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Consumer Knowledge and Perceptions of Food Irradiation: Ground Beef Study

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This paper explores consumers' perception of irradiated ground beef products and the role of irradiation in consumer purchase decisions. Data was collected with a survey of ground beef consumers. The research objective was the identification of important attributes leading to consumer preference and selection of irradiated beef products. Results showed that a majority of consumers had heard of food irradiation and would be willing to purchase irradiated food products, but they were somewhat concerned about the impact of irradiation on safety, taste, and nutritional value which were listed as the three most important attributes in food purchases. Consumers trusted medical professionals and food scientists the most and government the least when it came to irradiation of food. The identification of the attributes should provide a useful guidance for the beef industry in terms of determining marketing strategies to increase the level of consumer preference for irradiated products.

It has been well-documented that ionizing irradiation can effectively reduce or remove microbial contaminants in meat products and extend product shelf stability in the process (Murano 1995; Olson 1998; Thayer et al. 1992; Radomyski et al. 1994). In terms of its application to food, irradiation is defined as the application of energy to a specific material. The function of irradiation in food products is to reduce or destroy microorganisms, parasites, or insects (Andrews et al. 1998). Irradiation of fresh meats has obvious application because of the relatively short shelf stability of fresh meat due to spoilage microbes or pathogens detrimental to human health.

The application of irradiation to food products is in no way a replacement for good manufacturing practices in food production. Irradiation will not improve the eating quality of substandard products, but it may prolong the shelf stability of high-quality, properly manufactured food by slowing the growth of spoilage microbes. Shamsuzzaman et al. (1995) reported a significant increase in shelf life (samples exhibiting less than 10^5 CFU/g for total plate count) from 16 days to eight weeks when chicken breast meat was irradiated at a dose of three kiloGray. Similar results have been reported with chicken and lamb meat (Kannat et al. 1997).

While the safety of irradiated fresh meat is less in question among scientists and consumers alike,

irradiated food products still seems to have negative connotations for consumers.

Many studies have examined consumer acceptance and willingness to pay for food irradiation via surveys, lab, and supermarket simulations (Lorenzen and Heymann 2003; National Cattlemen's Beef Association Study 2002; Hashim et al. 2001; Rimal et al. 1999; International Food Information Council [IFIC] 1998).

Consumer awareness of irradiation has steadily increased over the past 20 years (Hashim et al. 2001). Among U.S. consumers, 23% reported awareness of irradiation in 1984. This number had increased to 66% by 1986 and to 87.5% by 1995.

Focus-group results of the study by IFIC (1998) showed a positive correlation between consumer's acceptance of food irradiation and level of awareness about the irradiation process. Frenzen et al. (2001) concluded that males, persons with some college education, persons with household income of \$30,000 or more, and persons who had heard of food irradiation were more willing to buy irradiated meat and poultry.

Consumer concerns have increased with the growing number of reported food-borne illnesses and food-product recalls. Brewer, Sprouse, and Rousson (1994) reported that as consumer concerns for food safety increased, so did concerns about product shelf stability and microbial contaminants.

The question remains if awareness of irradiation results in increased purchases of irradiated meat products. Lusk, Fox, and McIlvain (1999) reported that consumers who were informed of the process of food irradiation were more willing to accept ir-

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radiated beef. Furthermore, Hashim et al. (2001) indicated that point-of-purchase information regarding food irradiation had contrasting effects in that some consumers shifted toward the purchase of irradiated beef and some consumers were discouraged from the purchase. These authors also reported that consumers did not discern between various cuts of beef or between ground beef versus whole muscle when making decisions about irradiated beef purchases in general. Similar studies have given conflicting reports on consumer knowledge and acceptance of irradiated meat products (Malone 1990; Nayga 1996).

Most of the aforementioned research focuses on simulated supermarket studies, telephone surveys, and mail surveys. The current study used surveys in conjunction with focus-group sessions to assess the awareness and acceptance of consumers for irradiated beef products in Central Illinois.

