



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Meat Managers' Expectations Regarding Marketing of Irradiated Red Meats

Joe Gaynor, Kim Jensen, and Edward Jaenicke

The objective of this study is to assess meat managers' expectations about impact of the recent regulatory approval of irradiated raw meat and meat products on marketing decisions and plans by supermarkets and grocery meat retailers. Forty managers of meat departments were interviewed in person to obtain the information for the study. While many of the meat managers believed that irradiation would help increase shelf life and reduce spoilage, they were less optimistic about consumers being willing to pay a higher price for the irradiated product than the non-irradiated product.

The USDA recently approved use of ionizing radiation for refrigerated or uncooked red meats to reduce levels of foodborne pathogens, particularly *Escherichia coli* O157:H7. Irradiation techniques have the capability to reduce harmful bacteria, parasites, and viruses such as *Campylobacter*, *Clostridium botulinum*, *Cyclospora*, *Escherichia coli* O157:H7, Hepatitis A, *Salmonella*, *Staphylococcus aureus*, *Listeria monocytogenes*, and *Toxoplasma gondii* (Thomas and Stauber 1997). Besides reducing the levels of foodborne pathogens, irradiation can also reduce spoilage and extend the shelf life of perishable food products.

Although a large share of meat—especially ground beef—is sold through the food-service sector, perceptions by the supermarket and grocery retailing industry are of particular interest because the industry will likely be strongly influenced by the Food Safety and Inspection Service (FSIS) labeling requirements. The industry has expressed concerns that consumers may view the labeling (the phrase “treated with irradiation” or “treated by irradiation” and the “radura” symbol) as a “warning” rather than an “informational” notice (Gay 2001).

Additional product costs resulting from irradiation, coupled with perceived consumer concerns, have likely led to cautious industry adoption of irradiation of red meats. While a number of studies

have examined consumers' perceptions regarding irradiated foods, studies of industry perceptions are lacking. The purpose of this study is to assess meat managers' expectations about the impact of recent regulatory approval of irradiated raw meat and meat products on marketing decisions and plans by supermarkets and grocery meat retailers.

Because many of the new USDA rules and requirements for irradiated meat products address consumers' information needs, supermarket and grocery retailers will likely have a key role in educating consumers about irradiated meat products and the meaning of the radura symbol. Labels on packages of meat and poultry products irradiated in their entirety must bear the radura symbol (Figure 1). Unless the word “irradiated” is part of the product name, labels also must bear a statement such as “treated with radiation.” The logo must be used in conjunction with the required statement. Any label bearing the symbol or any wording of explanation of the logo must be approved by FSIS (Derfler 2000). For products irradiated in their entirety but not sold in packages (such as products in the meat case, for example), the required logo must be displayed to the purchaser with a clearly viewable label, counter sign, card, or other appropriate



Figure 1. Radura Symbol.

Gaynor and Jensen are graduate research assistant and professor, respectively, Department of Agricultural Economics, The University of Tennessee. Jaenicke is assistant professor, Department of Agricultural Economics, The Pennsylvania State University.

Funding for this study was provided in part by a grant from the National Research Initiative Grants Program, USDA.

This review was coordinated by the previous Editor.

device bearing the information that the product has been treated with radiation. The inclusion of an irradiated-meat-product ingredient in any multi-ingredient meat or poultry product must be reflected in the ingredient statement on the finished-product labeling. Optional labeling statements about the purpose for radiation processing may be included on the product label in addition to the stated requirements provided that such statements are not false or misleading. Statements indicating a specific reduction in microbial pathogens must be substantiated by proper documentation (Derfler 2000).

At the time of this study, industry adoption of irradiated red meat was far from widespread. Wal-Mart, Iowa Beef Processors, Colorado Boxed Beef, Excel, and Cargill are among companies either irradiating meat, planning to irradiate meat, testing products, or conducting test markets for irradiated meats (Epstein 2001). Estimated costs of irradiating red meats have ranged from one-half to six cents depending on the size of the irradiation facility (Kaye and Turman 1999; Bogart and Tolstun 1999; Engeljohn 1999). These costs may drop due to scale economies, however, if irradiated products become more widely accepted (Andress, Delaplane, and Schuler 2000). Along with uncertainty about consumer reaction, these additional costs have been cited as potential limitations to the market for irradiated products (Frenzen et al. 2000; Lutter 1999).

