Acceptability of Irradiation Technology to Food Service Providers

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ABSTRACT

Restaurant managers in Kansas were surveyed to investigate attitudes toward food irradiation and willingness to buy and serve irradiated hamburger patties. Results indicate that 54% of restaurants would purchase irradiated ground beef if it were available at the same price as regular product. Only 11% indicated that they would not purchase irradiated product. Females and respondents from restaurants with a policy of cooking ground beef to at least 166F were less likely to choose irradiation. However, among respondents preferring irradiated to regular ground beef, females valued the process higher than males. Median willingness-to-pay for irradiation for females was estimated at 6.25c/lb and for males at 3.94c/lb.

Introduction

According to widely quoted statistics from the Centers for Disease Control, food-borne pathogens cause approximately 76 million illnesses, 325,000 hospitalizations and 5,000 deaths each year in the United States (5). Public awareness of food-safety and concern about the risk of food-borne illness has increased over the past decade. Numerous studies have examined consumers' knowledge, attitudes and perceptions about food safety, their willingness-to-pay for enhanced food safety, and their willingness to accept new technologies such as food irradiation that can enhance food safety. Regarding acceptability of irradiation, results point to an increasing level of acceptance by consumers and the importance of providing accurate information about the process (1,10).

However, with American households now spending over 42% of every food dollar away from home (9), it is clear that decisions made by food-service and restaurant managers will have an important bearing on the market share for irradiated food. Irradiation can provide important benefits to restaurants both in terms of reducing bacterial contamination in food preparation areas (and consequently reducing the probability of an incident of food-borne illness and the associated costs) and extending the shelf (refrigerator) life of certain products. It is perhaps surprising then that, as far as we are aware, none of the studies examining acceptance of irradiation have targeted restaurant managers.

In this paper we survey a sample of restaurant managers regarding their attitude to irradiation and their willingness to purchase and serve irradiated hamburger patties. We focus on hamburgers due to their widespread consumption – they accounted for approximately 76% of the 7.2 billion beef servings in commercial restaurants in 1999 (8) - and, following several well-

publicized outbreaks of *E.coli* infection and product recalls involving ground beef, its perceived riskiness in terms of food-borne illness.

Methods

A list of 697 Kansas restaurants was obtained from the Kansas Restaurant and Hospitality Association. After eliminating establishments such as coffee shops, pizza places, etc where hamburgers were unlikely to be served, the survey[1] was mailed to a total of 525 restaurants. After 2 weeks, follow-up surveys were mailed to non-respondents, and after an additional 2 weeks, reminder letters were sent to those who still had not responded.

The survey began by eliciting the respondent's current level of knowledge about irradiation (from "never heard of" to "know quite a bit about") and their attitude (positive, negative, or neutral) toward the process. It then provided some information about irradiation, including details about its effectiveness in destroying pathogenic bacteria, and the fact that irradiation leaves no residue and does not induce radioactivity. In a second version of the survey instrument (Version B) mailed to half of the sample, we included additional information about supermarket sales of irradiated hamburgers. Next, the question eliciting the respondent's attitude to irradiation was repeated and was followed by a series of questions about whether, and why or why not, the respondent would purchase irradiated hamburger patties for sale in his/her restaurant.

Respondents indicating a willingness to purchase the irradiated patties were then asked a double-bounded discrete choice question to elicit the level of premium they would be willing-to-pay (WTP) for irradiation. The WTP questions took the following format:

[1] A copy of the survey instrument is available on request

A. Would you pay $1.44 per pound for irradiated hamburger patties if regular patties cost $1.40 per pound?

_____ **Yes** (Please go to question B) _____ **No** (Please go to question C)

B. Would you pay $1.46 per pound for irradiated hamburger patties if regular patties cost $1.40 per pound?

_____ **Yes** _____ **No**

C. Would you pay $1.42 per pound for irradiated hamburger patties if regular patties cost $1.40 per pound?

_____ **Yes** _____ **No**

To estimate the distribution of WTP values, the price at which irradiated hamburgers were offered in this question varied across respondents. In addition to the set of prices illustrated above (i.e., $1.44, $1.46, and $1.42), we used two additional sets – ($1.46, $1.48, and $1.44) and ($1.48, $1.50, and $1.46) – for different sub-samples of respondents.

