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20. Irradiation and Food Safety: Consumer Attitudes and Awareness

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Food irradiation offers many advantages to producers, as well as consumers. Irradiation of food promises an improved sanitation level, extended food shelf life, safe transport of produce, replacement of chemical fumigants, and a reduction of mold (Schutz et al. 1989, Bruhn et al. 1986, Pszczola 1990). Food irradiation technology, on a macro scale, has the potential to lower health care costs due to less foodborne illness (Roberts 1985), expand export business, and ease world hunger through the reduction of spoilage and waste (Diehl 1983). Opponents of irradiation claim that irradiation will make food radioactive, will reduce levels of essential nutrients, will help to conceal food contamination, will pose serious occupational and environmental hazards, and in general will increase risks to public health (Pszczola 1990).

Conflicting claims by advocates and opponents of irradiation have generated intense controversy and have made irradiation a political and psychological issue. It is still uncertain whether the public will accept irradiated food despite comprehensive research and endorsement by major health organizations, international expert committees, and scientific societies.

The U.S. Food and Drug Administration (FDA) has approved irradiation at certain doses for fruits and vegetables, dry or dehydrated herbs, spices, seeds, teas, vegetable seasonings, for the *Trichinae* parasite in pork, for sprouting in white potatoes, and for disinfecting wheat and wheat flour (Pszczola 1990). Recently, the FDA approved irradiation to control bacteria such as *Salmonella*, *Listeria*, and *Campylobacter* in fresh and frozen uncooked poultry products. The poultry industry has not been willing to incur the financial risk of investing in irradiation technology because of perceived consumer resistance to irradiated chicken (Feedstuffs 1992). Pork processors and the seafood industry have also been wary of the technology due to perceived consumer resistance.

Distrust of irradiation technology is allegedly generated by consumer misconceptions. Whether misconceptions exist or not, it is important that the public's attitudes and degree of awareness of the benefits of irradiation be studied thoroughly. The public's attitudes and awareness of the benefits of irradiation are crucial to consumer acceptance of irradiated food, and consumer acceptance is critical to the viable adoption of this technology and a realization of the advantages it offers.

An understanding of the public's perception and judgement of irradiated food will aid food processors in deciding whether to incur the financial risk of investing in this technology. It will aid government agencies, such as FDA, in evaluating existing policies and in devising new regulations which will reconcile scientific and social forces. Further, it will assist in developing and implementing effective consumer education programs aimed at stressing the positive aspects of irradiation. The objectives of this chapter are to analyze consumers' attitudes toward irradiated food, to examine the extent of consumers' knowledge and awareness of the process of irradiation, and to identify the several facets which should be included in an effective consumer education program.

Survey Design

The consumer panel maintained by the Consumer Information Management System (Huang and Misra 1990) of the University of Georgia was used to administer a survey to accomplish the above objectives. Panel members represent a stratified sample (by income) of Georgia consumers. A mail survey among 500 panel households was conducted during the Fall of 1992 (contact the authors for a copy of the complete survey). The survey resulted in 236 returned questionnaires representing a response rate of 47 percent.

Several questions on a variety of topics concerning irradiation were asked of the panel participants. Though no attempt was made to educate consumers about the irradiation technology, definitions of some of the terms frequently used in the questionnaire were provided. The questionnaire was carefully designed to minimize its effect on consumer responses and to collect information that reflects consumer's own attitudes. Questions related to consumer perceptions about irradiation and other food safety concerns were asked first to avoid any input (education) the survey instrument may have given.

A pre-selected list of seven concerns was presented to determine the relative consumer risk perception about several food safety concerns. Respondents were asked to express their perception about these food safety concerns on a scale of "no problem" to "extremely serious problem." The seven food safety concerns were: pesticide residues, animal drug residues, growth hormones, food additives, bacteria, irradiation, and naturally-occurring toxins.

The four most frequently cited disadvantages of irradiation were presented

to focus more precisely on consumers' attitudes toward irradiation, and panelists were asked to express their concerns about these claims. The four statements were:

a. The possibility of food becoming radioactive due to irradiation.
b. The possibility of reduced levels of nutrients due to irradiation.
c. The risk of workers at irradiation facilities becoming ill.
d. The risk of environmental pollution due to irradiation facilities.

Questions were asked directly on the necessity of irradiation for specific foods. These foods were fruits, vegetables, poultry products, pork products, beef products, and seafood. Panelists were also asked whether they would buy food that was treated with radiation. Those who expressed an unwillingness to buy irradiated food and those who were undecided were asked to indicate specific reasons for their response from a list of four pre-selected reasons.