Methodology

Survey methodology was used to gather information on attributes of ground beef products as perceived by the consumers. The survey was a convenience sample of voluntary respondents from Central Illinois. Therefore, the results may not be viewed as representative of the entire community's perceptions, but rather as a direct understanding of consumers with sufficient interest in the research project to participate in the survey.

The survey was administered in several outlets, including focus groups, a local grocery store, the Chamber of Commerce's agribusiness event at Illinois State University Farm, and the McLean County Fair. An Illinois State University Department of Agriculture display was used to draw consumers' attention to the research at the latter three events. A letter describing the survey was provided to the participants. Consumers who ate ground beef products and were older than 18 were eligible to participate in the study. Consumers were asked to complete a survey instrument. Information about participants' awareness of food irradiation, their willingness to purchase irradiated beef, consumer concerns, and demographic information including age, education, income, and gender were collected with the survey. Participation in the survey was encouraged by asking potential participants to provide their contact information for a chance to win a leather duffel bag.

Focus groups were conducted over a two-week period. Participants were recruited through e-mails, posters, and word-of-mouth. Each participant was offered a free leather duffel bag for compensation of their time. Illinois State University students, faculty, and staff, as well as the general public were contacted. Four focus groups included 29 participants. An animal-science professor moderated the sessions. Participants were asked to fill out a survey before the discussions started. Each group discussion was audio taped with the approval of participants. At the end of the discussions, participants were asked to fill out the same survey. The goal of the focus groups was to understand what the consumers knew about food irradiation before the discussion session and to find out if discussions played any role in changing their minds on several aspects of food irradiation.

Data Analysis

Participants' answers were coded and entered into an Excel worksheet. Data was analyzed using Excel as well as SPSS and SAS statistical software packages. Chi-square test results were reported at 5% significance level.

A total of 119 surveys were completed. The demographic characteristics of the participants are shown in Table 1. Participants were primarily 25–54 years of age (61%). Female participants constituted 56% of the total participation. Sixty percent of the participants were married and 88% of them had at least some college education. A majority of the participants were Caucasians (92%) followed by African-Americans (3%), Asians (2%), Hispanic (1%), Pacific Islander (1%), and Other (1%). Income distribution varied from less than \$15,000 to more than \$75,000. Distribution of ethnicity and income were somewhat similar to Census 2000 findings for the Central Illinois region. A majority of the participants said neither they nor their family members and close friends worked within the beef industry (80%).

Sixty-eight percent of the participants had heard of food irradiation before taking the survey and 71% said that they would buy irradiated ground beef. This awareness percentage is very close to the findings of the American Meat Institute Foundation study conducted by the Gallup Organization (AMI 1993). The Gallup organization interviewed 1,005 adults concerning their awareness, knowledge, and attitude towards food irradiation. This study found that 73%

Table 1. Demographic Characteristics of Participants (n=119).

Characteristic	Percentage	Characteristic	Percentage
Gender		Participant, family member(s), or close friends worked within the beef industry	
Male	44	No	80
Female	56	Yes	20
Age		Household income	
18–24	17.6	less than \$15,000	16
25–34	16.8	\$15,001–\$24,999	7
35–44	16.0	\$25,000–\$34,999	7
45–54	27.7	\$35,000–\$44,999	16
55–64	13.4	\$45,000–\$54,999	12
65–74	5.0	\$55,000–\$74,999	17
75 and over	3.4	\$75,000 and Over	25
Marital status		Education	
Single	25.2	High school (diploma)	11.8
Engaged	1.7	Some college	27.7
Married	60.5	Associate degree	7.6
Divorced	10.1	Bachelor's degree	34.5
Widow	2.5	Post-graduate degree	18.5
Number of children		Ethnicity	
0	60.5	Caucasian/White	93.3
1	14.3	Black or African-American	2.5
2	15.1	Asian	1.7
3	6.7	Hispanic	0.8
4	2.5	Pacific Islander	0.8
5	0.8	Other	0.8

of consumers had heard of irradiation. Participants with less than \$25,000 income and those who have not heard of irradiation were less willing to buy irradiated ground beef products (Table 2).