Several studies have addressed consumers' attitudes toward irradiated foods (Bailey 1996; Bruhn 1995; Fox et al. 1996; Fox et al. 1998; Frenzen et al. 2000; Hashim, Resurreccion, and McWatters 1995; Henson 1995; Resurreccion, et al. 1995; Sapp, Harrod, and Zhou 1995). The ranges of projected consumer rejection vary greatly from about 10 percent up to 53 percent. Findings from one study have shown, however, that perceptions are influenced by information regarding irradiation provided to consumers, with educational slide shows or posters having a positive effect (Hashim, Resurreccion, and McWatters 1995). A study conducted by the USDA and other agencies suggests that about 47 percent of consumers would be willing to purchase irradiated ground beef (Frenzen et al. 2000). However, only about 23 percent would be willing to pay a premium for irradiated meat or poultry products. Findings from the study also showed that a large portion of consumers had never heard of irradiation and felt they had insufficient information about

risks and/or benefits. Some food retailers have introduced irradiated ground beef only to withdraw it due to lack of consumer interest (Herzog and Daykin 2000). Hinson, Harrison, and Andrews (1998) found that consumers familiar with irradiation were significantly more likely to buy and pay more for irradiated products than were those who had never heard of irradiation. The findings from these studies suggest that consumer education could be key to acceptance of irradiated meat products.

Study Objectives

The objective of this study is to assess meat managers' expectations about the impact of the recent regulatory approval of irradiated raw meat and meat products on marketing decisions and plans by supermarkets and grocery meat retailers. Specific goals of the study are to ascertain:

- when and if meat managers believe irradiated red meat products will be sold by their stores,
- what percentage of their stores' red-meat sales they project as irradiated after five years,
- what irradiated meat products the managers' believe might be marketed first,
- whether they believe an irradiated meat product will likely be sold as a branded product at a higher price or an unbranded product at a price comparable to the non-irradiated product, and
- expectations of managers regarding potential costs and benefits from selling irradiated red-meat products.

Differences in expectations about selling irradiated red meats and marketing plans are examined across type of retailer, including independent, regional chain, or national chain. Differences in expectations of pricing/branding strategies and of potential costs and benefits from selling irradiated red meat products are examined across type of retailer, education level of the meat manager, and experience level in the food retail industry.

Data and Methodology

In the summer of 2001, 40 Knoxville, Tennessee-area grocery retailers were surveyed about marketing decisions for irradiated raw meat and meat products. The survey was aimed at managers of meat departments in area grocery stores and supermar-

kets. The meat-department managers were interviewed in person. Respondents were assured their participation was voluntary and that individual responses would be kept confidential. The managers were employed by several types of retailers, including national chains (47.5 percent), regional chains (20.0 percent), and local independent stores (32.5 percent).

The survey was composed of three parts and took twenty to twenty-five minutes to complete. The first section of the survey addressed existing and expected marketing plans for irradiated meat, and included questions about when or if irradiated red-meat products would be adopted in grocery retail stores, at what level the marketing decision would be made, and how the irradiated products might be merchandised. This section also contained questions about whether or not information about irradiation had been provided to the meat managers by their employers. The second part of the survey contained questions about meat managers' views regarding the potential costs and benefits of irradiation. The third section of the survey included questions about store and manager characteristics. This section included the type of retailer (national, regional, or independent), years of experience of the meat manager, and level of education of the meat manager.

The results are summarized with means and percentages. Throughout this document, "N" represents the number of responses to a particular question. Multiple means comparison tests are conducted using an F-statistic to test for overall differences in means from a Generalized Linear Model (GLM). When differences among the means across the variable (for example, differences in projected mean share of irradiated meats across retailer type) are found, t-tests are then conducted to compare means. The calculated F, from the GLM, is

$$F = \text{Model Mean Square} / \text{Error Mean Square}$$

and is compared with the table value for the 95%-confidence interval ($\alpha=.05$) for $k-1$ and $n-k-1$ degrees of freedom. To control for experiment error, individual means are only compared when the overall F-statistic indicates differences among the means. When two means are compared, the t-test is calculated as

$$\left| \bar{y}_1 - \bar{y}_2 \right| / \sqrt{s^2 (1/n_1 + 1/n_2)},$$

When there are more than three means to be compared, the Bonferroni inequality is used to control the comparison error rate. Bonferroni t-tests are calculated as

$$\left| \bar{y}_i - \bar{y}_j \right| / s \sqrt{1/n_i + 1/n_j} \geq t(\varepsilon; v)$$

where $\varepsilon = \alpha/(k(k-1)/2)$ for comparison of k means (Miller 1981).