Another set of questions dealt with the extent of consumer knowledge and awareness of the process of irradiation. Panel members were initially asked to self-evaluate their knowledge of the irradiation process. In addition, ten factual statements were presented with "true," "false," and "don't know" answer options.

A final set of questions was developed to assist in the formulation of an effective consumer education program. Panel members were presented with a number of arguments in favor of irradiation and the advantages of irradiation. Respondents were asked to evaluate each statement separately and to indicate how the evaluation affected their perception of the process of irradiation. They were also asked to identify the most persuasive argument and/or advantage statement in favor of the irradiation process. Finally, panel members were asked to identify the sources on which they depend for information and to express their confidence in comments on food safety by various interest groups.

Survey Results

Respondent Characteristics

Table 20.1 presents the socioeconomic and demographic information on the sample used in this study. It was not surprising that the majority of the respondents were female, 61 percent, since the primary family food shopper completed the questionnaire. The racial composition of Georgia is approximately 74 percent white as compared with over 82 percent white households represented in the sample. The mean age of the respondents was close to 50 years and about 56 percent of the sample respondents had at least some college education. More than one-quarter (29 percent) of the respondents

TABLE 20.1 Sample Characteristics of Survey Respondents

Characteristics	White	Nonwhite	Total
	---------- % ----------		
GENDER			
Male	33.5	5.4	38.9
Female	49.8	11.3	61.1
AGE			
Less than 35 years	14.7	4.1	18.9
36-45 years	21.7	4.1	25.8
46-65 years	29.0	6.5	35.5
More than 65 years	18.0	1.8	19.8
EDUCATION			
Noncollege	32.4	11.3	43.7
College	50.9	5.4	56.3
MARITAL STATUS			
Married	63.1	8.6	71.6
Other[a]	20.3	8.1	28.4
HOUSEHOLD INCOME			
Less than $20,000	20.2	9.1	29.3
$20,000-$29,000	14.4	2.4	16.8
$30,000-$39,000	13.5	2.4	15.9
$40,000-$49,000	10.6	0.5	11.1
$50,000 or more	25.0	1.9	26.9
HOUSEHOLD SIZE			
1 person	13.1	3.6	16.7
2-4 persons	62.6	9.0	71.6
5 or more persons	7.7	4.1	11.7
PLACE OF RESIDENCE			
Urban	42.1	11.3	53.4
Rural	41.2	5.4	46.6

[a]This group includes unmarried, divorced/separated, and widowed respondents.

had annual household incomes of less than $20,000. Over a third (38 percent) had incomes of $40,000 or more. The sample tended to be demographically upscale with better educated and higher income consumers slightly overrepresented in comparison with census statistics.

Attitudes Toward Food Irradiation

Relative Risk Perception. The list of seven food safety concerns served to focus respondent perceptions on the seriousness of problems associated with the listed concerns. The seven-point scale of "no problem" to "extremely serious problem" was converted into three groups: little or no problem, moderate problem, and serious or extremely serious problem. Table 20.2 presents the information on consumer perceptions toward these concerns.

The results indicate that pesticide residues were perceived to be the greatest safety threat, followed by growth hormones, animal drug residues, bacteria, food additives, irradiation, and naturally occurring toxins. This finding is consistent with findings by the Food Marketing Institute (FMI 1991), where pesticide/herbicide residues, antibiotics, and hormones were perceived as more serious safety threats than irradiation. Bruhn et al. (1986) also found that consumers are more concerned about chemical sprays and preservatives than irradiation.

Consumer responses, isolated for irradiation, indicate that approximately 40 percent of the respondents perceived irradiation to be either a serious or extremely serious problem. This result compares with the national results of Wiese Research Associates (1984) of 42 percent, FMI (1988) 36 percent, Brand Group (1986) 27 percent, and Bruhn et al. (1988) 29 percent for the Western region.

TABLE 20.2 Consumer Perceptions of Suggested Food Safety Concerns

Safety Concern	Little or No Problem	Moderate Problem	Serious Problem
	----------% ----------		
Pesticide residues	19.1	26.7	54.2
Animal drug residues	21.9	27.4	50.7
Growth hormones	20.9	27.4	51.6
Food additives	25.0	32.4	42.6
Bacteria	25.6	24.6	49.8
Irradiation	34.6	26.1	39.3
Naturally occurring toxins	54.9	22.8	22.3

Concern About Ramifications of Irradiation. Another measure of consumers' concerns about irradiated food is their perception of the ramifications of the technology. Opponents claim that irradiation will make food radioactive, will reduce levels of essential nutrients, and will pose serious occupational and environmental hazards. Respondents were asked to report their concern about these alleged ramifications of irradiation on a scale of "not concerned" to "extremely concerned."

