To the Graduate Council

I am submitting herewith a thesis written by Joseph M. Gaynor Jr. entitled "Meat Managers' Expectations Regarding Marketing of Irradiated Red Meat." I have examined the final paper copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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Meat Managers' Expectations Regarding Marketing of Irradiated Red Meat

A Thesis
Presented for the
Master of Science Degree
The University of Tennessee

Joseph M. Gaynor Jr.
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Dedication

I dedicate this thesis to my family:

Joseph Sr., Melody, Lacy, Philip, and Mellisa

for standing beside me through the good, the bad,

the ugly, and helping in ways many will never know.

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Abstract

To reduce the health risks associated with food borne pathogens, on December 15, 1999, the United States Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS) approved the sale of irradiated uncooked red meat products (USDA/FSIS, 2001). In spite of this policy change, many food retailers have not started selling irradiated red meat products. This study examines grocery retail meat managers' expectations regarding if and when their store will likely market irradiated red meat and potential marketing strategies. 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. The managers' profitability expectations of selling irradiated red meats are examined, along with possible influences on these expectations. Possible influences on profitability expectations include education of the meat manager, store type, familiarity with legal regulatory requirements, views on potential risks to environment and health, potential benefits of shelf-life extension, potential time-savings, and their beliefs about how consumers may react to irradiated products. Data to conduct the study were obtained through in-person interviews of 40 Knoxville area managers of grocery retail meat departments during the summer of 2001.

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CHAPTER I

INTRODUCTION

Background

Illnesses from food borne pathogens substantially impact the nation's health care costs, both through increased medical care and lost productivity. The estimated total annual cost of medical care and lost productivity caused by food borne illness ranges between 5.6 and 9.4 billion dollars in 1993 (Buzby and Roberts, 1996). To reduce these types of health risks, on December 15, 1999, the United States Department of Agriculture Food Safety and Inspection Service (USDA/FSIS, 2001) approved the sale of irradiated uncooked red meat products.

In spite of this policy change, many food retailers have not taken full advantage of the new rule. On the day the new rule became effective, May 15, 2000, the *Wall Street Journal's* Richard Gibson wrote, "In the next few weeks several retailers – including giant Wal-Mart Stores Inc. (WMT) – will begin selling frozen hamburger patties that have been zapped to kill harmful bacteria and other pathogens." In addition to Wal-Mart, companies currently participating in test markets include: Carrot Top, Hy-Vee, DeLoach's Meat Market, Rainbow Foods, Roundy's Inc., Save-Mart, Pick 'n' Save, Wyndle's Foodland (Oder, 2001; Herzog and Daykin, 2000; and Bruhn, 2000). These test markets cover relatively few geographic areas: the Twin Cities, MN; Milwaukee, WI; Lincoln, NE; Northbrook, IL; Des Moines, IA; West Bend, WI; Oklahoma City, OK; Modesto, CA; and Fort Lauderdale, FL (Oder, 2001). The companies conducting these test markets range from large companies like Wal-Mart, to regional grocers like Pick 'n'

Save, down to 'mom and pop' grocers such as DeLoach's Meat Market in Lake Land, FL (Lore and Souhrada, 2000; Herzog and Daykin, 2000; Gibson, 2000). While companies have initiated customer trial markets, no company has yet made a nation-wide commitment to the sale of irradiated meats.

Many companies not participating in test markets suggest that consumer acceptance will be low, implying an insufficient market for irradiated food products (Henkel, 1998; Lutter, 1999). However, findings from consumer surveys have suggested that a majority of consumers would accept irradiated meats and other foods (Frenzen *et al.*, 2000; Olson, 1998; and Bruhn, 1995). With so few major retailers test marketing irradiated products, this raises the question: why have most major food retailers avoided the use of irradiated meat in their meat departments? While a number of studies have examined consumers' perceptions, no studies have examined meat managers' views on irradiated meat products. This research evaluates grocery retail meat managers' expectations regarding marketing of irradiated uncooked red meat products. Knoxville-area retailers were surveyed in-person about their knowledge of meat irradiation and expectations regarding their store's plans to market irradiated red meat. The study examines potential marketing strategies (especially those concerning labeling and price) for irradiated meat. The study also examines meat managers' profitability expectations for irradiated red meats.

Commercial Use of Irradiation Technology

Currently, irradiation technologies are used to sterilize many household products. For example, Band-Aids, cotton balls, contact lens solution, baby pacifiers, cosmetics, wool, surgical gloves, and a host of medical instruments use irradiation for sterilization.

Between 1983 and 1992, bulk dried spices were about the only food products that were irradiated on a large scale in the United States. In 1992, irradiated produce started selling in supermarkets, and by 1995, annual irradiated tropical fruit sales amounted to more than 200,000 pounds. Irradiation has been approved for the use in a number of food product markets, including wheat in October 1963, white potatoes in August 1964, spices and vegetables seasoning in July 1983, fresh pork in 1985, fresh fruits in April 1986, fresh poultry in September 1992, and fresh or frozen red meat in 1999 (Olson, 1998; and Bruhn, 2000).

Currently, there are three technological processes by which food products can be irradiated. Gamma ray treatment entails running the food though a machine that is designed to expose the product to radioactive elements such as Cobalt-60 or Cesium-137. The gamma ray technique has the ability to penetrate thick products. The drawback to this procedure, however, is that after the radioactive elements go though their life cycle, they leave radioactive waste for which disposal involves major costs and also raises issues of public safety. Electron beam treatment, the second process, requires running the product though a device that produces electrons from a heated filament sitting inside a vacuum tube. This treatment delivers more irradiation per second than the gamma ray treatment, but its short-coming is that it penetrates the surface of the product to only about an inch and a half. It is less expensive than the gamma ray treatment and does not require disposal of radioactive waste. Lastly, food can be irradiated with X-rays. The X-ray treatment, which is similar to the electron beam but uses more energy, can penetrate much deeper than the electron beam (Skerrett, 1997).

The New USDA/FSIS Regulations

Several requirements and guidelines for irradiating red meats are outlined in the USDA rule allowing irradiation of meat products. Meat and poultry products may be irradiated to reduce food borne pathogens and to extend product shelf-life by the use of sources of ionizing radiation using the three methods described above. Establishments irradiating meat and poultry products must do it in accordance with a Hazard Analysis and Critical Control Point (HACCP) system. Dosimetry, which is an accurate measurement of doses of radiation, must meet a number of calibrations, effective, consistency, and safety requirements. Safety operations of an irradiation facility must be properly documented.

Special-labeling requirements for irradiated meat products must be met, under the new regulations. Labels on the packages of meat and poultry products irradiated in their entirety must bear the radura logo shown in Figure 2.1 (Appendix 1). Unless the word "irradiated" is part of the product name, labels also must bear the statement "treated with radiation." The logo must be used in conjunction with the required statement (treated with irradiation), if the statement is used. The statement is not required to be more prominent than the declaration of ingredients. Any label bearing the logo or any wording of explanation with respect to this logo must be approved by the Food Safety Inspection Service (FSIS) (Derfler, 2000).

For meat or poultry products that have been irradiated in their entirety, but are sold in packages (such as products in the meat case, for example), the required logo must be displayed to the purchaser with either the labeling of the bulk container plainly in view or a counter sign, card, or other appropriate device bearing the information that the

product has been treated with radiation. In either case, the information must be prominently and conspicuously displayed to purchasers. 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 that there have been specific reductions in microbial pathogens must be substantiated by proper documentation (Derfler, 2000). A copy of the irradiation regulations concerning labeling is found in Appendix 5.

Study Objectives and Data

The objectives of this study are to assess meat managers' expectations about impacts of regulatory approval of irradiated raw meat and meat products on marketing decisions and plans by supermarkets and grocery meat retailers and to ascertain managers' expectations of the profitability potential of irradiated red meats. Specific goals of the study are to ascertain:

- when and if meat managers believe irradiated red meat products will be sold in 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,
- expectations of managers regarding potential costs and benefits from selling irradiated red meat products, and
- influences on the profitability expectations for irradiated red meat products, such as meat manager and store characteristics, meat manager familiarity with irradiation, opinions regarding irradiation, and views regarding customer perceptions.

The data to conduct the study were gathered through in-person interviews of Knox County area supermarket and grocery retail meat managers. The interviews were conducted during the Summer of 2001. The design and implementation of the survey were done according to guidelines provided by the survey design literature (Dillman, 1978; Fowler, 1984; and Fink and Kosecoff, 1985; Yin, 1994). A small pretest of four surveys was conducted to see if any portions of the survey were difficult to understand or needed to be modified. Based on the pretest results, the survey was finalized. A copy of the final survey is found in Appendix 4.

This thesis follows a two-article document format. Prior to presenting the two articles, a review of the literature will be presented in Chapter II. A copy of the first article entitled "Meat Managers' Expectation Regarding Marketing of Irradiated Red Meats," is presented in Chapter III. A copy of the second article entitled "Retail Meat Managers' Profitability Expectations for Irradiated Red Meats," is then presented in Chapter IV. A discussion of overall conclusions and their implications is presented in

Chapter V. The Appendices contain all figures and tables, a copy of the survey instrument, and the USDA/FSIS irradiation regulations concerning labeling requirements.

CHAPTER II

LITERATURE REVIEW

This chapter presents findings from the literature of relevance to marketing of irradiated meat products. The three main topics are: (1) Costs of Food Borne Illness, (2) Consumer Acceptance of Irradiated Foods, and (3) Marketing Practices for New Meat Products.