A chi-square statistic is used to test for association between row and column variables in a frequency table (i.e., type of irradiated meat product to be sold first and type of retailer). The Pearson chi-square statistic is calculated and compared with the table value with (number of rows-1)(number of columns-1) degrees of freedom at $\alpha=.05$:

$$Q_p = \sum_i \sum_j (n_{ij} - m_{ij})^2 / m_{ij}$$

where m_{ij} = row total*column total/n and n_{ij} = the cell frequency in the i^{th} row and j^{th} column (Fienberg 1977).

Results

Existing and Expected Marketing Plans for Irradiated Meat

None of the responding meat managers said that irradiated meat products (red meat, poultry, or pork) were currently being sold in their stores (N=40). Most (97.5 percent) also stated that they did not believe any other stores within their company or any area stores run by other companies were currently selling irradiated meat products. Ninety-five percent said their companies had not provided information to their stores on the subject of irradiated meats. Table 1 summarizes these responses.

As shown in Table 2, none of the responding meat managers expected irradiated meat products to be carried by their stores in the next six months, and only a small percentage expected them to be carried in the next year. Most expected them to be carried in three years or more. Twenty-five percent did not believe their stores would ever carry irradiated meat products. While 50 percent of regional chain retailers believed their store would never carry irradiated meat products, only 7.7 percent of independents believed their stores would never carry the products. Due to some categories containing no

Table 1. Current Sales of Irradiated Meat Products (Red Meat, Poultry, or Pork) (%).

Question	Yes	No	Don't Know
Does your store currently sell any irradiated meat products—red meat, poultry, or pork?	0.0	100.0	0.0
Does any other store within your company currently sell irradiated meat products—red meat, poultry, or pork?	0.0	97.5	2.5
Does any area store run by other companies currently sell any irradiated meat products?	0.0	97.5	2.5
Has your company provided any information to its stores on the subject of irradiated red meats?	5.00	95.00	0.0

Table 2. Expectations Regarding When Store Will Carry an Irradiated Meat Product, by Retailer Type (%).

Time Frame	Overall (N=40)	Independents (N=13)	Regional (N=8)	National (N=19)
In the next six months	0.0	0.0	0.0	0.0
In the next year	2.5	0.0	0.0	5.26
In the next three years	35.00	38.46	37.50	31.58
More than three years from now	37.50	53.85	12.50	36.84
Never	25.00	7.69	50.00	26.32

Table 3. Projected Percent of Red Meat Sales That Will be Irradiated in 5 Years, by Retailer Type.

Statistic	Overall (N=23)	Independents (N=8)	Regional (N=4)	National (N=11)
Mean projected percent of red meat sales that will be irradiated in 5 years	26.52	25.00	28.75	26.82
F-Statistic	.03			

Table 4. Irradiated Red Meat Product Likely to Be Sold First, by Retailer Type (%).

Irradiated Red-Meat Product Likely to be Sold First	Overall (N=23)	Independents (N=8)	Regional (N=4)	National (N=11)
Ground beef	82.61	100.0	75.00	72.73
Other	17.39	0.0	25.00	27.27

responses, a chi-square test of association was not conducted for the data in Table 2.

When asked if someone within their store would be responsible for making decisions about buying and selling irradiated red meat or other irradiated meat products, 27.50 percent stated someone would, while 72.50 stated that someone outside their store would make the decisions. When asked whom the meat managers expected would make decisions about buying and selling irradiated meats, the most common responses were the president, vice president, owner, district manager, or meat director.

As indicated in Table 2, about 25 percent indicated that their stores would never sell irradiated meats. Among those indicating they would sell irradiated meats at some time, the projected percentage of the store's meat sales after five years that would be irradiated was 26.52 percent (Table 3). As indicated by the F-statistic, no significant differences were found in the projected percents across type of retailer.

