Determinants of Unsafe Hamburger Cooking Behavior

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For presentation at the American Agricultural Economics Association Meetings,
Salt Lake City, Utah, 1998.

Abstract

Using a national consumer survey on hamburger cooking practices, this study suggests that taste, tenderness, and juiciness are somewhat more important than food safety knowledge and much more important than risk perceptions to consumers in the decision to cook hamburgers lightly. Newspapers were the most important information source associated with higher food safety knowledge while TV and radio were the most important information sources associated with higher perceived risk of lightly cooked hamburgers. Only education and urban residence were important direct demographic effects; other demographic variables were associated with behavior through knowledge and attitudes.

The authors are grateful to Sara Fein, Marjorie Davidson, and Ed Mozes for advice on the questionnaire, to Jay Variyam and Anthony Yeboah for helpful suggestions on the analysis, and to Michael Ollinger and Tanya Roberts for comments on the manuscript. Any errors are the sole responsibility of the authors. The opinions expressed herein are those of the authors and do not necessarily represent the U.S. Department of Agriculture, the Economic Research Service, North Carolina Agricultural and Technical State University, or CSR, Inc.

Introduction

Recent incidents of food safety problems have heightened the concern for the safety of the food in the U.S. According to the Council for Agriculture and Science Technology (CAST), foodborne pathogens cause 6.5 - 33 million cases of human illness in the United States and up to 9,000 deaths each year (CAST 1994). In recent years *E. coli* O157:H7 has emerged as a source of microbial contamination of the food and has attracted attention from both the public and policy makers because of the relatively high death rate associated with illness from this pathogen (American Gastroenterological Association, 1995, Petersen et al. 1996). Consumption of hamburgers, particularly lightly cooked hamburgers has been identified as a risk factor in *E. Coli* O157:H7 infection (Kassenborg et al., 1998). Ground beef can also be contaminated with other pathogens such as *Salmonella* and *Campylobacter*.

Thorough cooking of hamburgers destroys *E. coli* and other pathogens. However, despite previously publicized outbreaks of foodborne illness and recommendations to avoid eating lightly cooked meat, some persons continue to eat lightly cooked or raw meat and run the risk of contracting foodborne illness. The 1993 FDA Food Safety Survey reported that of 1,620 respondents, almost one quarter reported that they usually eat their hamburgers rare, medium rare, or medium, where the respondent refers to a hamburger that is pink in the center as medium (Levy and Fein, 1994). While new food safety regulations are intended to reduce the probability of pathogen contamination during processing, consumer education is also required to minimize the impacts of any remaining contamination. Consumers already receive consumer education from meat labels, supermarket brochures and other materials from FSIS and state and local agencies. The Clinton Administration's Food Safety Initiative includes a specific focus on expanding consumer education to improve safe handling practices.

Targeting and designing messages for food safety education requires information about which groups have low knowledge levels or attitudes which conflict with food safety messages, the effect of knowledge and attitudes on behavior, and the effect of demographics and information sources on knowledge and attitudes. Prior to the study reported here, FDA conducted national studies in 1988 and 1993 that included information on hamburger cooking behavior as well as food safety knowledge and risk perceptions (Levy and Fein 1994). A study of Texas consumers also included the role of hamburger style preferences, an important component of behavior (McIntosh, et al. 1994).

This study provides more up-to-date national data, and for the first time includes hamburger style preferences in a national study. The objectives of this study are (1) to examine the role of knowledge, risk perceptions, and palatability attributes in determining food preparation behavior; (2) to examine the role of information sources and illness experience in determining knowledge and risk perceptions; (3) to identify target groups for consumer food safety education; and (4) to identify important messages for food safety education.

The rest of the paper is organized as follows: the next section describes a framework for modeling safe cooking behavior. This is followed by a section on data used in the study and sample characteristics. The next section describes the empirical specification and estimation methods. The final section is a discussion of the results of the analysis and their implications.