Cost of Food Borne Illness

Many health experts say that using food irradiation is a safe way to reduce food borne pathogens and harmful organisms in the food supply (Henkel, 1998). Irradiation techniques have the capability to kill harmful bacteria, parasites, and viruses such as: *Campylabacter*, *Clostridium botulinum*, *Cycolospora*, *Escherichia coli* O157:H7, *Hepatitis A*, *Salmonella*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Toxoplasma gondi*, and a host of other harmful microorganisms (Thomas and Stauber, 1997).

Illnesses from food borne pathogens substantially impact the nation's health care cost. According to Buzby and Roberts, the estimated total annual cost of medical care and lost productivity caused by food borne illness ranges between 5.6 and 9.4 billion dollars. Moreover, Buzby and Roberts say these amounts undervalue the true cost of food borne illness to the world at large because they omit the cost of pain and suffering, use conservative estimates of statistical value of human life, and do not include chronic complications associated with food borne pathogens.

Not only is there a cost to the final consumer, but costs of these types of outbreaks can spell financial disaster for food companies. For example, Hudson Foods was shutdown by the USDA in October of 1997, after *E-coli* was discovered in their hamburger. In November of the same year, Tyson Foods bought out Hudson Foods, because of the mounting debts due to the outbreak (Hughes, 1997). In the aforementioned examples, irradiation of products, such as ground beef, could potentially have reduced the incidence of food borne illness and the financial consequences to the meat packers.

Currently, the estimated cost for irradiation per pound of meat is half to six cents (Engeljohn, 1999). It is expected that as irradiated products become more accepted that the cost of irradiation will drop due to economies of scale (Andress *et al.*, 2000). In addition to reducing food borne illness, other benefits from irradiated red meat products are shelf-life extension and reduced spoilage (Buzby and Morrison, 1999).

Consumer Acceptance of Irradiated Foods

Frenzen *et al.* (2000), Bruhn (*et al.* 1986 and 1995), Resurreccion *et al.* (1995), and Huang *et al.* (1998) all conducted surveys that examined consumers' perceptions of irradiated products. In 1987, Huang *et al.* found that fruits treated with irradiation reduced demand by 23 percent. However, according to three recent surveys, 50 to 80 percent of consumers state they are willing to buy irradiated foods (Frenzen, 2000; Bruhn, 1995; and Resurreccion *et al.*, 1995). While results from Bruhn's 1995 survey showed 67 percent of consumers thought it was 'appropriate' to irradiate poultry; slightly fewer consumers deemed it 'appropriate' to irradiate pork and beef.

Surveys and test markets (Bruhn, 1986 and 1995; Resurreccion, *et al.*, 1995; and Huang *et al.*, 1987) have shown that consumers' willingness to purchase irradiated food climbed from 50 percent to 80 percent over the period from 1986 to 1995, but in recent years has faltered (Figure 2.4: Appendix 1).[1] From 1996 to 1999, willingness to purchase fell from approximately 70 percent to 55 percent. Frenzen *et al.* link this decline to a substantial increase in the news stories about food irradiation (Figure 2.5: Appendix 1), which took place during the approval process of the new FSIS raw meat rule. Frenzen *et al.* cite lack of knowledge to be a large reason for this type of decline.

As displayed in Tables 2.1 and 2.2 (Appendix 1), Frenzen *et al.*, give reasons why irradiated products may not sell as well as non-irradiated products. For example, 22.7 percent of consumers were willing to purchase irradiated beef at a premium, while 24.5 percent were willing to purchase irradiated chicken at a premium (Table 2.1). The information in Table 2.2 suggests that "insufficient information," "safety concerns," and "irradiation doesn't make the food safer" are among the leading reasons why consumers do not buy irradiated products (Frenzen, 2000).

Fox *et al.* (1996 and 1998), and Bailey (1996) both conducted "consumers' willingness to pay" experiments to evaluate potential prices for irradiated products. They found that consumers were willing to pay between 70 and 90 cents to exchange a non irradiated pork and chicken sandwich for an irradiated one. Fox *et al.* (1996 and 1998) and Bailey (1996) cite age, education level, and perceived risks as the major factors affecting the willingness to pay estimates. For example, Fox *et al.* found that age

[1] Shoppers were asked how likely they were to buy foods that had been irradiated to kill germs and keep food safe.

adversely affected adult consumers' willingness to pay estimates, and in test groups as many as 73% were willing to pay to avoid a treated sandwich (1998). However, Bruhn *et al.* found that after giving consumers information about irradiation, 71 percent of consumers actually bought irradiated beef (1986).

The results from these studies indicate information and education were important for consumer acceptance of irradiated red meat. Others reinforcing this conclusion are Ytuarte and Torno. The success of irradiated red meat will likely be reliant on the steps in educating the average consumer (Ytuarte, 2000) and a strong information campaign (National Provisioner, 2001).

Marketing Practices for New Meat Products

While the supermarket industry is a key outlet market for the meat industry, the nature of meat products marketing is changing, moving increasingly toward branded products. For example, Tyson, Iowa Beef Packers (IBP), and a host of other meat brands now exist (Roger, 2001). As individual companies begin branding products, certain responsibilities shift from retailer to the processor. Twenty years ago, for example, the butchering and packaging of chicken were treated as beef is today. But as Tyson and other companies began branding, processors took on these responsibilities (cutting and final packaging). Supermarkets' meat departments now can operate with much fewer butchers because of the time saved by simply putting out a prepackaged product (Whitehurst, 2000). The fact that the industry is moving toward branded products, suggests that irradiated red meats may be sold primarily as branded products.

Because irradiation of meat products is relatively new, it is unclear how retailers' marketing strategies will compare to those of the previous meat product introductions. A key question is how closely an irradiated product will substitute for a non-irradiated product.

Analysis of a similar product introduction such as low fat ground beef (LFGB) may help answer this question. Brester *et al.* states that the introduction of LFGB will affect the supply and demand for all ground beef (1993). Taken from Brester *et al.*, Figure 2.2 (Appendix 1) represents the market supply and demand curves for all ground beef products at the retail level. Before the introduction of LFGB, D_0 represents market demand curve for all ground beef products, and S_0 represents the market supply curve of ground beef. Assuming that consumers value reductions in fat content of ground beef, the introduction of LFGB shifts the market demand curve of all ground beef products from D_0 to D_1. Because LFGB is more expensive to produce than other ground beef products, the market supply curve will also shift from S_0 to S_1. These shifts generate a new equilibrium that is represented by E_1, which will produce a higher price than the original. However, the direction of the change in the equilibrium quantity is ambiguous and depends upon the relative magnitudes of the demand and supply shifts. Brester *et al.* say the size of the demand shift caused by the introduction of LFGB depends upon several factors: (a) the overall acceptance of LFGB by consumers, (b) the quantity of the ground beef substituted for other meat or non-meat products, and (c) the amount of substitution among ground beef products.

Brester *et al.* develop a structural model to estimate price, quantity, and welfare effects and estimate the impact of LFGB on retail demand, supply, prices, and quantities.

Their results may shed light on the types of marketing tactics that are feasible for irradiated meat products. Perhaps the most relevant result for new irradiated products was that consumer acceptance of LFGB was the primary factor determining the demand shift. They also found by increasing the quality of certain attributes, such as leanness and palatability, this "new product" can carry a price premium. If consumers believe irradiation of red meat products is increasing quality of the products by the removal of harmful food borne pathogens, then the irradiated red meat products could carry a price premium over the non-irradiated products.

Mowen (1990), Servi (1990),and Kotler and Armstrong (1996) analyze new product development strategies from a marketing perspective. Several marketing strategies may be pertinent for irradiated meat. A "premium pricing strategy" involves charging a high price for a high-quality product. A "good-value pricing strategy" entails setting a lower price (but above production costs) for a high-quality product. Targeted profits are much lower than the premium pricing strategy. An "overcharging pricing strategy" uses a higher price for a lower-quality product to recover moneys lost to production costs. Finally, an "economy pricing strategy" prices a lower-quality product at a low price in hopes that the sales volume will recover production costs. Figure 2.3 (Appendix 1) illustrates the relationship between price, quality, and each strategy (Kotler and Armstrong, 1996). A number of studies provide mixed results regarding whether consumers would pay a premium for irradiated red meats (Frenzen et al., 2000; Fox et al., 1996 and 1998). However, irradiated red meats were introduced in the Minneapolis area at a premium (two pound box at a price of $4.99, 60 cents higher than non-irradiated

ground beef) and were marketed as branded products (under the Huisken and Taste Club labels) (Smith, 2000).

CHAPTER III

MEAT MANAGERS' EXPECTATIONS REGARDING MARKETING OF IRRADIATED RED MEATS

Background

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

Although a large share of meat, in particular 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. Industry concerns have been expressed 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 lead 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 2.1, Appendix 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 (treated with irradiation), if the statement is used. 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 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).