Next, the survey provided information about carcass pasteurization – a process used in beef slaughter facilities to reduce bacterial contamination. Respondents were informed that carcass pasteurization would kill over 99% of harmful bacteria but, because it was carried out at the carcass stage, it was possible for meat to become re-contaminated – unlike irradiation which, the information stated, was carried out on final packaged products so that recontamination would not occur before reaching purchasers. Following this information, respondents were asked whether they would prefer to purchase hamburger manufactured from pasteurized carcasses or irradiated hamburger if both were available at the same price.

The final questions in the survey elicited demographic information about the restaurant and the restaurant manager.

Results

Response rate

From an initial mailing of 525 surveys, 106 were returned complete. The second mailing to non-respondents resulted in an additional 43 responses. Following reminder letters, an additional 19 surveys were returned, for a total of 168. Allowing for 18 undelivered surveys, the overall response rate was 33%. Of the 168 returned, 150 were complete and useable.

Demographics

The average respondent was 48 years old and seventy-five percent were male. Fifty-six percent had a college degree or higher. Seventy-three percent indicated that they were the owner of or partner in the restaurant while twenty-seven percent were managers. The majority of responses, eighty percent, were from independent as distinct from chain restaurants. Average seating capacity was 136, years in operation was 20 years, and average sales were between $500,000 and $750,000. Average lunch entree price was between $5.00 and $7.50, while the average price of the dinner entree was between $7.50 and $10.

When asked about the restaurant's policy for serving ground beef, 28% said they cooked it as requested by the customers (even if rare), 26% said they cooked it to at least 160F (medium) while 41% said they cooked to at least 166F (medium-well).

Knowledge of and Attitude to Irradiation

Fifty-eight percent of respondents indicated that they knew at least something about food irradiation prior to the survey, with only 10% indicating that they had never heard about the process. When asked a similar question about carcass pasteurization, only twenty-seven percent

said they knew something about it, while forty-nine percent said they had never heard about the process.

Respondents had a generally favorable prior attitude toward food irradiation - 38% positive, 54% neutral, and only 8% negative. After reading the information contained in the survey, attitudes were even more favorable – 73% positive, 21% neutral, and 6% negative. Thus the overall effect of information was to move over 30% of the population from a neutral to a favorable stance. Only two individuals recorded a less favorable attitude to irradiation after reading the information.

Willingness to Purchase Irradiated Hamburgers

Eighty-one respondents (54%) indicated that they would buy irradiated hamburger patties if they were available at the same price as regular patties; fifty-three respondents (35%) said they were not sure while the remaining sixteen respondents (11%) said they would not buy the irradiated product. Of those sixteen half had indicated that their personal attitude to food irradiation was negative, but only three believed that irradiated foods were unsafe to eat.

Of eighty-one respondents who would purchase irradiated patties, sixty-six considered the irradiated product to be safer, but only sixteen thought their consumers would prefer it. It is not surprising then that only twenty-nine of those respondents (36%) would advertise the fact that they were serving irradiated burgers.

Later in the survey, when asked about their preference between irradiated and "carcass-pasteurized" patties, one hundred and two respondents (78%) preferred the irradiated product. Not surprisingly, all sixteen who preferred "regular" patties to irradiated patties also chose "carcass-pasteurized" patties in preference to irradiated patties. For those who preferred

irradiated to "regular" (i.e., the 81 respondents referred to above), 86% of them preferred irradiated product over "carcass-pasteurized."