Killing harmful bacteria was a very important reason for 85% of the participants to buy irradiated ground beef, while longer shelf life was very important to 35% of the consumers. The International Food Information Council (IFIC 1998) found that 77% and 38% of the participants indicated that killing disease-causing bacteria and longer shelf life, respectively, were very important to them.

Some participants were not comfortable with the term “irradiated” (26%), while 34% were somewhat comfortable and 40% were comfortable with the term. The term “irradiation” was also a point of concern for IFIC study participants—about half the participants said they feel comfortable with the term (IFIC 1998). If the consumer is comfortable with the term, they are more likely to buy irradiated ground beef products.¹ Participants of the survey said they

¹ Chi-square test. Significant result at 5% significance level.

Table 2. Demographic Characteristics and Willingness to Buy Irradiated Ground Beef.

Characteristics	Population Distribution (%)	Willing to buy irradiated ground beef (%)	Chi-square Test (P)
Gender			0.063
Male	44	35.1	
Female	56	36.0	
Age			0.303
18–24	18	10.5	
25–54	60	42.1	
55 and older	22	18.4	
Income			0.020
Less than \$25,000	23	11.6	
\$25,000–\$54,999	35	28.6	
More than or equal to \$55,000	42	31.3	
Education			0.500
High school or less	12	8.8	
College	70	48.2	
Post-graduate	18	14.0	
Marital status			0.404
Married	60	44.7	
Other than married	40	26.3	
Number of children			0.484
none	61	45.6	
1	14	8.8	
2 or more	25	16.7	
Ethnicity			0.798
Caucasian/White	93	65.8	
Other than Caucasian	7	5.3	
Participant, family member(s), or close friends worked within the beef industry			0.085
Yes	20	17.2	
No	80	50.5	
Heard irradiation			0.020
Yes	68	52.6	
No	32	18.4	

would be likely to purchase a food item labeled with "Treated by Irradiation" (78%); however, more participants were likely to purchase a food item if it was labeled "Treated by Cold Pasteurization" (87%). A little more than half of the participants said they took time to read label contents of ground beef products (53%).

Most of the participants reported that they would buy irradiated poultry (72%), vegetables (57%), and spices (61%). The AMI Foundation study had similar findings on consumers' willingness to purchase irradiated products—52% and 47% of the participants said they would irradiated poultry and fruits and vegetables, respectively, after the benefits of irradiation were explained (AMI 1993).

Many of the participants said that they would allow their children to consume irradiated food products (67%). If the taste of the ground beef product was unchanged, then 75% of the participants said they would buy irradiated ground beef. Although 71% of the participants said they would buy irradiated ground beef products, only 26% were willing to buy it at additional cost. However, 72% of the participants said they would purchase the irradiated food product if it was sold at no additional cost. The median premium the participants would pay per pound for irradiated ground beef was six cents. This represents a potential premium of 4–5.5 cents per pound over the estimated cost of irradiating meat (Frenzen et al. 2000; Cardona 2003).

Many agreed that food irradiation is a tool for food safety (94%) and that it eliminates harmful bacteria (97%). Participants who agreed with the safety and bacteria elimination statements were more willing to buy irradiated ground beef products than were those who did not agree with these two statements.²

Safety, taste, and nutritional value were the most important attributes, followed by price and longer shelf life of the product. The International Food Information Council study also reported that for irradiated foods, taste was more important to consumers than price (IFIC 1998). Participants of the IFIC study also appreciated the safety benefit more than the promise of extended shelf life.

Some of the participants were concerned that the irradiation process would make food radioactive (30%), that chemical changes in irradiated food are

harmful (41%), that irradiated foods are unmarked in grocery stores (41%), that irradiation adversely affects the nutritional value of food (37%), and that an accident in an irradiation facility could lead to a meltdown (35%). They were also concerned about the transportation of radioactive materials that facilities require to irradiate food (44%). The AMI study showed that 61% of the participants were concerned that irradiated food may become radioactive (AMI 1993). It is important to note that 23–36% of the current study's participants did not have an opinion on these statements.