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). It is anticipated if irradiated products become more accepted, the cost of irradiation will drop due to economies of scale (Andress *et al.*, 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 and perceptions of irradiated foods (Bailey, 1996; Fox *et al.*, 1996; Frenzen *et al.,* 2000; Hashim, Resurreccion, and McWatters, 2000; Henson, 1995; Resurreccion, *et al.*, 1995; Sapp, Harrod, and Zhoa, 1995). The ranges of projected consumer rejection vary greatly from about 10 percent up to over 50 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, 2000). A study conducted by the Center for Disease Control 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 them due to lack of consumer interest (Herzog and Daykin, 2000). Hinson, Harrison, and Andrews found that consumers familiar with irradiation were significantly more likely to buy and pay more for irradiated products than those who had never heard of irradiation (1998). 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 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 grocery store, including independent, regional chain, or national chain. Also, differences in expectations about pricing/branding strategies and of potential costs and benefits from selling irradiated red meat products are examined across type of grocery store, including independent, regional chain, or national chain.

Data and Methodology

In the summer of 2001, 40 Knoxville, Tennessee area grocery retailers were surveyed regarding marketing decisions for irradiated raw meat and meat products. The survey was aimed at managers of meat departments in area grocery stores and supermarkets. 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 (47.50 percent), regional chains (20.0 percent), as well as local independent stores (32.50 percent).

The survey was comprised of three parts and took about 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 information regarding 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 regarding 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 percents. 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). The null hypothesis is

$$H_0: \bar{x}_1 = \bar{x}_2 = \ldots = \bar{x}_j,$$

and the alternative hypothesis is

$$H_a: H_0 \text{ is not true.}$$

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. To control for experiment error, individual means are only compared when the overall F-statistic indicates differences among the means. The calculated F, from the GLM is:

F=Model Mean Square/Error Mean Square

and is compared with the table value for the 95% confidence interval (α=.05) for k-1 and n-k-1 degrees of freedom. When two means are compared, the t-test is calculated as

$$t = \left|\overline{y_1} - \overline{y_2}\right| / \sqrt{s^2(1/n_1 + 1/n_2)}.$$

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

$$t = \left|\overline{y_i} - \overline{y_j}\right| / s\sqrt{1/n_i + 1/n_j} \geq t(\varepsilon; v)$$

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 null hypothesis is

H_o: No significant association between x and y,

and the alternative hypothesis is

H_a: H_0 is not true.

The Pearson chi-square statistic is calculated and compared with the critical value with (number of rows-1)(number of columns-1) degrees of freedom at α=.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 his/her store (N=40). Most (97.5

percent) also stated that they did not believe any other stores within their company or area stores run by other companies were currently selling irradiated meat products. Ninety-five percent said their companies had not provided information to its stores on the subject of irradiated meats. Table 3.1 (Appendix 2) summarizes these responses.

As displayed in Table 3.2 (Appendix 2), none of the responding meat managers expected irradiated meat products to be carried by his/her store 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. The Chi-square test of association between when the manager expects the store will carry an irradiated meat product and the type of retailer revealed no significant association.

When asked if someone within their stores would be responsible for making decisions about buying and selling irradiated read meat or other irradiated meat products, 27.50 percent stated someone would, while 72.50 percent stated that someone outside their stores 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 3.2, 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 3.3, Appendix 2). 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 3.4, Appendix 2). All the meat managers in independent stores stated their store would most likely sell irradiated ground beef first, while 75 percent of the managers at regional stores and 72.73 percent 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 Chi-square test of association between type of product to be sold first and type of retailer did not reveal significant association. It should be noted that some of cells in the Frequency tables have less than five observations. This affects the statistical validity of the Chi-square test.

A majority (69.57 percent of managers) said they believed that irradiated ground beef would be sold as an un-branded 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 3.5, Appendix 2). While 75 percent of the managers at the independent retailers said their stores would likely sell irradiated 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. A Chi-square test of association between branding and pricing strategy and type of retailer revealed no significant association.

The perceptions of the meat managers regarding branding and pricing strategies for irradiated ground beef across education and experience levels are summarized in

Table 3.6 (Appendix 2). While no differences in perceptions about strategies were found across education level, differences were found across experience level at the 90 percent confidence level. The meat managers with less than 15 years of experience in food retailing were much more likely to believe that irradiated ground beef would be sold as an unbranded product at a price comparable to non-irradiated ground beef than were more experienced meat managers.

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

The mean ratings of managers' expectations and opinions regarding irradiation of red meat are presented in Table 3.7 (Appendix 2). The differences in means were tested using paired means comparisons. The opinion ratings for each of the statements presented to the managers could take on the following values, 1=strongly disagree, 2=disagree, 3=no opinion, 4=agree, and 5=strongly agree. As can be seen in Table 3.7, 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 store 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 store would be willing to pay a much higher price for an irradiated red meat product. The superscripts beside each mean denote means that were not significantly different from each other. 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 and opinions regarding irradiation of red meat across type of retailer are presented in Table 3.8 (Appendix 2). The F-statistics did not reveal any significant differences in opinions across type of retailer.

The mean ratings of managers' expectations and opinions regarding irradiation of red meat across type of retailer across education and experience levels are displayed in Table 3.9 (Appendix 2). 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 store will have to pay a higher price from meat packing companies for irradiated meat products than did the managers that had a high school degree or less in education. However, the college educated or higher managers 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 displayed in Table 3.9, no differences in expectations or opinions regarding 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 merchandise irradiated red meats within the next

year. The meat managers also project that in a five-year time span irradiated meats will comprise just over a quarter of red meat sales. 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 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 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 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. 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 than for similar non-irradiated meat products than less educated meat managers. 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 profitability expectations from less educated meat managers.

CHAPTER IV

RETAIL MEAT MANAGERS' PROFITABILITY EXPECTIONS FOR IRRADIATED RED MEATS

Background and Justification

Recently, USDA's Food Safety and Inspection Service (FSIS) approved the use of ionizing radiation for treating refrigerated or frozen uncooked meat to reduce the levels of foodborne pathogens. Irradiation can reduce *E. coli* (O157:H7), *Salmonella*, and *Campylabacter* occurrence in raw meats, which can cause serious illness and death. Buzby *et al.* estimated the annual cost of premature deaths from *E. coli* in the U.S. to be between $160 million and $700 million (1998). Irradiation interferes with bacterial cell processes and reproduction, not only improving the safety of meat products through destruction of microbial pathogens, but also increasing shelf life through removal of spoilage sources (USDA/FSIS, 2001).[1] Increased shelf life provides greater flexibility and logistical efficiency associated with transportation and distribution, and therefore, could result in reduced marketing costs for food processors, wholesalers, and retailers.

While food irradiation has been widely accepted by the scientific community as a safe method for reducing foodborne pathogens (Sapp, 1995), findings from several studies produced mixed results regarding consumers' acceptance of irradiated red meat

[1] Andrews *et al.* report that shelf life increased from 8-10 weeks for non-irradiated ground beef to 26-28 weeks for ground beef exposed to a 1.54 kGy dose of irradiation. Shelf life increased to as much as 70 weeks for various beef cuts exposed to a 2.0 kGy dose of irradiation while under vacuum.

products (Bailey, 1996; Fox *et al.,* 1996; Hashim, Resurreccion, and McWatters, 1995; Henson, 1995; Resurreccion *et al.* 1995; Sapp, Harrod, and Zhoa, 1995). Industry adoption of red meat irradiation has been cautious, perhaps due to FSIS labeling requirements, uncertainty about consumer reaction, and concerns about costs of the technology. Under current FSIS labeling requirements, grocery retailers most directly face the uncertainties associated with merchandising irradiated products. Furthermore, supermarkets are the primary outlet choice for consumers buying beef (Medina and Ward, 1999).

Concerns about consumer reaction are, in part, focused on potential reaction to the current FSIS labeling requirements, *i.e.* "radura" symbol and phrase "treated with irradiation" or "treated by irradiation" (See Figure 2.1, Appendix 1). Irradiated ground beef has been introduced in some markets, only to be withdrawn later due to lack of interest on the part of consumers (Herzog and Daykin, 2000). These concerns are coupled with added costs to processors and retailers of irradiating ground beef estimated at one-half to 6 cents per pound (Kaye and Turman, 1999; Bogart and Tolstun, 1999; Engeljohn, 1999).

Although a number of studies have examined consumers' perceptions of irradiated products, no studies have analyzed retailers' perceptions of the profitability potential of irradiated red meats. Because much of the exchange of information regarding irradiated red meat products will occur between retailers and consumers and, more specifically, local meat managers and consumers, the perceptions and expectations of the meat managers will provide important insight into the issue of whether irradiated red meat products will become prevalent in U.S. grocery stores and supermarkets. The

purpose of this study is to ascertain grocery retail meat managers' perceptions regarding profitability potential of irradiated red meats and influences on these perceptions. The study also examines how these profitability expectations may influence meat managers' views of projected market share, timing of introduction, and market strategy for irradiated red meats.

Studies of Consumer Perceptions

Several recent studies found a wide range of consumer rejection of irradiated products. Estimates of consumer rejection range from 15 to 36 percent (Bailey, 1996; Fox *et al.,* 1996; Hashim, Resurreccion, and McWatters, 1995; Henson 1995; Resurreccion *et al.*, 1995; Sapp, Harrod, and Zhoa, 1995). Findings from a study conducted by the Center for Disease Control and other agencies suggest that nearly half of consumers would be willing to purchase irradiated ground beef, but less than a quarter would be willing to pay a premium (Frenzen *et al.*, 2000). It is import to note that the acceptance or rejection of irradiated food products may be affected by consumers' familiarity with irradiation, how the choice is presented, or the level of education about irradiation provided in the experiment. Hinson, Harrison, and Andrews found that consumers familiar with irradiation were significantly more likely to buy and pay more for irradiated products than those who had never heard of irradiation (1998). Schutz, Bruhn, and Diaz-Knauf found that consumers preferred irradiated fruit over fruit preserved using chemical fumigants (1989). Baker found that consumers were willing to pay for a reduction in pesticide usage and accept some deterioration in the quality of produce (1998). Hashim, Resurreccion, and McWatters found an increased percentage of

consumers accepted irradiated chicken breasts after viewing educational slide shows or posters (1995). The results from these studies underscore the potential importance of consumer education and the potentially pivotal role of retail meat managers in consumer acceptance or rejection of irradiated meat products.