We used an ordered-probit model to investigate relationships between the choice of irradiated hamburger and the respondent's characteristics or characteristics of their restaurant. We assigned a value of zero to the dependent variable for individuals who would not purchase irradiated product, a value of 1 for those who were unsure, and a value of 2 for those who would. Explanatory variables included the respondent's prior knowledge of irradiation, their gender, age, and education level (whether they had a B.S. equivalent or higher), whether the restaurant was a chain or independent, and the restaurant's policy for cooking ground beef (a dummy variable for restaurants always cooking ground beef to at least medium-well).

Table 1 presents definitions and summary statistics for the explanatory variable in addition to the estimated ordered probit coefficients. Several studies (e.g., 3) have shown that the more information consumers have about irradiation the greater the likelihood they will choose irradiated products. Here we find a similar (although not statistically significant) effect for restaurant managers – the positive coefficient on 'KnowIrrad' suggests that the more knowledgeable the respondent is about the process the more likely they are to choose irradiated product. Interestingly, the more educated the respondent the less likely they are to choose irradiation – the coefficient on 'BS' (respondents having a BS degree or higher) is negative and statistically significant. However, Fox *et al*. (1) found that individuals with higher levels of education were more likely to be classified as either opponents or proponents of irradiation and less likely to be neutral on the subject. In view of that finding the result here is not altogether too surprising.

The coefficient on ‘female’ is negative and close to being statistically significant at the 10% level. Prior studies have typically found female consumers to be less accepting of the irradiation process (e.g. 11). This gender effect would seem to also apply to restaurant managers. Consumer studies have generally not found a consistent effect associated with age, but in this group older respondents were significantly more likely to choose irradiated product.

Restaurants with a policy of cooking ground beef to at least medium-well doneness (166F) were less likely to choose irradiated product. This is not surprising because irradiation would presumably provide a greater benefit in terms of risk reduction for restaurants that cook to a lower temperature (medium = 160F) or to the level requested by the customer. Interestingly, respondents associated with chain restaurants were more likely to indicate that they would purchase irradiated product. The additional information about supermarket sales of irradiated ground beef in one version of the survey (the variable ‘SalesInfo’) had no impact on responses See Mulik (7) for additional details.

Willingness-to-pay for Irradiation

Table 2 summarizes the data from the double-bounded willingness-to-pay question. The first column shows the initial price at which irradiated ground beef was offered – this amount varied from $1.44/lb to $1.48/lb across three versions of the questionnaire, while the price for regular ground beef was held at $1.40/lb. Depending on the respondent’s choice at the initial price, they were directed to a second choice question at a price either 2c/lb lower or higher than the initial price. Thus, given the two-part nature of the question there are, for each respondent, four possible responses: both answers are "yes"; both answers are "no"; a "yes" followed by a "no"; and a "no" followed by a "yes".

With irradiated ground beef priced at $1.44/lb, 29 of 47 respondents (62%) chose the irradiated product. Of those 29 individuals, 21 indicated they would be willing to purchase irradiated product at $1.46/lb. At higher initial prices ($1.46 and $1.48/lb), fewer individuals chose the irradiated product.

Hanemann et al. (4) described the procedure for estimating a regression model using double-bounded discrete choice data. Briefly, a Yes-Yes response indicates that the respondent's true WTP is above the higher price offered in the 2nd part of the WTP question, a No-No indicates WTP is below the lower price, etc. Individual and restaurant characteristics in addition to the prices being offered are expected to influence the probability of observing a particular type of response (yes-yes, yes-no, etc) and thus influence WTP. Hanemann et al describe the derivation of the associated log-likelihood function and how the estimated parameters are used to find median WTP values for the sample. We specified a model using the same set of explanatory variables reported in table 2 and used the TSP statistical package to estimate the model. Parameter estimates are reported in table 3.

Only the coefficient on offer price is statistically significant perhaps reflecting the relatively low number of observations (N=124). Of the other estimates it interesting to note the positive and relatively large coefficient associated with female gender. While females were less likely to choose irradiated product (table 2), among those who preferred irradiated to regular product females had higher willingness-to-pay. Median WTP was calculated as the intercept parameter, α, divided by the slope parameter, β, in a model where all slope parameters except that on price (B) are set to zero. For females, median willingness-to-pay for irradiation was estimated at 6.25c/lb and for males at 3.94c/lb.

