1989.
- Food Marketing Institute. Trends 1989: Consumer Attitudes and the Supermarket, Washington, D.C., 1989a.
- Food Marketing Institute. "Consumer Confidence in Food Safety", one-page, unnumbered insert into Trends 1989: Consumer Attitudes and the Supermarket, Washington, D.C., 1989b.
- Forbes, Allan L. "Microbiological Contamination of Food", (pp.43-44) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Freedman, Alix M. "As Fresh Refrigerated Foods Gain Favor, Concerns About Safety Rise", The Wall Street Journal, March 11, 1988, p.19.
- Hazlett, Thomas. "Perspective of Regulators", (pp.28-33) in Agricultural Issues Center, Regulating Chemicals: A Public Policy Quandary, University of California, Davis, 1988.

- Ingersoll, Bruce. "Eaters Beware: Fish-Poisoning Cases Lead to Calls for U.S. to Inspect Seafood", The Wall Street Journal, April 8, 1988, p.1.
- Ingersoll, Bruce. "Bad Catch: Digging for Fast Profit, Fishermen Harvest Much Tainted Shellfish", The Wall Street Journal, June 8, 1989, p.A1.
- Ingersoll, Bruce. "Slicing it Thin: Meat Inspection Cuts Proposed by Reagan are Hot Issues for Bush", The Wall Street Journal, February 2, 1989, p.A1.
- Institute of Food Technologists, Expert Panel on Food Safety and Nutrition. "The Risk/Benefit Concept as Applied to Food", Food Technology, March 1988, pp.119-126.
- Kendall, Don. "USDA Says Salmonella Taints at Least 1 in 3 Chickens", Minneapolis Star Tribune, July 9, 1989, p.2T.
- Kennedy, Donald. "Humans in the Chemical Decision Chain" (pp.9-19), in Harold O. Carter and Carole Frank Nuckton (editors). Chemicals in the Human Food Chain: Sources, Options and Public Policy, Agricultural Issues Center, University of California, Davis, 1988.
- Kiplinger Agriculture Letter, July 14, 1989.
- Kramer, Carol S. "Food Safety: Consumer Preferences, Policy Options, Research Needs", pp.143-170 in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Kramer, Carol S. and Karen P. Penner. "Food Safety: Consumers Report Their Concerns", National Food Review, U.S. Department of Agriculture, Economic Research Service, NFR-33, Spring 1986.
- Krissoff, Barry. "The European Ban on Livestock Hormones and the Implications for International Trade", National Food Review. Economic Research Service, U.S. Department of Agriculture, Vol. 12, No. 3, July-September 1989, pp. 34-36.
- Labuza, Theodore P. Food and Your Well-Being, St. Paul, MN: West Publishing Co., 1977.
- Lowrance, Walter W. Of Acceptable Risk: Science and Determination of Safety, Los Altos, CA: William Kaufman, 1976.
- Manges, Michele. "Trying to Lure Back Seafood Consumers", The Wall Street Journal, June 27, 1989, p.B1.