Study Objectives

The objective of this study is to ascertain grocery retail meat managers' expectations the profitability potential of irradiated red meats. The study examines influences on the expectations of meat managers, such as meat manager and store characteristics, meat manager familiarity with irradiation, opinions regarding irradiation, and views regarding customer perceptions. The study also examines how the projected timing of adoption by their retail stores, projected percent of red meats allocated to irradiated red meats, and merchandising may be influenced by these profitability expectations. The effects of expected profitability potential on whether the manager believes their store will use a branded products strategy, when they believe the product will be introduced, and the percent of red meat sales they believe will be irradiated products in their store after five years, are examined.

Data and Methodology

In the summer of 2001, 40 Knoxville, Tennessee area meat department managers in grocery stores were interviewed in person regarding their views on irradiated red meat and meat products. Respondents were assured their participation was voluntary and that individual responses would be kept confidential. Meat managers with several types of

retailers were represented in the survey, including national chains (47.5 percent), regional chains (20.0 percent), and local independent stores (32.5 percent).

The survey contained questions about meat managers' views regarding the profitability potential of irradiated red meat to their stores. To assess the meat managers' views about their knowledge level of irradiation, they were asked about their familiarity with the regulations and technological processes of irradiation. The meat managers' were asked questions about their views of potential risks of irradiation, effects on product shelf life, and costs to retailers. The managers were asked about their perceptions of how consumers may react to irradiated red meat products. The survey also included questions about the type of retailer (national, regional, or independent), years of experience of the meat manager, and level of education of the meat manager.

Meat managers perception's about the profitability of red meat irradiation (PROFIT) are hypothesized to be influenced characteristics of the meat manager (education level and years experience in food retailing), type of store (independent, regional chain, or national chain), meat manager familiarity with the regulatory requirements and technological processes used in red meat irradiation, meat managers' views regarding the safety, effect on spoilage/shelf life, and costs of irradiation, and meat managers' perceptions of how consumers may react to irradiated red meats. The variable names, definitions, and means are presented in Table 4.1 (Appendix 3). The hypothetical model was as follows:

$$\Pr(PROFIT=i) = f(X) = f(EDUC, EXPER, REGION, NATION, LEGAL, PROCESS, RHEALTH, RENVIRON, SHELFLIFE, TSAVE, HCOST, CONSSAF, CONSACPT, CONSHPP, RADURA),$$

where 1=strongly agree, 2=agree, 3=no opinion, 4=disagree, and 5=strongly disagree. If the model is expressed in the cumulative probability form, and the explanatory variables are represented by X then:

$$g(\Pr(PROFIT \leq i|X)) = \alpha_i + \beta' X, \text{ where } 1 \leq i \leq 4.$$

It is hypothesized that higher education levels (*EDUC*) and more years of experience (*EXPER*) in food retailing will increase the probability of meat managers believing irradiation will have a high profitability potential for retailers. The logic behind this hypothesis is that more educated managers may be more open or knowledgeable about the use of new technologies. The effects of being a manager in a regional (*REGION*) or national (*NATION*) chain cannot be hypothesized. Larger chains may try to "test market" irradiated meat first, rather than introduce irradiated meat throughout the entire chain. Larger chains may also be more likely to introduce the new product first because of financial their position compared with smaller chains or independents. Independent stores may not have the luxury of a test market, so they actually could be quicker to introduce irradiated meat products.

A manager's familiarity with the legal, regulatory, (*LEGAL*) and process of irradiation (*PROCESS*) is hypothesized to have a positive effect on the manager's views regarding the profitability of meat irradiation. There could be a presents of multicollinearity between the variables *LEGAL*, *PROCESS*, and *EDUC*. A manager's belief that irradiation poses little health (*RHEALTH*) or environmental risks (*RENVIRON*) and will reduce spoilage (*SHELFLIFE*) is hypothesized to have a positive effect on views regarding profitability. A manager's belief that irradiation of meat products will create a substantial time-savings (*TSAVE*) in the meat department is hypothesized to also have a

positive effect on the views regarding the profitability potential of irradiated meats. Managers who believe that their stores will have to pay a higher price for irradiated red meats (*HCOST*) are hypothesized to be less likely to believe irradiated red meats have a high profitability potential.

The effect of managers' perceptions of consumers' food safety concerns (*CONSSAF*) is unclear because concerns about food safety could have positive effect on sales, if consumers are concerned about pathogens in red meat products, or a negative effect if consumers view irradiation negatively. Meat managers' belief that consumers would be very accepting of irradiated meat (*CONSACPT*) and would pay a higher price for irradiated meat than non-irradiated meat (*CONSHPP*) would likely have a positive influence on meat managers' views of the potential profitability of irradiated red meats. Meat managers who believe the 'radura' symbol (*RADURA*) will have a positive effect on product sales are hypothesized to be more likely to believe the profitability potential for irradiated red meat products is high.

An ordered logistic model can be estimated for the observed ratings by meat mangers regarding potential benefits to food retailers' profitability of red meat irradiation. The opinion rating of potential profitability benefits being high (*PROFIT*) could take on the values of 1 for 'strongly agree' to 5 for 'strongly disagree'. The probabilities of *PROFIT* are then

$$\Pr(PROFIT = 1) \quad F(\alpha_1 + \beta'X),$$

$$\Pr(PROFIT = 2) \quad F(\alpha_2 + \beta'X) - F(\alpha_1 + \beta'X),$$

$$\Pr(PROFIT = 3) \quad F(\alpha_3 + \beta'X) - F(\alpha_2 + \beta'X),$$

$$\Pr(PROFIT = 4) \quad F(\alpha_4 + \beta'X) - F(\alpha_3 + \beta'X),$$

$$\Pr(PROFIT = 5) \quad 1 - F(\alpha_4 + \beta'X),$$

where F is the logistic distribution or $e^{\beta X}/(1+e^{\beta X})$ (Greene, 1993).

The significance of the overall model is evaluated with the Log Likelihood Ratio test (LLR). The null hypothesis is

$$H_o: \ \beta_1 = \beta_2 \ldots\ldots = \beta_k = 0,$$

and the alternative hypothesis is

$$H_a: \ \beta_1 = \beta_2 \ldots\ldots = \beta_k \neq 0.$$

The test statistic is found by subtracting the unrestricted *–2 log L(UR)* (UR= intercept and *k* explanatory variables) from the restricted *–2 log L(R)* (R= intercept only). The formula is as follows

$$LLR = 2[\log L(UR) - \log L(R)].$$

The test statistic is distributed as chi-square with *k* degrees of freedom. If the calculated statistic is greater than the critical value of Chi-square, then the overall model is significant. Another measure of overall fit of the model is the percent of responses correctly classified. To calculate the percent correctly classified, the predicted values for profitability expectations are compared with the actual values and then put into percent form.

Significance of the individual parameter estimates are tested with Wald tests. The null hypothesis is

$$H_o: \beta_i = 0,$$

and the alternative hypothesis is

$$H_a: \beta_i \neq 0.$$

The Wald statistic is calculated by dividing the parameter estimate by the standard error then squaring the value. The formula for the Wald statistic is:

$$Wald = (\hat{\beta} / S_{\hat{\beta}})^2.$$

The calculated Wald statistic is compared with the critical value of Chi-square value to determine the whether the estimate is significant. If the calculated statistic is greater than the critical value, then H_o is rejected. The test is conducted with one degree of freedom.

The values of the parameter estimates cannot be evaluated directly as slopes measuring the change in probability of profitability expectation level with a change in the explanatory variable. However, the signs and significance of the coefficients can be used directly. A positive sign on a β coefficient indicates than an increase (decrease) in the X variable causes an increase (decrease) in the probability that the manager will strongly agree that irradiation has higher profitability potential. A negative sign on a β coefficient indicates than an increase (decrease) in the X variable causes a decrease (increase) in the probability that the manager will strongly agree that irradiation has high profitability potential. The reverse would be true for the effects on probability that the meat manager

strongly disagrees. Without further calculations, no interpretations of the effects of the explanatory variable on probability of 'agree,' 'no opinion,' or 'disagree' can be made.

Comparisons of meat managers' profitability responses against responses on branding strategy and against product introduction predictions are evaluated with frequency tables and Chi-square tests of association. A Chi-square statistic is used to test for association between row and column variables in a frequency table (*i.e.* profitability expectations and whether a branded strategy will be used). The Pearson chi-square statistic is calculated as

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

and compared with the critical value with (number of rows-1)*(number of columns-1) degrees of freedom at the 95 percent confidence level. The values m_{ij}=(row total*column total)/n and n_{ij}=the cell frequency in the i^{th} row and j^{th} column (Fienberg, 1977). If the calculated Q is greater than the critical value of Chi-square, then the hypothesis of no association between the variables is rejected.

