**Comparison of National and Poor Households:
Results of a Survey of Consumer Knowledge and Risk Perceptions
of Food-Related Biotechnologies**

Robin Douthitt
University of Wisconsin–Madison

Lydia Zepeda
University of Wisconsin–Madison

Deana Grobe
Oregon State University

January 1996

Acknowledgments

Table of Contents

Executive Summary

The primary goal of this study was to better understand what factors influence consumers' risk perceptions toward recombinant bovine growth hormone (rbGH) and recombinant porcine growth hormone (rpGH), and to determine whether these risk perceptions differ between poor and nonpoor samples. This report summarizes the findings of a national survey of household food shoppers measuring consumer knowledge and risk perceptions of rbGH and rpGH, one year after the FDA approved rbGH for commercial use. A total of 1,910 interviews, averaging sixteen minutes in length, were completed. The findings were reported by comparing poor and nonpoor samples, where the poor sample was composed of those respondents who met the USDA poverty guideline requirements.

We found that the poor respondents, when compared to the nonpoor respondents, were less aware of biotechnology and rbGH. A smaller percentage of the poor sample approved of biotechnology than the nonpoor sample, and a larger percentage of poor respondents disapproved of the use of rbGH. But awareness of and willingness to purchase rpGH-treated pork if approved by the FDA was similar for both samples. In both samples, the majority stated there had been no change in the amount of milk they bought since the FDA approved rbGH. However, 10.6 percent of aggregate fluid milk consumption was identified by respondents as having come from untreated herd milk. Similarly, a majority of the poor and nonpoor samples stated they thought milk should be labeled so consumers could distinguish between milk from treated and untreated herds. More respondents from the nonpoor sample preferred untreated milk than from the poor sample.

Respondents from the poor sample were more likely to be concerned about the current safety of rbGH with respect to human ill health effects, and they were also more likely to be concerned about the future discovery of human ill health effects than the nonpoor respondents. In order to understand the differences in risk perception between the two samples, we compared the poor and nonpoor

respondents who were concerned to those who were not concerned about the future discovery of health risks. The findings are as follows:

- For both samples, the concerned group disagreed with the milk-belief statements "milk is a natural product" and "milk is a pure product" more so than the not concerned group.

- The nonpoor sample ranked physicians as their most trustworthy food-related information source, followed by the USDA and FDA, while the poor sample ranked the USDA as most trustworthy, followed by farmers' organizations and the FDA. Both samples ranked advertisements as being the least trustworthy food-related information source.

- The concerned group from both samples disagreed that "bGH is naturally found in milk"; more respondents from the not-concerned group tended to agree with this statement.

- The concerned group had strong agreement with the locus-of-control questions regarding the future of today's children and feeling helpless in the world, for both samples.

- The concerned group members were also more likely to identify with environmentalists and animal rights groups. A larger percentage of poor respondents strongly identified with these two groups than nonpoor respondents.

The report also analyzed the differences based on gender. To summarize:

- Males were more aware of biotechnology and rbGH.

- Males had a greater overall approval of biotechnology and a more favorable opinion of rbGH.

- Females were less likely to want to purchase rpGH-treated pork if it is approved by the FDA.

- Females were more concerned about current and future discovery of rbGH's health effects.

- A greater percentage of females preferred milk from untreated herds.

- More females felt there should be labels to distinguish between milk from treated and untreated herds.

Comparison of National and Poor Households:
Results of a Survey of Consumer Knowledge and Risk Perceptions
of Food-Related Biotechnologies

INTRODUCTION

This report summarizes the results of a national survey of food shoppers which measured consumer knowledge and risk perceptions of two food-related applications of biotechnology. By developing risk-perception measures, the authors will be able to determine which factors influence consumers' risk perceptions and suggest what role regulators have in influencing those perceptions. Although biotechnology is being applied to food-production processes, we limit our work specifically to consumers' risk perceptions of recombinant bovine somatotropin (rbGH) and recombinant porcine somatotropin (rpGH). An evaluation of rbGH and rpGH provides a comparison of whether or not there are greater risk perceptions for one biotechnology in particular, or if there are similar perceptions of risk for both biotechnologies. They provide an interesting contrast, particularly because they are similar substances; rpGH use endows pork with "benefits that consumers value, leaner pork products," while "consumers do not perceive a benefit from rbGH" (Senauer, Asp, and Kinsey 1991, p. 264).

Previous research has shown inconsistencies regarding income's effect on consumers' risk perceptions of rbGH-treated herd milk (McGuirk, Preston, and Jones 1992; Grobe and Douthitt 1995). Thus, a primary goal of the study was to better understand the conceptual relationship between income and consumers' risk perception of two specific food-related biotechnologies. The supporting objectives were to analyze the correlates to consumer risk perception and the impact of commercial use of rbGH on consumer demand for fluid milk, one year after rbGH's approval by the Food and Drug Administration (FDA).