Results show that consumers are seriously concerned about the ramifications of the irradiation technology (Table 20.3). Are panelists inconsistent? In Table 20.2, it was observed that consumers expressed a relatively low level of risk perception for irradiation. Yet, they expressed a rather high level of concern about specific irradiation ramifications. One possible explanation may be that though irradiation is not perceived as a more serious safety threat than chemicals and preservatives, its potential ramifications are still under close scrutiny. The risk of environmental pollution due to irradiation was listed as a matter of high or extremely high concern by over 65 percent of the respondents. Approximately 64 percent expressed high or extremely high concern for possible occupational hazards, 60 percent expressed similar concern on the possibility of food becoming radioactive, and about 53 percent were concerned about the possibility of reduced levels of nutrients due to irradiation.

Interestingly, more consumers were concerned about possible occupational and environmental hazards due to food irradiation than to potential health risk. One possible explanation for this finding may be that consumers tend to link irradiation with the nuclear industry. Mention of irradiation technology, possibly, triggers thoughts of nuclear accidents and associated nuclear waste disposal in the minds of consumers.

Is Irradiation Necessary? Table 20.4 indicates that consumers perceive there is a necessity for irradiation of specific foods. About 60 percent of the respondents perceived that the irradiation of pork is very necessary. This was

TABLE 20.3 Consumer Concern About Specific Irradiation Ramification

Ramifications	Little or No Concern	Moderate Concern	Extremely/ High Concern
	----------% --- ----------		
Food becoming radioactive	23.8	16.0	60.2
Reduced levels of nutrients	20.5	26.2	53.3
Environmental risk	13.1	21.8	65.1
Occupational hazard	14.8	21.4	63.8

TABLE 20.4 Consumer Perception About the Necessity of Irradiation

Food Product	Not Necessary	Somewhat Necessary	Very Necessary
	----------% ----------		
Fruits	34.0	40.0	26.0
Vegetables	31.1	42.0	26.9
Poultry	12.9	30.0	57.1
Pork	12.9	27.5	59.6
Beef	16.2	38.4	45.4
Seafood	14.7	27.2	58.1

followed by about 58 percent and 57 percent strongly recommending irradiation of seafood and poultry, respectively. Irradiation was also thought to be very necessary for beef products by about 45 percent of the respondents. The irradiation of fruits and vegetables was not perceived to be a high priority by the responding consumers.

These results suggest that more consumers perceived irradiation as necessary for seafood and meat products, particularly in comparison to fruits and vegetables. Ironically, the poultry, pork, and seafood industries are hesitant to adopt irradiation technology, whereas the fruit and vegetable industries are proceeding with irradiation. The fruit and vegetable industries have been persistent in exploring the technology, despite opposition from consumer activists. The Vindicator food irradiation facility in Florida has continued to expand its operation to include citrus, fruits, spices, tomatoes, and onions (Turcsik 1992).

Does a perception toward the necessity of irradiation translate into a willingness to purchase irradiated food? To assess this critical question, respondents were asked specifically whether they would buy food that was treated with radiation. Only 13 percent of these respondents expressed an unwillingness to buy irradiated food. About 31 percent of the respondents were willing to purchase irradiated food while a majority (56 percent) were undecided. This is consistent with the Brand Group (1986) study classification of "rejecters," "undecideds," and "acceptors" of irradiated food. This latter study estimated, on the basis of a national sample, that 5-10 percent can be classified as rejecters, 55-65 percent can be classified as undecideds, and 25-30 percent as acceptors. This result suggests that consumers have not changed their willingness to purchase irradiated food during the last 5 years. This may be simply because the issue of irradiation has not really been before the public.

Respondents who were either unwilling to purchase irradiated food or undecided were then asked to specify reasons for their response. The list of four pre-selected reasons was:

a. Is harmful and may lead to health complications.
b. Poses occupational hazards for those involved.
c. Poses serious environmental hazards.
d. Not sure whether the process is safe.