Differences in the mean projected share of red meats that will be comprised of irradiated products across views is tested about profitability with a t-test. If the variances are unequal, the two means are compared with

$$t = \left|\overline{y_1} - \overline{y_2}\right| / \sqrt{(s_1^2 / n_1) + (s_2^2 / n_2)},$$

where $\bar{y}_1$ and $\bar{y}_2$ are the means to be compared, s_1^2 and s_2^2 are the variances of y_1 and y_2, and n_1 and n_2 are the number of observations used in calculating each mean.[1] The degrees of freedom are approximated as

$$df = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\frac{(s_1^2/n_1)^2}{(n_1 - 1)} + \frac{(s_2^2/n_2)^2}{(n_2 - 1)}}.$$

Results

Ordered Logistic Model of Profitability Expectations

The results from the estimated ordered logit model are displayed in Table 4.2 (Appendix 3). The values in parentheses below each coefficient are the estimated standard errors. The Log Likelihood ratio is 56.9301, while the critical value of Chi-square with 15 degrees of freedom is 30.58, indicating the overall model is significant at the 99 percent confidence level. The model correctly classifies responses regarding profitability expectations 88.4 percent of the time.

Characteristics

As was expected, the educational level of the meat manager (*EDUC*) is positive and significantly different from zero at the 90 percent confidence level. This result indicates that, holding other factors constant, meat managers with a some college or

[1] The equality of variances is tested (using an F-test) prior to the t-test. The calculated F=larger variance/smaller variance, with n –1 for the larger variance (numerator) and n-1 for the smaller variance (denominator) degrees of freedom.

greater education are more likely to strongly agree that irradiation of red meat has high profitability potential than those with less than college education. The result also indicates these managers are less likely to strongly disagree with high profitability potential of irradiated red meats. The years of experience in food retailing (*EXPER*) was expected to have a positive sign. While the sign of the coefficient is positive, the coefficient is not significantly different from zero. The coefficient on *REGION* is negative and significantly different from zero at the 95 percent confidence level. The coefficient of *NATION* is negative and significantly different from zero at the 99 percent confidence level. These results show that compared with local independent grocers, managers at regional chains (*REGION*) or national chains (*NATION*) have a negative influence on the probability that the manager strongly agrees with high profitability potential of red meat irradiation.

Meat Manager Familiarity With Irradiation

The coefficient of the variable measure managers' views about their familiarity with legal and regulatory requirements of irradiated meat (*LEGAL*) is positive and significantly different from zero at the 90 percent confidence level. This result indicates that meat managers who disagree that they have a high level of knowledge about meat irradiation legal and regulatory requirements are more likely to strongly agree that irradiation of red meat has high profitability potential than those managers who have greater perceived familiarity with the legal and regulatory requirements. This result was not expected. The coefficient of "Could Clearly Explain How Irradiation Process Works

to Customers" (*PROCESS*) is negative, but the coefficient is not significantly different from zero.

Opinions Regarding Irradiation

The coefficient of the variable representing the opinions regarding lack of risks to human health (*RHEALTH*) is positive, but not significantly different from zero. The estimated coefficient of opinions regarding whether irradiation poses no risk to the environment (*RENVIRON*) is negative and significantly different from zero at the 95 percent confidence level. This result indicates that meat managers who view irradiation as having little environmental risk are more likely to agree that irradiation of red meat has high profitability potential than those who feel irradiation is a risk to the environment. The coefficient of whether they believed irradiation would substantially increase shelf life of red meat and reduce spoilage (*SHELFLIFE*) is negative and significantly different from zero at the 90 percent confidence level. This result suggests that meat managers who strongly agree that irradiation will increase the shelf life of a meat product are more likely to strongly agree that irradiation of red meat has high profitability potential than those who do not believe irradiation will increase self-life. The coefficient of the opinion rating of whether offering irradiated meats will result in substantial time-savings in the meat department (*TSAVE*) is negative and significantly different from zero at the 99 percent confidence level. This result indicates that meat managers who strongly agree (disagree) that irradiation will result in substantial time savings in the meat department are more likely to strongly agree (disagree) that irradiation of red meat has high profitability potential than those who do not believe there will be time-savings. The

coefficient of the variable representing whether the managers believed their store will have to pay a higher price to meat packer (*HCOST*) is not significant at the 90 percent confidence level or greater.

Views Regarding Customer Perceptions

The coefficient of *CONSSAF*, the variable measuring managers' perceptions of consumers' concerns regarding food safety is positive and significantly different from zero at the 95 percent confidence level. This result shows that if meat managers strongly agree (disagree) that consumers are highly concerned about food safety, the less likely (more likely) they are to believe irradiation has high profitability potential. This result could suggest that meat managers believe consumers' concerns about pathogens in red meat products may be outweighed by concerns about any potential risks from irradiation. The sign of the coefficient of the variable measuring perceptions of customers acceptance of irradiated red meat (*CONSACPT*) is negative and significantly different from zero at the 90 percent confidence level, suggesting that meat managers who view their customers as not accepting of irradiated red meats are less likely to strongly agree that irradiation of red meat has high profitability potential than those who feel their customers would be accepting of irradiated red meats. The coefficient of the opinion rating variable for whether customers would be willing to pay a higher price for irradiated red meats (*CONSHPP*) is positive and significantly different from zero at the 99 percent confidence level. This unanticipated result indicates that managers' beliefs about positive consumer acceptance do not translate into beliefs about high profitability potential. The coefficient of the variable representing views about expected impact of the radura symbol on sales of

irradiated red meats (*RADURA*) is negative and significantly different from zero at the 90 percent confidence level. This suggests that meat managers who believe the radura symbol will have a negative impact on irradiated red meat sales are less likely to strongly agree that irradiation of red meat has high profitability potential than those who do not believe that the radura symbol will have a negative effect.

Market Strategy, Timing of Introduction, and Projected Sales Share

The results from the two-way frequency analysis comparing introductory market strategy and profitability expectations are found in Table 4.3 (Appendix 3). Regardless of profitability expectations between 70 and 80 percent of the surveyed managers believed irradiated red meats would be introduced as unbranded products. The Pearson chi-square statistic was .086, while the critical value of Chi-square at a 90% confidence level with one degree of freedom is 2.71. Therefore, no significant association between whether the manager believes the products would be introduced as branded products and profitability expectations is found.

The results from the two-way table comparing timing of introduction and profitability expectations are found in Table 4.4 (Appendix 3). Over 53 percent of those holding positive expectations about profitability believe irradiated red meat products will be introduced in their store within the next year or the next three years. Less than 30 percent of those holding neutral or negative views about profitability believe irradiated products will be introduced in their store within the next three years. However, the calculated Pearson Chi-square statistic is 4.018, while the critical value of the Chi-square at a 90% confidence level with 3 degrees of freedom is 6.25. This result suggests no

significant association between anticipated timing of introduction and profitability expectations.

The results from the differences in the mean projected share of irradiated red meat across profitability expectations are found in Table 4.5 (Appendix 3). The managers agreeing or strongly agreeing irradiated red meat will be profitable forecast irradiated meats to capture 24% of total red meat sales after five years. Managers strongly disagreeing, disagreeing, or no opinion regarding irradiated red meat profitability forecast irradiated meats to capture 13.1% of total red meat sales after five years. When the two means are compared statistically, the calculated t is –1.26, while the critical value of t at a 90% confidence level with 18 degrees of freedom is 1.330.[1] This indicates no statistical difference in mean share across the two groups.

Conclusions and Implications

The results form this study show that over 37 percent of the responding meat managers agree or strongly agree that irradiated red meat products has high profitability potential. About 43 percent have no opinion, and the remaining 20 percent disagree or strongly disagree with irradiated red meats having high profitability potential. Most of the managers believe the irradiated products will be sold using an unbranded strategy, with irradiated products eventually comprising less than a quarter of red meat sales. Over 53 percent of the meat managers in agreement with high profitability potential for irradiated

[1] The calculated F to test equality of variances is 3.51, while the critical value of the F-test with 13 degrees of freedom (numerator) and 20 degrees of freedom (denominator) is approximately 3.23. This indicates the variances across the two groups are not equal.

red meats feel the products will be introduced in their store within the next year or next three years, while less than 30 percent of those with lower profitability expectations believe the products will be introduced within that time frame. Findings from the study suggest that managers in independent local stores have more positive profitability expectations than those in regional or national chains. This could imply that managers in independent stores see irradiated red meat products as a potential market niche. Education of meat managers also influences their perceptions, reinforcing the idea that education efforts for irradiated meat products at the store level may be appropriate. Unexpectedly, familiarity with legal and regulatory aspects of irradiation was found to have a negative influence on the likelihood of high profitability expectations. One possible explanation for this finding is that managers most familiar with the legal and regulatory aspects may be more familiar with the labeling requirements for irradiated products. The food industry has expressed concerns on use of the term "irradiated" and how consumers may react. Views about potential environmental risks, potential benefits of shelf life, and time-savings influenced meat managers profitability expectations. This result suggests that meat managers concerns about consumers views on food safety, in particular the perceptions of the safety of irradiation and how consumers may react to the radura symbol, influence their views on profitability. These findings point toward the importance of providing information materials outlining the potential food safety benefits, as well as shelf-life benefits, at the store level. One caveat to the findings from this study is that they are for one geographic area. Further research should investigate meat managers' profitability expectations on a national level.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

The results from this study suggest that most meat managers in the Knoxville area believe that their retail chains will not merchandise irradiated red meats within the next year. The meat managers also project that in a five-year time span that irradiated meats will comprise just over a quarter of red meat sales. 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 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. More experienced meat managers felt that the irradiated ground beef would be sold as a branded product at a higher price (as, for example, with some organic or lean meats), while less experienced meat managers believed it would be sold as an unbranded product at a price comparable to non-irradiated ground beef.