Of those managers indicating their stores would sell irradiated red meats at some point in the future, 82.61 percent predicted they would sell irradiated ground beef first, while 17.39 percent would sell irradiated steaks, roast, or other products first (Table 4). All the meat managers in independent stores stated their stores would most likely sell irradiated ground beef first, while 75 percent of the managers at regional stores and 72.73 at national stores stated they would sell irradiated ground beef first. All stated that their stores would provide extra product information if irradiated ground meat was sold.

A majority of managers (69.57 percent) said they believed that irradiated ground beef would be sold as an unbranded product at a price comparable to regular ground beef, while only 30.43 percent said they believed the store would sell irradiated ground beef as a branded product at a significantly higher price than regular ground beef (Table 5). While 75 percent of the managers at the independent retailers said their stores would likely sell ir-

Table 5. Branding and Pricing Strategies for Irradiated Ground Beef, by Retailer Type (%).

Branding and Pricing Strategy	Overall (N=23)	Independents (N=8)	Regional (N=4)	National (N=11)
Branded and at a higher price than regular ground beef	30.43	25.00	0.00	45.45
Not branded and at a price comparable to regular ground beef	69.57	75.00	100.00	54.55

Table 6. Branding and Pricing Strategies for Irradiated Ground Beef, by Education and Experience Level (%).

Branding and Pricing Strategy	Education Level		Experience Level	
	Some College or Greater (N=8)	No College (N=15)	15 Years or More (N=13)	Less Than 15 Years (N=10)
Branded and at a higher price than regular ground beef	12.50	40.00	46.15	10.00
Not branded and at a price comparable to regular ground beef	87.50	60.00	53.85	90.00
Chi-square test	1.8636		3.4895*	

* Significant association at the 95-percent-confidence level.

radiated ground beef as an unbranded product, all the managers at regional stores indicated irradiated ground beef would be sold as an unbranded product. Nearly 55 percent of the managers at national chains said irradiated ground beef would be sold as an unbranded product.

The perceptions of the meat managers regarding branding and pricing strategies for irradiated ground beef across education and experience levels are summarized in Table 6. While no differences in perceptions about strategies were found across education level, differences were found across experience level. The meat managers with less than 15 years of experience in food retailing were much more likely than were more experienced meat managers to believe that irradiated ground beef would be sold as an unbranded product at a price comparable to non-irradiated ground beef.

Meat Managers' Expectations of and Opinions About the Benefits and Costs of Irradiation

The mean ratings of managers' expectations of and opinions about irradiation of red meat are presented in Table 7. Managers agreed with the statement that

they expected the irradiation process to substantially increase the shelf life of irradiated red-meat products and reduce spoilage. The second-most agreed with statement was that their stores would have to pay a higher price from meat-packing companies for irradiated meat products than for similar non-irradiated meat products.

Managers disagreed most with the statement that customers in their stores would be willing to pay a much higher price for an irradiated red-meat product. The managers had statistically equivalent opinions about the effects of irradiation on shelf life and having to pay a higher price for irradiated products. Fewer were in agreement with the statements about potential cost or time savings or profitability that might result from irradiation of red-meat products.

The mean ratings of managers' expectations of and opinions about irradiation of red meat across type of retailer are presented in Table 8. The F-statistics did not reveal any significant differences in opinions across type of retailer.

The mean ratings of managers' expectations of and opinions about irradiation of red meat across type of retailer across education and experience

Table 7. Managers' Expectations of and Opinions About Irradiation of Red Meats.

Expectations of and Opinions about Irradiation of Red Meats	Mean Opinion Rating (1=strongly disagree, ..., 5=strongly agree) (N=40)
I expect the irradiation process to substantially increase the shelf life of irradiated red-meat products and reduce "spoilage."	3.85 ^a
I expect my store will have to pay a higher price from meat-packing companies for irradiated meat products than for similar non-irradiated meat products.	3.73 ^{a,b}
I expect substantial cost savings due to the increased shelf life of irradiated red-meat products.	3.35 ^{b,c}
I would rate the potential benefits to food retailers' profitability from carrying irradiated meat products as extremely high.	3.32 ^{b,c}
I expect that offering an irradiated red-meat product will result in substantial time savings in the meat department.	3.18 ^c
Customers in my store would be willing to pay a much higher price for an irradiated red-meat product compared to the non-irradiated version.	1.73