In response, an overwhelming 93.5 percent of the respondents indicated that they are either unwilling to purchase irradiated food or are undecided primarily because they are not sure whether the process is safe. This result indicates that though the consumers perceive irradiation as necessary for certain foods, they demand more information about its safety.

Awareness About Food Irradiation

Self-Evaluation of Awareness. Respondents were asked whether they had heard of the irradiation process for preserving food prior to this survey. About 54.5 percent of the respondents indicated "yes," with the remainder indicating "no." This result compares with the nationwide awareness percentages presented by Schutz et al. (1989) of 59.7 percent, Brand Group (1986) of 66 percent, and Wiese Research Associates (1984) of 23 percent, and the regional results of Bruhn et al. (1988) of 45 percent.

Hearing about food irradiation does not necessarily provide a good measure of consumers' knowledge about the irradiation process. Respondents who had heard about irradiation were asked to rate their knowledge by choosing a statement from a pre-selected list of three statements. The three statements were:

a. I am sufficiently informed about the irradiation process.
b. I am somewhat informed about irradiation but do not feel comfortable to make an accurate assessment.
c. I have heard about the irradiation process but do not know anything about it.

Approximately 47 percent of the respondents who had heard about irradiation indicated that they do not know anything about it. The remainder of the respondents chose the second statement from the above list. None of the respondents indicated they were sufficiently informed. An estimate of the proportion of respondents having a meaningful level of knowledge about irradiation would seem to require that consideration be given only to that group of the respondents who have heard about irradiation and who feel that they are

at least somewhat informed about the process. This group of respondents accounted for only 28 percent of the total responding panel members.

Testing Consumer Knowledge. Another measure of consumer awareness of irradiation technology was developed based on the responses to ten factual statements with "true," "false," and "don't know" answer options (see Appendix 20.A, Table 20.A1). Three of these statements were true. Responses to these statements were translated to item scores and were coded so that 1 indicated a correct answer and 0 indicated a wrong answer or a don't know response. To construct an awareness variable, the item scores for each respondent were first summed to obtain a total score. The total awareness scores were then expressed as an index ranging from zero to 1. An index value of 1 corresponded to the highest possible total score of 10 points.

The arithmetic mean of this constructed awareness index was 0.279. This corresponds to a very low level of consumer awareness of food irradiation since 1 corresponds to perfect awareness. No respondent received a perfect score of 1.

Influence of Demographic Variables

Correlation of Demographics with Consumer Awareness. The data were analyzed to determine if consumer awareness of irradiation differs significantly among demographic subgroups using Chi-square contingency tests. The awareness index was collapsed into two categories representing "low" and "moderate or high" awareness for this purpose. Respondents receiving a score of 0.5 or less were clustered together in the low awareness group and respondents with a score greater than 0.5 were categorized as the moderate or high awareness group.

The results suggest a correlation between awareness of food irradiation and a respondent's gender, education, and household income. Table 20.5 shows that a relatively higher proportion of females had lower awareness of the irradiation process than males, and that this difference was statistically different from zero at the 5 percent level of significance. Respondents with a college education and higher incomes appeared more likely to have a better awareness of irradiation than those with less than a college education and with lower incomes.

These results are comparable with those of Schutz et al. (1989), who reported a higher level of awareness of irradiation for men, older people, and those with more education. Malone's (1990) study of consumer willingness to purchase irradiated fresh food also indicated a higher level of awareness for men, more highly educated people, and those with higher incomes.

Correlation of Demographics with Consumer Perception. It was noted earlier from Table 20.2 that about 39.3 percent of the respondents perceived irradiation to be either a serious or extremely serious problem and that 26.1 percent and 34.6 percent of the respondents perceived irradiation to be a

TABLE 20.5 Cross-Tabulation of Consumer Awareness Index by Economic and Demographic Characteristics (Chi-Square Contingency Test)

Characteristics	Consumer Awareness		Chi-Square Value
	Low	High	
	--------% --------		
RACE			0.198
White	86.49	13.51	
Nonwhite	89.19	10.81	
GENDER			3.796**
Male	81.40	18.60	
Female	90.44	9.56	
AGE			3.995
Less than 35	78.57	21.43	
36-45 years	91.07	8.93	
46-65 years	85.71	14.29	
More than 65	90.70	9.30	
EDUCATION			5.084**
Noncollege	92.78	7.22	
College	82.54	17.46	
MARITAL STATUS			2.139
Married	84.91	15.09	
Other	92.19	7.81	
HOUSEHOLD INCOME			8.117***
Less than $20,000	93.44	6.56	
$20,000-$29,000	88.89	11.11	
$30,000-$39,000	90.91	9.09	
$40,000-$49,000	82.61	17.39	
$50,000 or more	76.79	23.21	
HOUSEHOLD SIZE			1.226
1 person	92.11	7.89	
2-4 persons	85.53	14.47	
5 or more persons	88.46	11.54	
PLACE OF RESIDENCE			0.338
Urban	85.71	14.29	
Rural	88.35	11.65	