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. However, meat managers' expectations appeared to depend on their educational level.

The results from the logit model of profitability expectations, developed in the Chapter IV, suggest that education, confidence in environmental safety of irradiation,

positive views of shelf-life and potential time-savings all increased the likelihood that meat managers had high profitability expectations for irradiated red meat products. These results could suggest that packers of irradiated meats should provide educational materials to meat department managers and workers describing the environmental safety, shelf-life benefits, and spoilage reduction offered by irradiated red meat products.

Findings from the study suggest that managers in independent local stores have more positive profitability expectations than those in regional or national chains. This could imply that managers in independent stores see irradiated red meat products as a potential market niche. Unexpectedly, familiarity with legal and regulatory aspects of irradiation was found to have a negative influence on the likelihood of high profitability expectations. This may reflect meat managers' concerns about the labeling requirements for irradiated products. The food industry has expressed concerns on use of the term "irradiated" favoring other terms, such as "cold pasteurization." The influence of concerns about consumer acceptance and the radura symbol on profitability expectations may point to the need for educational materials to be distributed to consumers or on how meat department workers might respond to consumers' concerns.

In closing, this represents a study of local area meat managers' views. This study should be followed by a study covering a wider region of the nation. Also, future research might consider demographics and income level's of customers shopping in the stores.

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APPENDICES

APPENDIX 1

Figure 2.1. Radura

(Source: USDA/FSIS, 1999)

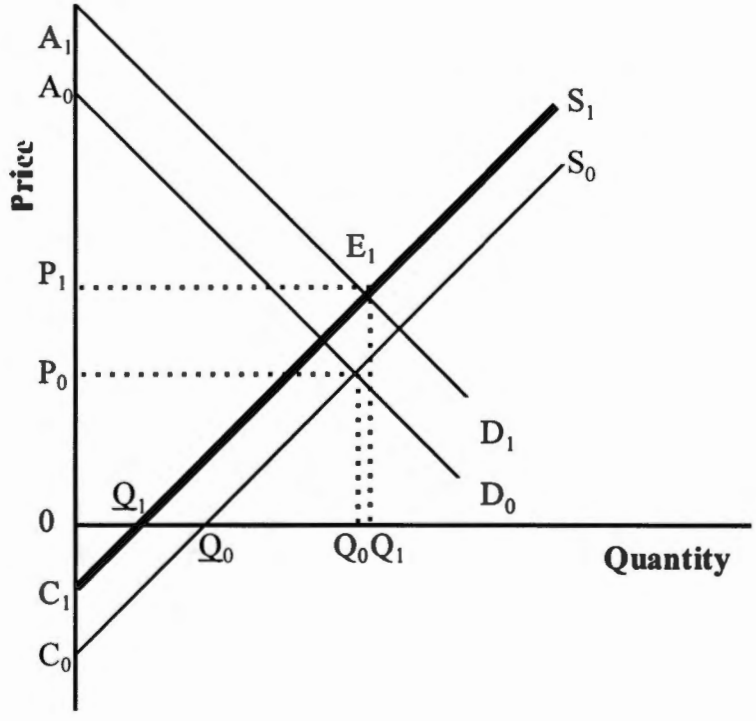

Figure 2.2. The Market Effects at the Retail Level of the Introduction of Low-fat Ground Beef.

(Source: Brester *et al.*, 1993)

		Price	
		High	**Low**
Quality	**High**	Premium Strategy	Good-value Strategy
	Low	Overcharging Strategy	Economy Strategy

Figure 2.3. Price vs. Quality Table

(Source: Kotler and Armstrong, 1996)

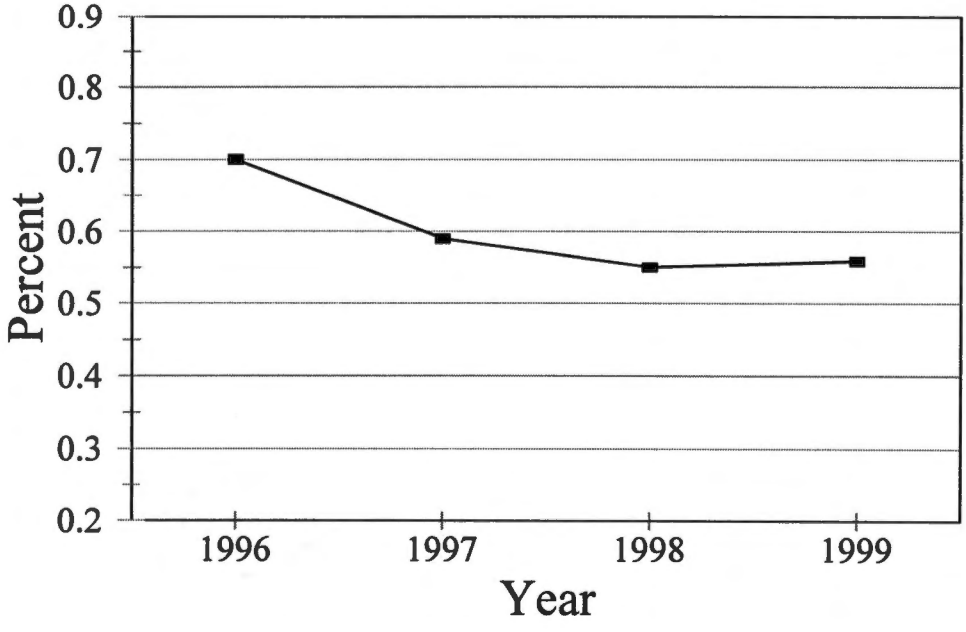

Figure 2.4.The Proportion of Consumers Who Were Likely to Buy Irradiated Products

(Source: Frenzen *et al.*, 2000)

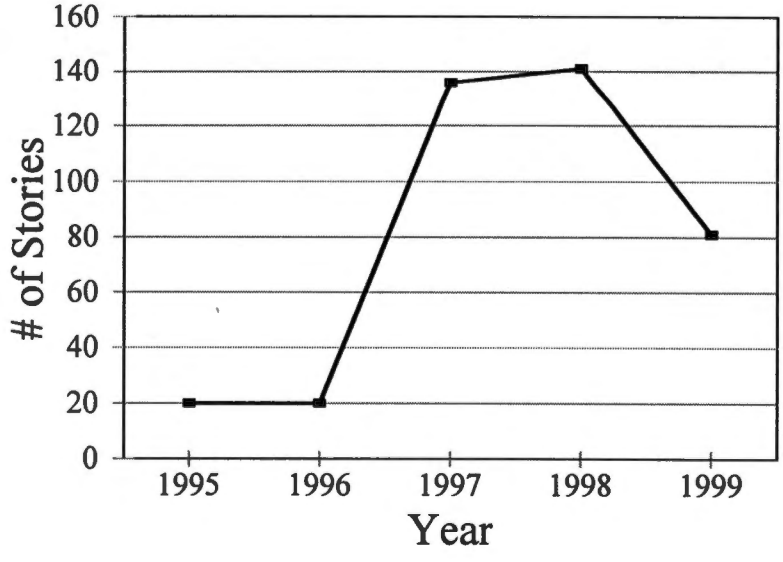

Figure 2.5. TV News and Newspaper Stories About Food Irradiation in the 1990's

(Source: Frenzen *et al.*, 2000)

Table 2.1. Consumer Willingness to Pay More for Irradiated Ground Beef and Chicken

Response	Ground Beef	Chicken
	Percent	
Willing to buy irradiated or poultry:		
Would pay more	22.7	24.5
Wouldn't pay more	7.0	7.2
Not sure about paying more	17.5	16.5
Not willing to buy or ensure about buying irradiated meat or poultry.	52.8[a]	51.9[b]
Total:	100.00	100.00

[a]Includes 2.3% of respondents who were willing to buy irradiated meat or poultry but did not buy ground beef.
[b]Includes 1.4% of respondents who were willing to buy irradiated meat or poultry but did not buy chicken.

(Source: Frenzen *et al.*, 2000)

Table 2.2. Most Important Reason Why Adults Would Not Buy Irradiated Meat of Poultry

Most Important Reason	Percent
Insufficient information about the risks and/or benefits	35.0
Concerned about safety of eating irradiated foods	22.7
Irradiation doesn't make food safer	4.2
Doesn't eat meat or poultry	4.0
Concerned about environmental impact of irradiation	3.9
Doesn't need irradiation to make food safe	3.5
Doesn't like trying new foods/products	3.3
Price of irradiated food	2.5
Taste/appearance of irradiated food	1.4
Other, unspecified reasons	10.2
Doesn't know/not sure	7.9
Refused to answer	1.4
Total	100.00

(Source: Frenzen *et al.*, 2000)

APPENDIX 2

Table 3.1. Current Sales of Irradiated Meat Products (Red Meat, Poultry, or Pork)

	Percent of Responses (N=40)		
	Yes	No	Don't Know
Does your store currently sell any irradiated meat products – red meat, poultry, or pork?		100	
Does any other store *within your company* currently sell irradiated meat products– red meat, poultry, or pork?		97.5	2.5
Does any area store run by *other companies* currently sell any irradiated meat products?		97.5	2.5
Has your company provided any information to its stores on the subject of irradiated red meats?	5.00	95.00	

Table 3.2. Expectations Regarding When Store Will Carry an Irradiated Meat Product by Retailer Type[a]

		Retailer Type		
Time Frame	Overall (N=40)	Independents (N=13)	Regional (N=8)	National (N=19)
		Percent of Respondents		
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
Chi-Square Test	7.06			

[a] Since some cells had zero percents, those categories could have been collapsed before running the Chi-square test.