A majority of participants said they could trust medical professionals (76.5%) and food scientists (75.6%) the most, followed by the food industry (59.6%) and the U.S. government (59.1%). Some of the participants thought endorsements by government and public health officials added credibility (39%), while 31% trusted public health organizations on irradiation of food. This is similar to the AMI study results, which showed that the American Medical Association's endorsements were more effective in increasing consumers' confidence in the irradiation process than were endorsements by the Food and Drug Administration, Department of Agriculture, or World Health Organization.

Less than 50% of the participants liked the concept of irradiation because of its health benefits and only 18% were motivated by the premise that irradiated ground beef would safeguard health. Few of the participants objected to every aspect of irradiation (15%), while 31% liked irradiation but not intensely. Very few of the participants (5%) did not see any benefit to irradiation, 22% had strong food-safety concerns, 3% did not trust current irradiated ground beef products, 50% had a mild level of safety concerns, and 20% had no concerns about the safety of irradiated ground beef products. Twenty-six percent of the participants wanted to be reassured about irradiation, while 44% wanted to remain neutral until safety was confirmed. Few participants suspected that irradiation involved long-term health-risk concerns (12%). As with the AMI study participants, the more knowledge Central Illinois consumers claimed they had about irradiation, the fewer concerns they had over its safety and other negative effects.³

Participants who object to every aspect of irra-

² Chi-square test. Significant results at 5% significance level.

³ Chi-square test. Significant results at 5% significance level.

diation, see no benefits to irradiation, do not trust current irradiated ground beef products, suspect that irradiation involves long-term health-risk concerns, and trust government on irradiation of food were less willing to buy irradiated ground beef products.⁴

Participants wanted to be reassured about irradiation. Most (76%) needed to know the taste of the ground beef product food would not change because of irradiation, 7% already believed irradiated ground beef products tasted better, and 17% believed the taste of ground beef would be negatively impacted by irradiation.

Conclusions

Central Illinois consumers had lower levels of awareness of irradiation compared to consumers in other studies in the literature (Hashim et al. 2001; AMI 1993). However, their somewhat higher level of willingness to purchase irradiated food products could be good news to the food-irradiation industry. Consumers in this study showed a need for reassurance about the safety of food irradiation and misconceptions like meltdown and radioactivity of the process need to be clarified. Consumers need more information from credible and trustworthy resources about the process of food irradiation. Additional information, especially from medical professionals and food scientists, would enable consumers to make informed and healthful dietary choices. Advertising of food products usually uses gender, age, income, education, and other social and economic factors to capture consumers' attention. In the case of promoting food irradiation, the industry should emphasize the impact of food irradiation on safety, taste, and nutritional value in their advertising efforts. Educational needs of the consumers should be recognized. Focus-group findings showed that there was a significant change in opinions of the consumers after the educational focus-group discussions.

We restricted our inquiry to consumers in Central Illinois. We would like to capture consumers' perception in a retail environment in the next stage of the research project. As a follow-up to this research project, a modified survey instrument will be used in retail/supermarket simulation. Results

between this research and a retail environment will be tested to check if there are any differences between consumer's intention to purchase vs. actual purchase behavior and the role of various attributes on these differences, if they exist. There is a need for this type of comparison in the literature, especially since many researchers rely on lab experiments and are often criticized for not conducting research in "real" environments (Lusk and Fox 2003).

A logistic regression analysis will also be used to analyze the impact of demographic characteristics and perceptions on willingness to buy irradiated ground beef products.

Conclusions of this study add to the body of evidence concerning consumer perceptions and acceptance of irradiation for meat products. If irradiation proves effective in improving food safety and extending shelf stability, value-added products could see additional consumer appeal resulting in greater demand and increased profitability within the U.S. meat industry.

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⁴ Chi-square test. Significant results at 5% significance level.

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