Note: The superscripts ** and *** correspond to levels of statistical significance of 5 percent and 10 percent, respectively.

moderate, or little or no problem, respectively. Cross-tabulation of consumer perceptions of irradiation by demographic variables and the awareness index revealed some interesting results.

Consistent with the Chi-square contingency test for consumer awareness, results suggested a statistically significant correlation between consumer perceptions and the respondent's gender, education, and household income (Table 20.6). Females, respondents with less than a college education, and lower income respondents appeared more likely to perceive irradiation as a relatively more serious problem than their counterparts. This is consistent with the findings of Schutz et al. (1989) that there is a higher level of concern about irradiation among women and less educated individuals.

A cross-tabulation of consumer perception and the awareness index showed statistical significance for the Chi-square statistic (Table 20.6). Consumers with low levels of knowledge about irradiation tended to perceive it as a more serious problem than those with moderate or high levels of awareness.

Disseminating Information

Studies of consumer awareness and attitudes toward food irradiation, including this one, show that individuals are ambivalent toward irradiated food. The overall results of all existing studies, despite methodological differences, show a general lack of information about food irradiation and a persisting consumer uncertainty. Several studies (Urioste et al. 1990, Schutz et al. 1989, Bord and O'Conner 1989, Terry and Tabor 1988, Bruhn et al. 1988) have shown that consumer education campaigns have a positive influence on perceptions about the acceptability of irradiation.

This study attempted to determine the importance of labeling and to identify various facets of an effective consumer education program from the consumer perspective. It identifies the advantages of irradiation and the arguments in favor of irradiation technology that the consumers believe to have a positive influence on their perceptions. Further, consumers' primary sources of information about irradiation and who they prefer to be relaying information were identified.

Attitudes Toward Irradiation Labeling. Attitudes toward irradiation labeling were most certainly favorable. Over 74 percent of the respondents, responding to a question that displayed the international food irradiation symbol, indicated that it is very important for irradiated products to be clearly labeled. Another 24.3 percent of the respondents perceived it to be somewhat important.

About 70 percent of the panelists felt that the international symbol of food irradiation, established to designate irradiated food products, is sufficient to inform consumers that the food is irradiated. However, the symbol was not perceived as a symbol of assurance for safety by over 80 percent of the respondents. This would seem to indicate that consumers want irradiated food to be labeled primarily because they want to know what they are buying.

TABLE 20.6 Cross-Tabulation of Consumer Perceptions of Irradiation by Economic and Demographic Characteristics, and Awareness Index (Chi-Square Contingency Test)

Characteristic	Consumer Perception			Chi-Square Value
	Little or No Problem	Moderate Problem	Serious Problem	
	----------%		----------	
RACE				2.740
White	35.26	26.59	38.15	
Nonwhite	20.69	27.59	51.12	
GENDER				6.396**
Male	41.56	28.57	29.87	
Female	27.42	25.81	46.77	
AGE				7.303
Less than 35	23.08	35.90	41.03	
36-45 years	44.23	15.38	40.38	
46-65 years	31.88	30.43	37.68	
More than 65	31.58	28.95	39.47	
EDUCATION				8.625*
Noncollege	22.22	27.16	50.62	
College	40.50	26.45	33.06	
MARITAL STATUS				1.479
Married	35.62	25.34	39.04	
Other	26.79	30.36	42.86	
HOUSEHOLD INCOME				18.079**
Less than $20,000	18.18	25.45	56.36	
$20,000-$29,000	44.12	23.53	32.35	
$30,000-$39,000	36.67	43.33	20.00	
$40,000-$49,000	31.82	31.82	36.36	
$50,000 or more	42.59	20.37	37.04	
HOUSEHOLD SIZE				0.473
1 person	32.26	29.03	38.71	
2-4 persons	34.01	26.53	39.46	
5 or more persons	29.17	25.00	45.83	
PLACE OF RESIDENCE				3.092
Urban	37.38	28.04	34.58	
Rural	28.42	25.26	46.32	
CONSUMER				8.087**
AWARENESS	31.15	28.42	40.44	
Low	57.14	10.71	32.14	
High				

Note: The superscripts * and ** correspond to levels of statistical significance of 1 percent and 5 percent, respectively.