Table 3.3. Projected Percent of Red Meat Sales That Will be Irradiated in 5 Years by Retailer Type

		Retailer Type		
	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 3.4. Irradiated Red Meat Product Likely to Be Sold First by Retailer Type

		Retailer Type		
Irradiated Red Meat Product Likely to be Sold First	Overall (N=23)	Independents (N=8)	Regional (N=4)	National (N=11)
		Percent of Respondents		
Ground Beef	82.61	100.0	75.00	72.73
Other	17.39	0.0	25.00	27.27
Chi-Square Test	2.59			

Table 3.5. Branding and Pricing Strategies for Irradiated Ground Beef by Retailer Type

		Retailer Type		
Branding and Pricing Strategy	Overall (N=23)	Independents (N=8)	Regional (N=4)	National (N=11)
		Percent of Respondents		
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
Chi-square Test	3.03			

Table 3.6. Branding and Pricing Strategies for Irradiated Ground Beef by Education and Experience Level[a]

	Education Level		Experience Level	
Branding and Pricing Strategy	Some College or Greater (N=8)	No College (N=15)	15 Years or More (N=13)	Less Than 15 Years (N=10)
	Percent of Respondents			
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*

[a] * indicates significant association between the two variables at a 90% confidence level.

Table 3.7. Managers' Expectations and Opinions Regarding Irradiation of Red Meats[a]

Expectations and Opinions Regarding 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, as compared to the non-irradiated version.	1.73

[a] Like letters indicate means that are not statistically different at a confidence level of 90 percent.

Table 3.8. Managers' Expectations and Opinions Regarding Irradiation of Red Meats by Retailer Type

Expectations and Opinions Regarding Irradiation of Red Meats	Retailer Type: 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, as compared to the non-irradiated version.	1.46	1.88	1.84	.72

Table 3.9. Managers' Expectations and Opinions Regarding Irradiation of Red Meats by Education and Experience Level[a]

Expectations and Opinions Regarding Irradiation of Red Meats	Education			Experience Level		
	Some College or Greater (N=15)	No College (N=25)	T Stat.	15 Years or More (N=21)	Less Than 15 Years (N=19)	T Stat.
	(Rating 1=Strongly Disagree, .., 5=Strongly Agree)					
I expect the irradiation process will 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 will occur due to the increased shelf life of irradiated red meat products	3.67	3.16	-1.46	3.33	3.37	0.1
I would rate the potential benefits to food retailers' profitability from carrying irradiated meat products are 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	3.2	3.16	-0.09	3.24	3.1	-0.29
Customers in my store would be willing to pay a much higher price for an irradiated red meat product, as compared to the non-irradiated version.	1.93	1.6	-1.06	1.57	1.89	1.07

[a] * indicates significant difference means at the 90 percent confidence level and ** indicates significance at the 95 percent confidence level.

APPENDIX 3

Table 4.1. Variable Descriptions, Names, Definitions, and Means.

Variable Description/Name	Definition	Mean (N=40)
Dependent		
Potential Benefits to Food Retailers' Profitability is High (*PROFIT*)	1 if strongly agree, …,5 if strongly disagree	2.675
Characteristics		
Education Level: Some College or Greater (*EDUC*)	1 if education level some college or greater, 0 otherwise	.375
Years Experience in Food Retailing (*EXPER*)	Years	18.575
Store Type		
Regional Chain (*REGION*)	1 if regional grocery or supermarket chain, 0 otherwise	.200
National Chain (*NATION*)	1 if national grocery or supermarket chain, 0 otherwise	.475
Meat Manager Familiarity With Irradiation		
Extremely Familiar with Legal, Regulatory Requirements (*LEGAL*)	1 if strongly agree, …, 5 if strongly disagree	4.225
Could Clearly Explain How Irradiation Process Works To Customers (*PROCESS*)	1 if strongly agree, …, 5 if strongly disagree	4.500
Opinions Regarding Irradiation		
Irradiation Poses Virtually No Risk to Human Health (*RHEALTH*)	1 if strongly agree, …, 5 if strongly disagree	2.950
Irradiation Poses Virtually No Risk to Environment (*RENVIRON*)	1 if strongly agree, …, 5 if strongly disagree	3.200
Irradiation Will Substantially Increase Shelf Life of Red Meat Products and Reduce Spoilage (*SHELFLIFE*)	1 if strongly agree, …, 5 if strongly disagree	2.150
Offering an Irradiated Red Meat Product Will Result in a Substantial Time Savings in the meat department (*TSAVE*)	1 if strongly agree, …, 5 if strongly disagree	2.825
Store Will Have to Pay a Higher Price for Irradiated Meat Products than for Non-Irradiated Ones (*HCOST*)	1 if strongly agree, …, 5 if strongly disagree	2.275

Table 4.1. Continued.

Variable Description/Name	Definition	Mean (N=40)
Views Regarding Customer Perceptions		
Customers are Extremely Concerned About Food Safety (*CONSSAF*)	1 if strongly agree, …, 5 if strongly disagree	1.200
Customers Would be Very Accepting of Irradiated Red Meat (*CONSACPT*)	1 if strongly agree, …, 5 if strongly disagree	3.850
Customers Would be Willing to Pay a Much Higher Price for Irradiated RedMeat Product than Non-Irradiated Red Meat (*CONSHPP*)	1 if strongly agree, …, 5 if strongly disagree	4.275
Expected Impact of "Radura Symbol" on Sales of Irradiated Meat Product (*RADURA*)	1=very positive, …, 5=very negative	3.125

Table 4.2. Estimated Ordered Logit Model for Meat Managers' Opinions of Profitability of Irradiated Red Meat Products.[a]

Variable	Estimated Coefficient	
α_1	8.5941	**
	(4.2593)	
α_2	10.7015	**
	(4.3020)	
α_3	16.2918	***
	(5.0663)	
α_4	20.4213	***
	(5.8272)	
Characteristics		
EDUC	2.4227	*
	(1.2915)	
EXPER	.0286	
	(.0405)	
Store Type		
REGION	-3.1431	**
	(1.3896)	
NATION	-2.9343	***
	(1.1302)	
Meat Manager Familiarity With Irradiation		
LEGAL	1.4539	*
	(.8128)	
PROCESS	-1.6263	
	(1.0102)	
Opinions Regarding Irradiation		
RHEALTH	.1534	
	(.7405)	
RENVIRON	-1.3012	**
	(.6637)	
SHELFLIFE	-1.5161	*
	(.7760)	
TSAVE	-1.5856	***
	(.4683)	
HCOST	-.2994	
	(.3655)	

Table 4.2. Continued.

Variable	Estimated Coefficient	
Views Regarding Customer Perceptions		
CONSSAF	2.4785	**
	(1.0290)	
CONSACPT	-1.5850	*
	(.8417)	
CONSHPP	1.9867	***
	(.7575)	
RADURA	-1.2847	**
	(.6448)	
Log Likelihood Ratio	56.9301	***
Percent Correctly Classified	88.4	

[a] '***' indicates significance at the 99 percent confidence level, '**' indicates significance at the 95 percent confidence level, and '*' indicates significance at the 90 percent confidence level.

Table 4.3. Frequency Table: Type of Market Strategy vs. Profitability Potential

	Type of Strategy	
Profitability Potential is High	Branded	Not Branded
	(Percent of Responses)	
Strongly Agree or Agree (N=15)	20.0	80.0
No Opinion, Disagree, or Strongly Disagree (N=25)	24.0	76.0
Chi-Square Test	.086	

Table 4.4. Frequency Table: Likely Timing of Introduction vs. Profitability Potential[a]

	When Irradiated Red Meat Will Likely Be Introduced in Their Store:			
Profitability Potential is High	In the Next Year	In the Next Three Years	Greater than Three Years	Never
	(Percent of Responses)			
Strongly Agree or Agree (N=15)	6.7	46.7	33.3	13.3
No Opinion, Disagree, or Strongly Disagree (N=25)	0.0	28.0	40.0	32.0
Chi-Square Test	4.018			

[a] Since some cells had zero percents, those categories could have been collapsed before running the Chi-square test.

Table 4.5. Mean Irradiated Red Meat Sales Share Across Profitability Potential

Profitability Potential is High	Mean Share of Red Meat Products Sales that Will Be Irradiated Within Five Years
Strongly Agree or Agree (N=15)	24%
No Opinion, Disagree, or Strongly Disagree (N=25)	13.1%
t	-1.26

APPENDIX 4

Irradiated Red Meat Marketing Survey
Spring 2001

Purpose of Survey:

To evaluate the impact of the recent regulatory approval of irradiated raw meat and meat products on marketing decisions and plans by Knoxville-area meat retailers.