- McCarthy, Colman. "Will U.S. Forgo Pretty Produce?" Minneapolis Star Tribune, July 25, 1988, p.17.
- Meyerhoff, Al. "Poisons in the Food We Eat", The Minneapolis Star Tribune, May 18, 1989, p.25A.
- Middlekauff, Roger D. "Issues of Food Safety and Quality Relating to Food Ingredients", (pp.45-49) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Minneapolis Star Tribune. "Tidbits", June 29, 1988, p.1T.
- Minneapolis Star Tribune. "What Bugging You. It May Be Something You Ate", April 21, 1989, p.6A.
- Minneapolis Star Tribune. "13 Convicted in Cooking-oil Deaths Trial", May 21, 1989, p.11A.
- Minneapolis Star Tribune. "Tidbits", June 14, 1989, p.1T.
- Minneapolis Star Tribune. "EPA Seeks to Act More Quickly on Barring Agricultural Chemicals", July 20, 1989, p.6A.
- National Academy of Science, Committee on the Scientific Basis of the Nation's Meat and Poultry Inspection Program, National Research Council. Meat and Poultry Inspection: The Scientific Basis of the Nation's Program, National Academy Press, Washington, D.C., 1985.
- Nazario, Sonia L. "EPA Under Fire for Pesticide Standards", The Wall Street Journal, February 17, 1989, p.B1.
- O'Beirne, David. "A Corresponding Viewpoint: Some Food Safety and Quality Issues in the European Community", (pp.177-187) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- Paarlberg, Don. Farm and Food Policy: Issues of the 1980s, Lincoln, NE: University of Nebraska Press, 1980.
- Passell, Peter. "For Safety's Sake", St. Paul Pioneer Press Dispatch, May 21, 1989, p.G1.
- Phelps, David. "Study Questions Safety of U.S. Meat Imports", Minneapolis Star Tribune, November 14, 1987, p.1A.
- Puze, Daniel P. "Ignorance Blamed for Most U.S. Food-Borne Illnesses", Minneapolis Star Tribune, January 11, 1989, p.5T.

- Roberts, Tanya. "Human Illness Costs of Foodborne Bacteria", American Journal of Agricultural Economics, 71:2, May 1989, pp. 468-474.
- Roberts, Tanya and Eileen van Ravenswaay. "The Economics of Food Safety", National Food Review, Economic Research Service, U.S. Department of Agriculture, Volume 12, No. 3, July-September 1989, pp. 1-8.
- Rosewicz, Barbara. "Pesticide Risk from Apples: Who's Right?" The Wall Street Journal, March 10, 1989, p.B1.
- Runge, C. Ford. "Trade in Disservices: Environmental Regulation and Agricultural Trade Competitiveness", Staff Paper P89-23, Department of Agricultural and Applied Economics, University of Minnesota, July 1989.
- Sachs, Sharin. "Safe Meat and Poultry", National Food Review, Economic Research Service, U.S. Department of Agriculture, Volume 12, No. 3, July-September 1989, pp. 31-33.
- Science. "Industry Toxicologists Keen on Reducing Animal Use", Vol. 236, 17 April 1987, p. 252.
- Shabecoff, Philip. "The Nation is Getting Ready to Cut Its Dose of Pesticides", The New York Times, April 16, 1989, p.E6.
- Sieber, James N. "Sources: Nonpesticides", (pp.23-36), in Harold O. Carter and Carole Frank Nuckson (editors). Chemicals in the Human Food Chain: Sources, Options and Public Policy, Agricultural Issues Center, University of California, Davis, 1988.
- Sinclair, Upton. The Jungle, New York: Doubleday/Page, 1906.
- Slovic, Paul. "Perception of Risk", Science, 236, 17 April 1989, pp. 280-285.
- Slovut, Gordon. "Wisconsin Cheesemaker Is Source of Salmonella, Says Minnesota Official", Minneapolis Star Tribune, September 2, 1989, p.1A.
- Stimmann, Michael. "Sources: Pesticides", (pp.37-43) in Harold O. Carter and Carole Frank Nuckson (editors). Chemicals in the Human Food Chain: Sources, Options and Public Policy, Agricultural Issues Center, University of California, Davis, 1988.
- U.S. Department of Commerce, Bureau of the Census. Statistical Abstract of the United States, 1989, January 1989.