Persuasive Arguments in Favor of Irradiation. Seven statements representing some arguments in favor of irradiation were presented to the respondents (see Appendix 20.A, Table 20.A2). Respondents were asked to express how each of seven statements would affect their concern about irradiation. Only 20-22 percent of the respondents indicated that statements such as irradiation has government approval, irradiated food has been eaten by American and Soviet astronauts in space, and the energy used for irradiation is similar to ultraviolet light, would either totally eliminate or reduce their concern about irradiation to a great extent.

Irradiation concerns of about a third of the respondents would be totally eliminated or reduced considerably if they were informed that irradiation has already been used in U.S. hospitals to sterilize medical and surgical products. Approximately the same proportion of respondents felt similarly about recommendations of various world organizations as to the safety of irradiation.

Irradiation concerns for about 35 percent of the respondents would be totally eliminated or reduced considerably if they were informed that irradiation is used in U.S. hospitals to sterilize utensils and food for patients with critical immunity problems. The most persuasive argument in favor of irradiation (chosen by 41 percent) was that extensive research has shown irradiated food to be safe, wholesome, and nutritious.

These results indicate that it is not sufficiently convincing to promote irradiation technology with seals of approval from the government and world organizations. Consumers appear to be asking for information based on extensive scientific research and real world tests. This should not be interpreted as contradicting earlier findings (Urioste et al. 1990, Bruhn and Noell 1987) that government authorization has a positive influence on the acceptability of irradiated food. Our finding only reinforces their judgement, while identifying additional persuasive arguments in favor of irradiation.

Persuasive Irradiation Benefits. Seven irradiation advantages were presented in another question, and panelists were asked to indicate how each of these statements was perceived as being an advantage for the process (Appendix 20.A, Table 20.A3). In general, all the advantage statements were perceived to indicate a major or somewhat major advantage of the irradiation process. The least persuasive advantage of the irradiation process was still perceived to be a major or somewhat major advantage by 60 percent of the respondents.

The potential of irradiation technology in facilitating the production of T*richina*-free pork and the transportation of processed food from specialized production areas to other areas was perceived as a major or somewhat major advantage by about 60 percent of the respondents. Approximately 67 percent of the respondents considered the possibility of lowering the cost of foods due to irradiation as a major or somewhat major advantage of the process.

The potential for reducing or eliminating the need for preservatives and extending the shelf life of fruits without using chemicals was considered as a

major or somewhat major advantage by 69 and 66 percent of the respondents, respectively. Irradiation as a solution to world hunger was perceived to be a major advantage by 72 percent of the respondents. The most persuasive advantage of the irradiation process was its potential for reducing or eliminating *Salmonella* contamination of poultry meat.

Several previous studies have shown that information provided to the consumer regarding the benefits of irradiation results in a positive influence on their attitudes. The results in this section provide a measure of the persuasiveness of several specific benefits of the irradiation process.

Whom Do Consumers Trust? Respondents were asked to express the extent of their confidence in comments on food safety issues by different interest groups. A five-point scale of "no confidence" to "high confidence" was used to record consumers' responses. The list of pre-selected groups included scientists from a university; representatives of a government agency, an independent laboratory, a chemical manufacturer, a consumer group, a grower association, or a supermarket; popular media personality or celebrity; and friends, family, or fellow workers.

The top choice by the panelists was university scientists, chosen to be most trustworthy by about 58 percent of the respondents. Table 20.7 shows that

TABLE 20.7 Consumers' Confidence in Comments Made About Food Safety by Various Groups of Individuals[a]

Group	Little or No Confidence	Moderate Confidence	High Confidence
	----------% ----------		
University scientists	13.9	27.8	58.3
Government agency	38.8	38.3	22.9
Independent laboratory	13.8	29.9	56.3
Chemical manufacturer	61.6	25.9	12.5
Consumer group	16.9	29.8	53.3
Grower association	41.0	36.1	22.9
Supermarket	49.3	37.0	13.6
Media personality or celebrity	52.1	21.3	8.6
Friends, family, fellow workers	30.4	30.8	38.8

[a]For purposes of analysis, the 5-point scale was collapsed into three groups. A ranking of 1 and 2 was taken to imply little or no confidence, a ranking of 3 was taken to imply moderate confidence, and a ranking of 4 and 5 was taken to imply high confidence.

university scientists were closely followed by representatives of an independent laboratory (chosen by 56 percent of the panelists) and of a consumer group (chosen by 53 percent). That consumers expressed such a high level of confidence in representatives of a consumer group is noteworthy, especially since consumer groups are generally perceived as staunch opponents of food irradiation. This probably suggests that consumers want to be assured of the safety of the irradiation process with absolute certainty. They want the approval not only of scientists and independent entities, but also from the opponents of the process.