A conceptual framework for safe cooking behavior

Consumer behavior researchers outside of economics have used the Health Belief Model to explain health preventive behaviors including food safety behavior (Schafer et al. 1993). The model assumes that individuals make rational decisions about health behavior based on awareness of a risk,

knowledge of the risk, and judgement about the level of the risk. Behavior is modeled as a function of a first set of beliefs that provides motivation for taking action and a second set that includes modifying factors that enhance or impede such action, such as the consumer's general motivation to improve his or her health, and the belief that his or her efforts will be effective, called self-efficacy. McIntosh's study of hamburger preparation in Texas modifies the model to include habits and attitudes which are not necessarily "rational", including hamburger style preferences.

In the recent economics literature on consumer demand for health-enhancing goods such as food safety and nutrition, the theory of household production (Becker 1965) and the theory of demand for characteristics (Lancaster 1971) are adapted to include health as an argument in the utility function, a health production function in the constraints, and the prices of health producing goods in the budget constraint (e.g. Variyam et al. 1995). Information can be conceptualized as affecting both the marginal utility of health and the perceived marginal physical product of health producing goods. The optimal consumption of health producing inputs (including time devoted to health-producing activities) is then a function of the prices of these inputs and the parameters of the utility and health production functions, including information. This framework can be easily reconciled with the Health Belief Model (and McIntosh's extensions) by interpreting the utility function as a description of the consumers' desire for better health, and interpreting the health production function as a perceived function incorporating the consumer's level of self-efficacy. The utility maximization framework has the advantage that it can very naturally accommodate a dislike for well done hamburgers as a cost of safe cooking behavior. Similarly, the cost could conceptually include any extra preparation steps needed to maintain the desirable qualities of a well-done hamburger or extra fat content accepted to improve the palatability of a well done hamburger.

Data and sample characteristics

Data were collected by the Market Research Corporation of America as a supplement to their on-going Menu Census Survey during March 1996 - February 1997. The Menu Census Survey is a nationally representative mail survey in which respondents complete a 2-week diary on food consumption followed by a questionnaire on attitudes related to food purchases. The survey covers about 2000 households who are selected from a 12,000 household purchase diary survey. Both the larger sample and the Menu Census Survey are selected as stratified samples to match U.S. Census data for geographic and demographic cells. Data for this study were obtained from a supplement to the attitude questionnaire which focused on hamburger preparation. The supplement was completed by the household adult with the most recent birthday in order to ensure equal probability of selecting male and female heads of households. The survey supplement was completed by 1133 individuals, of which 571 provided complete responses for use in this study.

To identify consumers who cook hamburgers lightly, the supplemental questionnaire asked respondents how they usually cook hamburgers for themselves to eat (rare, medium rare, medium, etc.) and consumers who usually cook hamburgers medium were asked what color indicates a medium hamburger. To measure food safety knowledge, respondents were asked why the amount of time a hamburger is cooked would affect a person's chances of getting sick from eating the hamburger. Answers were considered correct if they included the concept that heat kills bacteria. To measure perceived risk, respondents were asked to rate each hamburger style on the chances of getting sick (1=not at all likely...4=very likely). To measure perceived palatability of different hamburger styles, respondents were asked to rank hamburgers at each level of doneness on juiciness, taste, and tenderness (codes were converted so that 1=lowest ranked...5=highest ranked). The palatability measures were averaged for each hamburger style, and then averaged for rare, medium

rare and medium/pink to derive an index of palatability for lightly cooked hamburgers. To measure risk importance and palatability importance, respondents were asked to assign an importance level to the chances of getting sick, the juiciness, flavor, and tenderness of a hamburger patty (1=not at all important...4=very important). Respondents also answered questions about the frequency of hamburger consumption, whether they had ever been ill from hamburgers, other meats, poultry or seafood, and whether they had heard or read about safe preparation from several information sources. Demographic data were available from elsewhere in the Menu Census Survey. The sample of responses used in the study differs from U.S. Census totals for some groups (Table 1): for example, the sample is 95% white, compared to 83% for the U.S. population in 1994 (Bureau of the Census 1995). Similarly, household heads with college degrees make up 51% of the sample, compared to 23% of the U.S. population in 1996. The geographic distribution of the sample somewhat overrepresents the Midwest and underrepresents the South: 31% of the sample are from the Midwest (vs. 24% of the U.S. population) and 26% of the sample are from the South (vs. 35% of the U.S.) Twenty-one percent of the sample is from the West (vs. 22% for U.S.), and 22% are from the Northeast (vs. 20% of the U.S. population).