Note: Means with like letters beside them indicate no significant difference at the 95-percent-confidence level.

levels are displayed in Table 9. As indicated by a significant t-statistic, the managers with at least some college or higher education levels did not agree as strongly with the statement that their stores will have to pay a higher price from meat-packing companies for irradiated meat products than did the managers with a high school degree or less in education. However, managers with a college education or higher felt more positively about the potential profitability from carrying irradiated meat products than did those meat managers with a high school degree or less in education. No significant differences in opinions about effects of irradiation on shelf life, potential cost savings, time savings, or beliefs about consumers' willingness to pay were found across education level. Also, as shown in Table 9, no differences in expectations of or opinions about irradiation of red meats were found across experience level in the food retailing industry.

Conclusions

The results from this study suggest that most meat managers in the Knoxville area believe that their retail chains will not sell irradiated red meats within the next year. The meat managers also predict that irradiated meats will constitute just over a quarter of red-meat sales five years forward. These views about current and future marketing plans for irradiated meats did not appear to be influenced by whether the meat manager worked for an independent grocery store or for a regional or national chain. Irradiated ground beef appears to be the product that most of the meat managers believed would be sold by their stores first. Interestingly, more-experienced meat managers felt that the irradiated ground beef would be sold as a branded product at a higher price than non-irradiated ground beef (as, for example, with some organic or lean meats), while less-experienced meat managers believed it

Table 8. Managers' Expectations of and Opinions About Irradiation of Red Meats, by Retailer Type.

Expectations of and Opinions about Irradiation of Red Meats	Independent (N=13)	Regional (N=8)	National (N=19)	F-Statistic
	Mean Opinion Rating (1=Strongly Disagree, ..., 5=Strongly Agree)			
I expect the irradiation process to substantially increase the shelf life of irradiated red-meat products and reduce "spoilage."	3.46	4.13	4.00	2.12
I expect my store will have to pay a higher price from meat-packing companies for irradiated meat products than for similar non-irradiated meat products.	3.38	3.75	3.95	.60
I expect substantial cost savings due to the increased shelf life of irradiated red-meat products.	3.23	3.63	3.32	.34
I would rate the potential benefits to food retailers' profitability from carrying irradiated meat products as extremely high.	3.62	3.75	3.11	.80
I expect that offering an irradiated red-meat product will result in substantial time-savings in the meat department.	3.23	3.75	2.89	1.05
Customers in my store would be willing to pay a much higher price for an irradiated red-meat product compared to the non-irradiated version.	1.46	1.88	1.84	.72

would be sold as an unbranded product at a price comparable to the non-irradiated ground beef. While many of the meat managers believed that irradiation would increase shelf life and reduce spoilage, they were less optimistic about consumers being willing to pay a higher price for the irradiated product than for the non-irradiated product. However, meat managers' expectations appeared to depend on their education level. For instance, more-educated meat managers did not believe that their store would have to pay a higher price from meat packing companies for irradiated meat products. Also, meat managers with higher education levels

expected that the potential benefits to food retailers' profitability from carrying irradiated meat products would be higher than did less-educated meat managers.

References

- Andress, E., K. Delaplane, and G. Schuler. 2000. *Food Irradiation*. Cooperative Extension Service, Institute of Food and Agricultural Sciences. University of Florida.
- Bailey, William C. 1996. "Comparative Study of the Willingness to Pay for Organic and Irradi-

Table 9. Managers' Expectations of and opinions about Irradiation of Red Meats, by Education and Experience Level.

Expectations of and Opinions about Irradiation of Red Meats	Education		Experience Level			
	Some Greater College or (N=15)	No College (N=25)	T Statistic	15 Years or More (N=13)	Less Than 15 Years (N=10)	T Statistic
Opinion Rating (1=strongly disagree, ..., 5=strongly agree)						
I expect the irradiation process to substantially increase the shelf life of irradiated red-meat products and reduce "spoilage."	4.00	3.76	-0.85	3.95	3.74	-0.78
I expect my store will have to pay a higher price from meat-packing companies for irradiated meat products than for similar non-irradiated meat products.	3.07	4.12	2.42*	3.90	3.53	-0.84
I expect substantial cost savings due to the increased shelf life of irradiated red-meat products.	3.67	3.16	-1.46	3.33	3.37	0.10
I would rate the potential benefits to food retailers' profitability from carrying irradiated meat products as extremely high.	3.87	3.00	-2.53*	3.24	3.42	0.51
I expect that offering an irradiated red-meat product will result in substantial time-savings in the meat department.	3.20	3.16	-0.09	3.24	3.10	-0.29
Customers in my store would be willing to pay a much higher price for an irradiated red-meat product compared to the non-irradiated version.	1.93	1.60	-1.06	1.57	1.89	1.07

* Significant association at the 95-percent-confidence level.