Only about 23 percent of the respondents expressed a high degree of confidence in comments made by representatives of the government. Government agencies received a lower ranking than friends, family, and fellow workers, chosen by 39 percent of the respondents as highly trustworthy. It appears that the public's trust and confidence in the government's ability to guarantee the safety of food supplies has eroded.

Representatives of supermarkets and chemical manufacturers and popular media personalities or celebrities, were the three lowest ranked groups in terms of consumers' confidence. Popular media personalities or celebrities are considered the least trustworthy as about 52 percent of the panelists had no confidence in their comments on food safety issues.

Channels for Disseminating Information. Over 64 percent of the respondents identified radio and television as their major sources of information about irradiation. Approximately 54 percent indicated that they also depend on newspapers to receive information.

Though about 38 percent of the respondents identified magazines as a major source, this finding is ambiguous since it was not possible to identify specific magazines. No other listed source was found to be effective as they were chosen by only a very small proportion of the panelists. These results clearly suggest that radio, television, and newspapers are the most effective sources for disseminating information about irradiation to consumers.

Conclusions

Consumers are ambivalent in their attitude toward irradiated foods and are concerned about perceived hazards that may be associated with the technology. There is also some evidence that supports a view that public opinion is favorable to irradiation. One indication of a favorable public is that irradiation is perceived to be necessary for the preservation of several food products. Specifically, irradiation is perceived to be necessary for seafood and meat products. This finding should encourage the poultry, pork, beef, and seafood industries to reevaluate their perception of a public opinion which reflects only negative attitudes toward irradiation. Another indication of a more supportive

public is that only a very small proportion of those expressing opinions outrightly decline to buy irradiated food. It is true that irradiation technology has yet to receive an unconditional endorsement from the public. The public simply lacks sufficient information about the irradiation process and, therefore, is not convinced that it is safe.

Survey results clearly suggest that consumers' knowledge and awareness about the process of irradiation is at a low level. This lack of awareness was found to be responsible for the low degree of enthusiasm which characterized consumers' responses relative to the potential for irradiated food in the marketplace. Low awareness was also found to be significantly important in explaining higher levels of concern on the safety of irradiation. The overall lack of awareness of the irradiation process makes the successful introduction of irradiation dependent upon the development of a consumer education program that targets the entire population. The survey results indicate that women and individuals with less income and education are less informed about irradiation suggesting a possible focus for the program.

Several critical factors must be carefully considered in the development and implementation of an effective consumer education program. The survey suggests that the program should be equipped with extensive research findings on the effects of irradiation on food, individuals, and the environment. Environmental and occupational implications of the technology must be clearly and precisely addressed. Consumers must also be informed as to the current status of the technology in terms of where and how it is currently used and what have been the results of these real world tests. Irradiated products should also be clearly and precisely labeled and all the advantages and disadvantages of irradiation should be clearly and objectively spelled out.

University scientists should be encouraged to communicate directly with the public in view of the eroding public confidence in the government's ability to guarantee the safety of food supplies. It appears critical that scientific research findings pertaining to irradiation technology be relayed directly to the public via popular media such as television, radio, and newspapers. Independent expert committees and representatives of consumer/environmental groups may also be involved to further strengthen creditability in the implementation of an effective consumer education program.

In this chapter, a survey on consumer attitudes and evaluations of food safety technologies was analyzed. This study contributes to the broad spectrum of consumer valuation and attitudinal research, using survey instruments, that is designed specifically to explore consumers' knowledge and awareness about food safety and nutrition issues. Interpretation of the results of this survey on irradiation sheds additional insights on consumer attitudes. For example, we found that most consumers are unwilling to purchase irradiated food because they are uncertain about the safety of the process. The uncertainty can be attributed to the fact that the public has very little knowledge of the technology

and is basically unaware of what it has to offer in improving the safety of food products.