Nearly one-quarter of the sample reported that they cook hamburgers lightly (Table 1). Slightly over half correctly answered that heat kills bacteria. The average score for perceived risk was 2.6 out of 4 (very lightly), in between somewhat likely and likely. The average palatability score for hamburgers cooked lightly was 3.2 out of 5. On average, importance ratings were very similar for risk and palatability; respondents rated the importance of risk and palatability as 3.2 and 3.3 out of 4, respectively, both slightly higher than “important”.

Fourteen percent of the sample had ever been sick from hamburgers, other meats or poultry, or seafood. Newspapers and TV/radio were cited most frequently as information sources about how

to cook hamburgers safely, with both cited by 71% of the sample. Family, relatives, friends and colleagues, magazines, and labels were also important, cited by 61%, 58%, and 50% of the sample, respectively.

Empirical specification and estimation

We model the probability of cooking hamburgers lightly and attitudes which affect cooking behavior as a simultaneous system of six equations:. The behavior Cooks Hamburgers Lightly**,** *L***,** is modeled as a function of Food Safety Knowledge, *K*, the Perceived Risk of a lightly cooked hamburger, *R*, Risk Importance**,** *RI*, the Perceived Palatability**,** *P***,** of lightly cooked hamburgers, Palatability Importance, *PI*, and a vector of demographic variables, ***D.*** Definitions of K, R, RI, P, PI, and demographic variables included are explained in Table 1.

Because *K*, *R*, *RI*, *P*, and *PI* may be endogenously determined by factors influencing *L*, these variables are modeled as well. We modeled *K*, *R*, and *RI* as a function of exposure to food safety information from several sources, ***I***, foodborne illness experience, *E*, frequency of hamburger consumption, *F*, and demographic variables. Definitions of foodborne illness experience, frequency of hamburger consumption and information sources examined are explained in Table 1. We modeled *P* and *PI* as a function of demographic variables and frequency of hamburger consumption. The model is summarized as:

$$L = L\,(K, R, RI, P, PI, \mathbf{D})$$

$$K = K\,(\mathbf{I}, E, F, \mathbf{D})$$

$$R = R\,(\mathbf{I}, E, F, \mathbf{D})$$

$$RI = RI\,(\mathbf{I}, E, F, \mathbf{D})$$

$$P = P\,(F, \mathbf{D})$$

$PI = PI\ (\ F,\ \mathbf{D}\ ).$

Food Safety Knowledge and Cooks Hamburgers Lightly were estimated as probit models. Both were corrected for heteroskedasticity; in the equation for Food Safety Knowledge, errors were modeled as a function of the presence of children in the household; in the equation for cooks Hamburgers Lightly, errors were modeled as a function of monthly income. Risk Perception, Risk Importance, Perceived Palatability and Palatability Importance were estimated using OLS. The original survey questions for these variables were answered in ordered categories as described above; equations explaining those variables would have been more appropriately estimated using a limited dependent variable technique. But the model variables were created as averages of more than one category, resulting in distributions that were closer to continuous. Thus OLS estimation was acceptable.

Simultanaeity of the system was tested using the test described by Smith and Blundel (1986). Perceived Risk, Risk Importance, and Perceived Palatability were found to be recursively endogenous. Food Safety, and Palatability Importance were found to be non-recursively endogenous; the predicted values for these two variables were used in the estimation of the Cooks hamburgers lightly equation, and actual values were used for the other attitude variables. Because predicted values are included, standard errors reported by the LIMDEP Program for the Cooks Hamburgers Lightly equation are biased; therefore jackknife procedures (Efron and Gong 1983) were used to estimate standard errors for this equation.