Discussion

We investigated restaurant managers' acceptance of irradiation and their willingness to buy and pay a premium for irradiated hamburger patties. Fifty-four percent of respondents indicated that they would buy irradiated hamburger patties if they were available at the same price as regular patties while only eleven percent indicated that they would not. Female respondents and those with a college degree were less likely to buy irradiated patties, as were respondents from restaurants with a policy of serving hamburgers done at least medium-well.

Among respondents preferring irradiated to regular patties, females appeared to place a higher value on irradiation than did males. Median willingness-to-pay was estimated at 6.25c/lb for females and 3.94c/lb for males. These premiums are significantly lower than those typically observed in consumer studies (see 2). This is not surprising since presumably for restaurants, ground beef purchases are a much larger component of total outlays than for a typical consumer. The average premium observed here is marginally lower than the 6c/lb that Dairy Queen™ franchises in Minnesota[2] are currently reported to pay for irradiated ground beef (6). But if restaurant customers, like retail consumers, are willing to pay a premium for irradiated products, the gap between consumer valuation and the cost of irradiation suggests a potentially profitable opportunity for the restaurant trade.

Perhaps the most important finding in this study is that it illustrates, as have many others, both the need for education about irradiation and the positive impact of providing that education. Ten percent of restaurant managers who responded had never heard of irradiation and an additional thirty-two percent had heard of it but didn't know much about it. The information

[2] Dairy Queen initiated a trial with irradiated burgers in 6 franchises in Minnesota in Feb. 2002. Its initial success led to its expansion to 147 franchises by October 2002. While franchises were reportedly paying an additional 6c/lb (1½ c/patty) for irradiated ground beef, the restaurants were not passing the cost increase along to customers.

provided about irradiation in the survey, brief as it was, had the effect of shifting almost a third of respondents from a neutral to a positive attitude toward the process.

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TABLE 1

VARIABLE DEFINITIONS, MEANS, AND ORDERED PROBIT RESULTS

Variable	Definition	Mean	Ord. Probit*	p-value
Constant			0.52	0.30
KnowIrrad	Categorical: 0 = 'never heard of food irradiation', to 4= 'knew quite a bit about it. '	1.58	0.18	0.19
BS	Education level: 1 = respondent has BS or higher, 0 otherwise	0.56	-0.41	0.08
Female	1 = female	0.25	-0.37	0.12
Age	Age in years	47.8	0.21	0.03
MediumWell	Ground beef cooking policy: = 1 if always cooked at least med-well	0.41	-0.57	0.01
Chain	1 = chain restaurant; 0 otherwise	0.21	0.45	0.10
SalesInfo	1 = survey included information about irradiated ground beef sales	0.52	0.14	0.48

* Dependent variable = 0 if respondent would not buy irradiated hamburger patties at same price as regular, 1 if not sure, and 2 if they would buy irradiated.

TABLE 2

DISTRIBUTION OF WILLINGNESS TO PAY RESPONSES

Initial Price	Total N	Yes-Yes*	Yes-No	No-Yes	No-No
$1.44/lb	**47**	21	8	4	14
$1.46/lb	**40**	9	3	5	23
$1.48/lb	**40**	13	2	3	22

* Yes-Yes → respondent indicated that they would be willing to purchase irradiated patties at the initial offer price and at the higher price – i.e., the initial price plus 2c/lb. No-No → respondent is unwilling to purchase irradiated patties both at the initial price and a price 2c/lb below the initial price.

TABLE 3

DOUBLE BOUNDED LOGISTIC REGRESSION RESULTS

Variable	Coefficient	t-statistic
Constant (α)	0.353	0.37
KnowIrrad	0.154	0.62
BS	-0.154	-0.41
Female	0.509	1.29
Age	0.002	0.12
MediumWell	0.305	0.82
Chain	-0.467	-1.05
SalesInfo	0.441	1.22
Offer price (β)	22.04	5.63