The results have important implications for food industry decision makers and government officials in their assessment of the market potential for irradiated foods. In particular, the identification of consumers' fears for the safety of the technology pinpoints the need, as the first priority, to develop and disseminate information concerning food irradiation to gain consumer acceptance in the marketplace. Thus, results of the study provide a useful means to identify the most important components required in the development of an effective consumer education program.

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Appendix 20.A

SURVEY QUESTIONS

TABLE 20.A1 Complete Text for Question on Factual Statements to Measure Consumer Awareness of Irradiation

Please answer the following irradiation related questions by circling the number that you think represents the correct answer, where 1 = true, 2 = false, and 3 = don't know.

		True	False	Don't Know
A.	Food deliberately treated with radiation can at present be bought in some countries of the world.	1	2	3
B.	The United States leads the world in the number of irradiated foods available for retail sale.	1	2	3
C.	Food contains natural radioactivity.	1	2	3
D.	Scientists can easily detect food that has been irradiated.	1	2	3
E.	Food that has been treated with irradiation cannot be recontaminated.	1	2	3
F.	Irradiated foods retain most of their appearance, taste, and quality, making them almost indistinguishable from fresh raw foods.	1	2	3
G.	Irradiated food cannot be recognized for visible spoilage if it had gone bad.	1	2	3
H.	It is legal to irradiate food repeatedly.	1	2	3
I.	It is proved that consumption of irradiated food increases incidence of cancer in test animals.	1	2	3
J.	Food treated with radiation has a higher level of radioactivity than nonirradiated food.	1	2	3

TABLE 20.A2 Complete Text for Question on Arguments in Favor of Irradiation

The following statements represent some arguments that have been presented in favor of irradiation. Please indicate, by circling the number, how it would affect your concern about irradiation. Where, 1 = would totally eliminate any concerns I may have, 2 = would reduce my concern a lot, 3 = would reduce my concern a little, 4 = wouldn't affect my concerns at all, and 5 = not sure.

		Totally Eliminate Concerns				Not Sure
A.	The U.S. government has already approved such processing for spices and other seasonings, fruits and vegetables, pork, and poultry.	1	2	3	4	5
B.	The process has already been used in the U.S. to sterilize about 30% of all medical and surgical products used by American hospitals.	1	2	3	4	5
C.	The United Nations Food and Agricultural Organization, the International Atomic Energy Agency, and the World Health Organization Joint Expert Committee have recommended the process as being safe.	1	2	3	4	5
D.	Foods processed by this method have been eaten by the American and Soviet astronauts in space.	1	2	3	4	5
E.	The process is used in U.S. hospitals for patients with critical immunity problems who cannot tolerate any disease-causing organisms in their food.	1	2	3	4	5
F.	The energy used for this purpose is similar to ultraviolet light, only more powerful.	1	2	3	4	5
G.	Extensive scientific research has shown that proper use of this process poses no health hazards and the irradiated food is safe, wholesome, and nutritious.	1	2	3	4	5

TABLE 20.A3 Complete Text for Question Pertaining to Advantages of Irradiation

The following represent some of the advantages associated with the irradiation process. Please indicate, by circling the number, how do you see each of the following factors as being an advantage for the process. Where, 1 = a major advantage, 2 = somewhat of a major advantage, 3 = a minor advantage, 4 = no advantage, and 5 = not sure.

		Major Advantage				Not Sure
A.	The process would reduce or eliminate the need for preservatives, such as nitrates which are carcinogenic, in the processed meat.	1	2	3	4	5
B.	The process would reduce or eliminate *Salmonella* contamination of poultry meat.	1	2	3	4	5
C.	The process would reduce or eliminate the need to use chemicals on fruits and vegetables and extend their shelf life by several weeks to a month.	1	2	3	4	5
D.	The process would allow the U.S. livestock market to produce *Trichina*-free pork and open up the world market in which entry of pork is currently denied because the meat cannot be guaranteed free of *Trichina* parasites.	1	2	3	4	5
E.	The process would lower the cost of foods by greatly reducing the wastes due to spoilage or insect damage, and by eliminating the need for freezing and continued refrigeration.	1	2	3	4	5
F.	The process would allow items processed in specialized areas of the country, such as fish, fruits, and vegetables, to be shipped chilled but not frozen to other areas.	1	2	3	4	5
G.	The process would help ease the world hunger problem since today many countries lose 30% or more of their food production to spoilage and insects before it reaches the marketplace.	1	2	3	4	5