- ated Meat Products: An Experimental Design." *Consumer Interests Annual* 42:407-410.
- Bogart, S. and N. Tolstum. 1999. "Economic Aspects of Cold Food Pasteurization." In *Proceedings of the 1999 Particle Accelerator Conference*, A. Luccio and W. MacKay, eds. Institute of Electrical and Electronics Engineers, New York. 603-605.
- Bruhn, C. M. 1995. "Consumer Attitudes and Market Response to Irradiated Food." *Journal Food Protection* 58:175-181.
- Derfler, P. 2000. *FSIS Directive 7700.1*. Washington D.C.:U.S. Department of Agriculture, Food Safety Inspection Service, March 7.
- Engeljohn, D. 1999. *Irradiation of Meat and Meat Products*. U.S. Department of Agriculture, Food Safety and Inspection Service (USDA/FSIS), February 25.
- Epstein, V. 2001. "Stringent Rules Follow Recall at Dakota City, Neb. Meat Packer." *Omaha World-Herald* September 5.
- Fienberg, S. 1977. *The Analysis of Cross-Classified Data*. MIT Press, Cambridge.
- Fox, J., D. Hayes, J. Shogren, and J. Klieberstein. 1996. "Experimental Methods in Consumer Preference Studies." *Journal of Food Distribution Research* 27:1-7.
- Fox, J., J. Shogren, D. Hayes, and J. Klieberstein. 1998. "CVM-X: Calibrating Contingent Values with Experimental Auction Markets." *American Journal of Agricultural Economics* 80:455-465.
- Frenzen, P., A. Majchrowicz, J. Buzby, and B. Imhoff. 2000. "Consumer Acceptance of Irradiated Meat and Poultry Products." *Issues in Food Safety Economics*. U.S. Department of Agriculture, Agricultural Information Bulletin No. 757.
- Gay, L. 2001 "Irradiation Labels on Meat May Be Revised." *The Milwaukee Journal Sentinel* August 26.
- Hashim, I., A. Resurreccion, and K. McWatters. 1995. "Consumer Acceptance of Irradiated Poultry." *Poultry Science* 74:1287-1294.
- Henson, S. 1995. "Demand-Side Constraints on the Introduction of New Food Technologies: The Case of Food Irradiation." *Food Policy* 20:111-127.
- Herzog, K. and T. Daykin. 2000. "Irradiated Beef Starting to Show Up in State Groceries." *Milwaukee Journal Sentinel* August 1.
- Hinson, R., W. Harrison, and L. Andrews. 1998. "Impact of Socio-Economic Characteristics on Attitudes Toward Food Irradiation." *Journal of Food Distribution Research* 29:3.
- Kaye, R. and B. Turman. 1999. "Issues for Bringing Electron Beam Irradiators On-Line." Paper presented at *Food Irradiation Conference*, Washington, D.C., May 12-14.
- Lutter, R. 1999. *An Analysis of the U.S. Department of Agriculture's Proposal to Allow Irradiation of Meat*. AEI-Brooking Joint Center for Regulatory Studies. July.
- Miller, R. 1981. *Simultaneous Statistical Inference*. Springer-Verlag, New York.
- Resurreccion, A., F. Galvez, S. Fletcher, and S. Misra. 1995. "Consumer Attitudes Toward Irradiated Food: Results of a New Study." *Journal of Food Protection* 58:193-196.
- Sapp, S., W. Harrod, and L. Zhoa. 1995. "Social Demographic and Attitudinal Determinants of Consumer Acceptance of Food Irradiation." *Agribusiness* 11:117-130.
- Thomas, C. and M. Stauber. 1997. *Policy Statement on Food Safety*. Biology and Medicine Division and Isotopes and Radiation Division, American Nuclear Society. <http://www.wsu.edu/~rfileby/foodirr.html>.