- van Ravenswaay, Eileen. "How Much Food Safety Do Consumers Want? An Analysis of Current Studies and Strategies for Future Research" (pp.89-114) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.
- van Ravenswaay, Eileen and Mark Smith. "Food Contamination: Consumer Reactions and Producer Losses", National Food Review, Economic Research Service, U.S. Department of Agriculture, NFR-33, Spring 1986.
- Vento, Bruce F. "Food for Thought: What Are We Really Eating", Congressional Newsletter, U.S. Congress, Washington, D.C., July 1989.
- Wade, Betsy. "After a Bit of Floating Around in a Life Raft, Air Travel Takes on a New Perspective", Minneapolis Star Tribune, April 16, 1989, p.12G.
- Waldman, Steven. "Do Warning Labels Work?" Newsweek, July 18, 1989, pp.40-41.
- Wolf, Isabel D. and Richard V. Lechowich. "Current Issues in Microbiological Food Safety", Cereal Foods World, 34:6, June 1989, pp. 468-472.
- Zellner, James A. "Market Responses to Public Policies Affecting the Quality and Safety of Food and Diets", (pp.54-74) in Katherine L. Clancy (editor), Consumer Demands in the Marketplace: Public Policies Related to Food Safety, Quality and Human Health, National Center for Food and Agricultural Policy, Resources for the Future, Washington, D.C., 1988.

Table 10.1 Consumer Food Safety Concerns*

	1984		1985		1986		1987		1988		1989					
	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Serious Hazard	Something of a Hazard	Not a Hazard				
Residues, such as pesticides and herbicides	77		73		75		76		75		82		13		3	
Antibiotics and hormones in poultry and livestock	x		x		x		61		61		61		26		6	
Nitrates in food	x		x		x		38		44		44		38		5	
Irradiated foods	x		x		37		43		36		42		24		10	
Additives and preservatives	32		36		33		36		29		30		59		8	
Artificial coloring	26		28		26		24		21		28		48		19	

*May not add to 100 percent due to rounding.

x = Not asked.

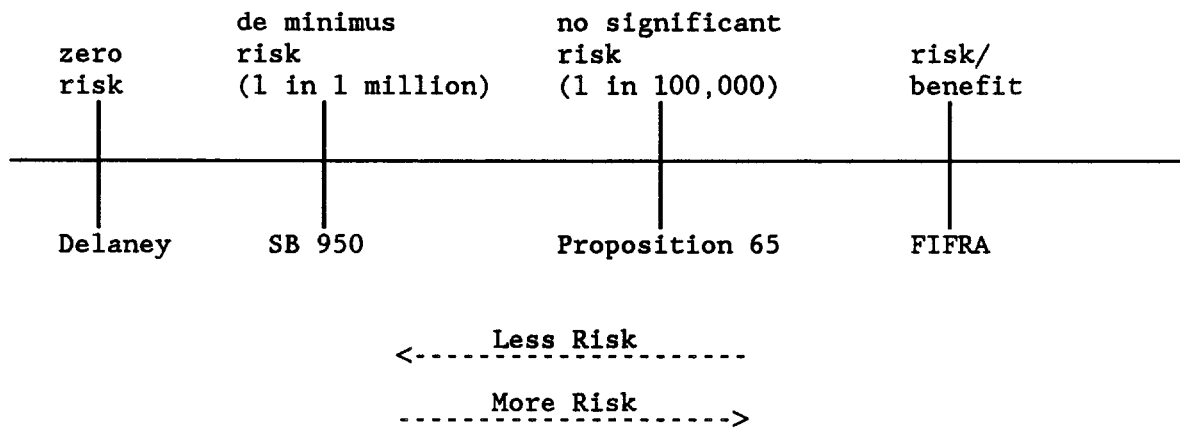
Source: Food Marketing Institute, 1989, p. 54.

Table 10.2 Factors Influencing the Perception of Risk

Decreased Perception of Risk	Increased Perception of Risk
Risk assumed voluntarily.....	Risk borne involuntarily
Effect immediate.....	Effect delayed
No alternatives available.....	Many alternatives available
Risk known with certainty.....	Risk not known
Exposure is an essential.....	Exposure is a luxury
Encountered occupationally.....	Encountered non-occupationally
Common hazard.....	"Dread" hazard
Affects average people.....	Affects especially sensitive people
Will be used as intended.....	Likely to be misused
Consequences reversible.....	Consequences irreversible

Source: Lowrance 1976, p. 87 and also reproduced in Dardis, 1988, p. 308.

Figure 10.1 Various Risk Standards



Source: Archibald, 1988, p. 39.