Results and discussion

Respondents with higher food safety knowledge, higher perceptions of risks of lightly cooked hamburgers, and who are high school graduates are all significantly less likely to cook

their hamburgers lightly. Respondents in large metropolitan areas are also less likely to do so, at a weaker level of significance ($p < 0.15$). Respondents who rank the palatability of lightly cooked hamburgers more highly are significantly more likely to cook their hamburgers lightly.

Risk importance and palatability importance were included in the cooking equation to distinguish between the perception of risk and palatability and the weight that consumers give these attributes in cooking choices. Neither was significant, suggesting that the risk and palatability ratings by respondents may capture the importance of these attributes as well.

The results of this equation have important implications for the design of consumer education. The size of the palatability effect (0.33) is slightly higher than the knowledge effect (-0.25), but much larger than the perceived risk effect (-0.02). Knowledge was measured as a dummy variable equal to 1 if the respondent understood that cooking hamburgers fully kills bacteria. This suggests that the respondent's understanding of why thorough cooking makes hamburger safer can matter more than just the perception that lightly cooked hamburgers are less safe. Thus, consumer education which includes the message that thorough cooking kills bacteria may be more effective than just the message that thorough cooking is safer. The large palatability effect suggests that designers of consumer education should explore methods to maintain the palatability of well-done hamburgers. Finally, the fact that few of the demographic variables were significant in this equation suggests that food safety knowledge, risk perceptions and perceived palatability of lightly cooked hamburgers may explain most differences in cooking behavior across demographic groups.

Respondents from households with wives under 29, those who consume hamburgers less frequently, and those who reported getting food safety information from newspapers, TV or radio, or other sources were all significantly more likely to correctly answer that thoroughly

cooking hamburgers kills bacteria. Respondents with higher incomes were also more likely to, at a weaker level of significance ($p < 0.15$). Respondents who reported learning about cooking hamburgers from labels were significantly less likely to identify the role of cooking in killing bacteria.

Respondents who reported getting food safety information from family and friends, from TV and radio, and those who had experienced foodborne illness rated the risk of lightly cooked hamburgers more highly than other respondents. Higher income respondents also gave higher risk ratings for lightly cooked hamburgers but again, this effect was small (0.05) and weak ($p < 0.15$). Respondents who reported getting food safety information from magazines or brochures gave significantly lower risk ratings to lightly cooked hamburgers. These results suggest the need for further exploration of the role of information source and the endogeneity of information sources. Respondents from the South and Northeast also gave lower ratings to the risk of lightly cooked hamburgers, as did respondents from households with wives under 29. While the youth effect is weak ($p < 0.15$), it is in the opposite direction as the youth effect on knowledge. The size and significance of illness experience effect (1.05, $p < 0.01$) suggest that effective consumer food safety messages should convey a clear picture of the consequences of foodborne illness.

The associations between information sources and food safety knowledge and perceived risk have important implications for consumer education as well. Information from newspapers was more closely associated with knowledge of the role cooking in killing bacteria than with the actual risk ratings of lightly cooked hamburgers. In contrast, information from TV and radio as well as family and friends was more closely associated with higher risk ratings than with knowledge of how cooking makes hamburgers safer. The negative association between labels and knowledge may be due to the lack of emphasis on bacteria in the label. The negative

association between brochures and perceived risk should be explored further. The brochures may not convey the risk of lightly cooked hamburger, but the endogeneity of information sources should be explored as well. For example, if college educated respondents are more likely to use brochures, use of brochures may be negatively associated with perceived risk because college educated respondents have lower perceived risk.

The determinants of high palatability ratings for lightly cooked hamburgers offer some information for targeting any messages attempting to increase the acceptance of well-done hamburgers. White respondents and those who consume hamburgers less frequently gave higher palatability rankings to lightly cooked hamburgers, while respondents from the Midwest gave lower rankings. Coefficients for South and Northeast were also negative (though not significant), suggesting higher palatability ranking of lightly cooked hamburgers in the West. The effect of higher income was positive, but very small and not significant. The effect of high school education was negative (suggesting a positive effect of college education), but small and not significant.