Before you begin...

Your participation is completely voluntary. The survey is aimed at managers of meat departments in area grocery stores and supermarkets. This research is design to gain an understanding of the retail decisions, and meat manager's attitudes toward new technological advances. Graduate students in the University of Tennessee's Department of Agricultural Economics will conduct the personal interviews. The survey has <u>three</u> parts and should take about twenty to twenty-five minutes to complete.

Also, all individual responses will be kept strictly confidential. Responses will be summarized, but no individual's information will be identifiable. Thank you! Your opinions are greatly appreciated.

Study Contacts:

Joseph Gaynor, Dr. Edward Jaenicke, or Dr. Kim Jensen
Dept. of Agricultural Economics
University of Tennessee
302 Morgan Hall
2621 Morgan Circle
Knoxville, TN 37996-4500
(865) 974-7231

Part I: Existing and Expected Marketing Plans for Irradiated Meat

1. (a) Does your store currently sell any irradiated meat products – red meat, poultry, or pork?

YES

NO

If YES, please list the products:

(b) *If NO, do you expect that your store will carry an irradiated red meat product...*

a. In the next six months?

b. In the next year?

c. In the next three years?

d. More than three years from now?

e. Never?

2. Does any other store *within your company* currently sell irradiated meat products– red meat, poultry, or pork?

YES

NO

DON'T KNOW

If YES, please list the products:

3. Does any area store run by *other companies* currently sell any irradiated meat products?

YES

NO

DON'T KNOW

If YES, please list the stores and, if possible, the products:

4. Do you expect that someone *within your store* is responsible for making decisions about buying and selling irradiated red meat or other irradiated meat products?

YES

NO

5. Who in your company (at what level) do you expect will make decisions about buying and selling irradiated meats?

Please list the position, the location of the position, and a name if possible.

6. As a percentage of your store's total red meat sales, what would you project as the expected share of irradiated red meat sales, after five years?

7. Which specific irradiated red meat product – for example, steaks, roasts, ground beef, etc. – would you expect your store to sell first?

8. Current regulations require that irradiated red meat products be labeled with the word "irradiated" and the "radura" symbol, which looks like this:

	Very Negative Impact	Moderately Negative Impact	No Impact	Moderately Positive Impact	Very Positive Impact
a. Please rate the expected impact that the "radura" symbol will have on the sales of an irradiated meat product.	1	2	3	4	5
b. Please rate the expected impact that the word "irradiated" will have on the sales of an irradiated meat product.	1	2	3	4	5

9. Hypothetically, *suppose* your store decided to sell an irradiated ground beef product.

   a. Would you position the irradiated ground beef next to regular ground beef?
      YES
      NO

   b. What percentage of the total space devoted to all ground beef products would be devoted to irradiated ground beef?

   c. Would you provide extra information for the irradiated ground beef? YES / NO

      If yes, would the extra information take the form of "Stickers"? YES / NO
      "Signs"? YES / NO
      "Leaflets"? YES / NO

      What other, if any, information-providing methods might you employ?

10. Again, suppose your store decided to sell an irradiated ground beef product. Which of the following two strategies do you think would work better in your store?

    a. Selling a *branded* irradiated ground beef at a price significantly higher than regular ground beef.

Or

    b. Selling an *un-branded* irradiated ground beef at a price comparable to regular ground beef.

If you picked (a), please go to question 11a.
If you picked (b), please go to question 11b.

11. (a) If you expect your store will carry irradiated red meat in the future, *do you expect it to be marketed like any other new branded meat product*? Or do you expect irradiated meat will be marketed in a completely different way?

(b) If you expect your store will carry irradiated red meat in the future, *do your expect it to be marketed like any other new un-branded meat product*? Or do you expect irradiated meat will be marketed in a completely different way?

If you expect irradiated meat to be marketed unlike other new products, please explain why you think it will be marketed so differently.

12. Are there any other marketing strategies – not mentioned above – that you might use to support the introduction of an irradiated red meat product within your store?

Part II: Retailer Information and Beliefs about Consumer Behavior, Food-Safety Concerns, and Acceptance of Irradiated Meats

13. Has your company provided any information to its stores on the subject of irradiated red meats?

YES

NO

If YES, please explain the type of information provided (e.g., memos, meetings, etc.).

14. On a scale of 1 to 5, please rate how strongly you agree or disagree with the following statements.

	Strongly Disagree				*Strongly Agree*
a. I expect the irradiation process to substantially increase the shelf life of irradiated red meat products and reduce "spoilage".	1	2	3	4	5
b. I expect substantial cost savings due to the increased shelf life of irradiated red meat products.	1	2	3	4	5
c.I expect that offering an irradiated red meat product will result in a substantial time savings in the meat department.	1	2	3	4	5
d.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.	1	2	3	4	5

15. On a scale of 1 to 5, please rate how strongly you agree with the following statements about food irradiation.

	Strongly Disagree				*Strongly Agree*
a. I am extremely familiar with the legal, regulatory requirements associated with irradiating raw meat and other red meat products for sale.	1	2	3	4	5
b. I am extremely familiar with the technological process used to irradiate raw meat and other meat products.	1	2	3	4	5
c. If a customer asked me about the meat irradiation process, I could clearly explain how it works.	1	2	3	4	5
d. I would rate the potential public health benefits of irradiated red meat products as extremely high.	1	2	3	4	5
e. I would rate the potential benefits to food retailers' profitability from carrying irradiated red meat products as extremely high.	1	2	3	4	5
f. Irradiation of food products poses virtually no risk to human health.	1	2	3	4	5
g. Irradiation of food products poses virtually no risk to the environment.	1	2	3	4	5
h. Customers in my store are extremely concerned about food safety.	1	2	3	4	5
i. Customers in my store would be very accepting of irradiated red meat.	1	2	3	4	5
j. Customers in my store would be willing to pay a much higher price for an irradiated red meat product, as compared to the non-irradiated version.	1	2	3	4	5

Part III: Store and Manager Characteristics

16. Please identify your current position, employer, and store location.

17. Please list the years of experience you have…

    a. In your current position: _____
    b. With your current employer: _____
    c. In the food retail industry:_____

18. Please identify the option below which best describes your highest level of educational pursuit:

    a. High school degree or equivalent
    b. Some college study
    c. College degree
    d. Some post-graduate study
    e. Post-graduate degree
    f. Other. Please list_____

19. Please pick the response below that best describes your current employer:

    a. An independent grocery retailer based in the Knoxville area.
    b. A regional grocery retailer based in the Southeast.
    c. A national grocery retailer.
    d. Natural Food/Healthy Food Retailer
    e. Gourmet Food Retailer
    f. Other? Please describe.

20. Please pick the response below that best describes the *total number of stores* (locally, regionally, and nationally) operated by your employer :

    a. One (1) store.
    b. Two (2) to Five (5) stores.
    c. Six (6) to 25 stores.
    d. Twenty-six (26) to 100 stores.
    e. More than 100 stores.

THANK YOU! If you have any comments about this survey, feel free to raise them now.

APPENDIX 5

The Food Safety and Inspection Service Final Ruling on Irradiated Meat Products With Respect to Labeling

(4) *Labeling*

(i) The labels on packages of meat food and poultry products irradiated in their entirety, in conformance with this section and with 21 CFR 179.26(a) and (b), must bear the logo shown at the end of this paragraph (c)(4)(i). Unless the word "Irradiated" is part of the product name, labels also must bear a statement such as "Treated with Irradiation" of "Treated by Irradiation." The logo must be placed in conjunction with the required statement, if the statement is used. The statement is not required to be more prominent than the declaration of ingredients required under § 317.2(c)(2). Any label bearing the logo or any wording of explanation with respect to this logo must be approved as required by Section 317.4 of this chapter or subparts M and N of part 381.

(ii) For meat food or poultry products that have been irradiated in their entirety, but that are not sold in packages, the required logo must be displayed to the purchaser with either the labeling of the bulk container plainly inwiew or a counter sign, card, or other appropriate device bearing the information that the product has been treated with irradiation. In either case, the information must be prominently and conspicuously displayed to purchasers. Unless the word "Irradiated" is part of the product name, the labeling counter sign, card, or other device also must bear a statement such as "Treated with Irradiation" or "Treated by Irradiation." The logo must be placed in conjunction with the required statement, if the statement is used.

(iii) The inclusion of an irradiated meat food or poultry product ingredient in any multi-ingredient meat food or poultry product must be reflected in the ingredient statement on the finished product labeling.

(iv) Optional labeling statements about the purpose for radiation processing may be included on the product label in addition to the stated requirements elsewhere in this section, provided that such statements are not false or misleading. Statements that there has been a specific reduction in microbial pathogens must be substantiated by processing documentation.

(Source: USDA/FSIS, 1999)

VITA

Joseph Michael Gaynor Jr. was born in Crossville, Tennessee on July 10, 1977 to Joseph and Melody Gaynor. He was a resident of Chestnut Hill from 1977 to 1995, where he attended public school and graduated from Cumberland County High School in 1995. He attended the University of Tennessee, Knoxville pursing an accounting degree, before discovering Agricultural Economics. He graduated in 1999 and now holds a Bachelor of Science degree in Agricultural Economics. After graduating from University of Tennessee, at Knoxville, he enrolled yet again at this institution of learning and offically received a Master of Science degree in Agricultural Economics in December of 2001.

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