Table 1. Model variables and sample statistics

Cooks hamburgers lightly	Percent: 23%
Food Safety Knowledge	Correct: 51%
Perceived Risk	Average score: 2.6 out of maximum 4. (1=Not at all likely...4=Very likely)
Perceived Palatability	Average index: 3.2 out of 5 (5 is *highest* ranked)
Risk Importance	Average: 3.2 out of 4 (1=Not at all important... 4=Very important)
Palatability Importance	Average rating: 3.3 out of 4 (1 = not important...4 = very important)
Lower Frequency	Average: 2.2 out of 5 (About 2-3/month)
Illness Experience	Percent ill from any source: 14%
Information Sources: "Family, relatives, friends, colleagues"	Yes: 61%
Newspaper	Yes: 71%
Magazine	Yes: 58%
Cookbook	Yes: 33%
"Television, radio"	Yes: 71%
Physician	Yes: 27%
"Label or instructions on a package"	Yes: 50%
"Brochures at grocery stores"	Yes: 30%
"Government sources (hotlines, extension offices)"	Yes: 31%
Other Sources	Yes: 15%
South	26%
Midwest	31%
Northeast	22%
White	95%
High School	40%
Grammar School	9%
Young Homemaker (under 29)	3%
Senior Homemaker (65 or over)	37%
No children	51%
Big city (500,000 or over)	42%
Small town/Rural (10,000 or less)	24%
Monthly Income (in Thousands)	Average: 2.7

Table 2. Determinants of Cooking Hamburgers Lightly, March 1996 - February 1997.

Determinant	Food Safety Knowledge	Perceived Risk	Risk Importance	Perceived Palatability	Palatability Importance	Cooks Hamburgers Lightly
Knowledge						* -0.25
Perceived Risk						* -0.02
Risk Importance						0.0003
Perceived Palatability						*** 0.33
Palatability Importance						0.09
South	-0.03	*-0.27	-0.02	-0.08	-0.08	0.03
Midwest	-0.03	-0.12	0.1	** -0.12	-0.04	0.03
Northeast	-0.08	**-0.37	-0.03	-0.02	-0.02	0.05
Young Homemaker	* 0.45	(w) -0.49	-0.24	0.01	0.01	0.08
Senior Homemaker	-0.08	-0.05	-0.12	0.04	-0.001	-0.02
Monthly Income	(w) .03	(w) 0.05	* 0.06	0.001	0.02	0.00004
White	0.07	0.001	-0.09	*** 0.28	-0.03	0.05
High School	-0.01	0.14	** 0.25	-0.06	-0.04	*** -0.09
Grammar School	0.002	-0.24	0.17	0.01	0.13	-0.04
No Children	0.02	0.02	-0.04	0.004	-0.02	0.01
Big City	-0.08	-0.03	0.15	-0.02	0.04	(w) -0.05
Small Town/Rural	0.05	0.16	0.16	-0.06	0.09	-0.02
Lower Frequency	* .05	-0.06	-0.03	*** 0.07	0.002	
Family,etc.	-0.05	* 0.21	* 0.20			
Newspaper	*** 0.30	0.15	* -0.23			
Magazine	-0.06	(w) -0.17	* -0.20			
Cookbook	-0.09	0.14	0.02			
TV\Radio	* 0.12	*** 0.45	*** 0.34			
Physician	-0.06	-0.37	0.11			
Label	** -0.12	-0.06	0.03			
Brochure	0.08	* -0.21	* -0.25			
Government	-0.02	0.32	* 0.22			
Other Information	* 0.15	-0.18	0.07			
Illness Experience	0.09	*** 1.05	0.08			
Adj R^2		0.08	0.02	0.02	-0.01	
Correct Predict	0.62					0.82

Blank: Not included. Significance levels: (w) < 0.15; * < 0.10; ** < 0.05; *** <0.01. In "Cooks Hamburgers Lightly" equation, predicted values used for knowledge and palatability importance, and standard errors estimated by jackknife.

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