This report will specify the survey design and interview, sample composition, and response rates. We then present our findings in a descriptive and demographic summary of the poor and nonpoor samples. Findings are presented for the following issues:

- awareness, approval, and knowledge of food-related biotechnology applications

- concern about current health effects and the future discovery of health effects

- perceptions of risk associated with biotechnology food applications, including consumer beliefs about food product characteristics, confidence in federal food regulators, and personal experiences and circumstances that may influence risk perceptions

- consumer demand for fluid milk in response to the commercial use of rbGH

- preference for milk from rbGH-treated or untreated herds,

- response to labeling to distinguish between milk from rbGH-treated versus untreated herds, and

- gender comparison regarding food-related biotechnologies.

SURVEY DESCRIPTION

Survey Research Methodology

Focus group sessions were first conducted to explore qualitative insights regarding the effects of income and gender on the perceived risks of biotechnologies. Three convenience samples of individuals who lived in or near Benton County, Oregon, were selected, and focus groups were conducted on November 17, 28, and 29, 1994. Different target groups were represented in each of the samples, including a sample of low-income women (n=8), middle- to high-income women (n=9), and middle- to high-income men (n=7). The focus group results were used to help clarify vague empirical measures of risk-perception antecedents, as well as to assist in formulating more concise questions for the survey instrument.[1]

Survey questions were designed according to theories of risk perception (Eom 1993; Hadden 1989; Grobe and Douthitt 1995) and the results of the focus group sessions. Variables defining risk perception were incorporated into the question design. Surveys from other studies that have evaluated

rbGH and food safety were used as references for particular question wording (Sterngold, Warland, and Herrmann 1994; McGuirk, Preston, and Jones 1992; Research Alliance 1990; Slusher 1990; Smith and Warland 1992). The survey instrument was designed to analyze whether there were certain factors or experiences (personal, health-related, beliefs, attitudes) influencing consumers to feel there was a risk associated with the rbGH product. The survey instrument design also incorporated the impact of the commercial use of rbGH one year after its approval by the FDA. Thus, the survey instrument included items to evaluate: personal circumstances and health risk factors that might influence consumers' risk perceptions, factors of risk perception specific to the biotechnologies (rpGH and rbGH), the effects of commercial adoption of rbGH on consumer demand for fluid milk, consumer self-protection or risk-averting response, and support for and availability of product labeling.

Three different survey techniques were used to allow for validity testing of responses for a particular question order or word usage. For four of the questions, a randomization of responses was used.[2] For example, when asking about milk beliefs, four belief statements were randomized for each respondent. The second survey technique alternated the use of the terms "administering" and "injecting" rbGH for two questions.[3] The third technique alternated the block of questions for rbGH and the block of questions for rpGH,[4] thus allowing testing for possible influence of the rbGH discussion on the discussion of rpGH and vice versa.

Survey Interview

A nationwide survey of primary household food purchasers' attitudes toward the use of rbGH and rpGH was conducted by the Letters and Science Survey Center (LSSC) from March 1 through June 27, 1995, approximately one year after the FDA approved the commercial use of rbGH. (The LSSC is a unit of the College of Letters and Science at the University of Wisconsin–Madison.) A total of 1,910 interviews averaging sixteen minutes in length were completed. The adjusted response rate for the entire sample frame was 56.1 percent (see Table 1).

Thirty-eight survey interviewers were briefed on the background and goals of the study, the funding source, and a detailed description of the instrument. A pretest consisting of nineteen completed interviews was performed in mid-February 1995, and the survey instrument was revised based on interviewers' and pretest respondents' input. The interview was conducted using a Computer-Assisted Telephone Interview (CATI) system. The text of each question appeared on the screen for the interviewer to read. The routing through the interview was computer-determined, based on programmed skip patterns. Question wording could be adapted according to answers previously given in the interview. The computer allowed only valid responses; when an invalid response was entered, the computer asked the interviewer to reenter the response.

Telephone calls were conducted at all times of day and night, including weekends. However, most interviews were completed in the evening and on weekends. When each telephone number was called, the interviewer would determine whether or not a working residential number had been reached. Each residential number was then screened to verify that it was associated with a household. Working residential households located in the continental United States were then further screened to determine whether there was at least one household resident who was 18 years or older. Finally, the person selected as the interview respondent was the person identified as a household resident "who is age 18 or older and primarily responsible for the household's food purchasing decisions." Only that person could be interviewed; no substitutions were allowed.

TABLE 1

Response Rate Calculations

Sample	Response Rate

Entire Sample: National, WI, VT, Poor

$$\frac{1910}{1910+1038+145+156+5+(.602*248)} = \frac{1910}{3403}$$

56.1%

National Sample

$$\frac{969}{969+585+80+77+1+(.576*131)} = \frac{969}{1787}$$

54.2%

Wisconsin Sample

$$\frac{187}{187+77+6+8+(.584*14)} = \frac{187}{286}$$

65.3%

Vermont Sample

$$\frac{186}{186+73+5+15+(.513*29)} = \frac{186}{294}$$

63.3%

Poor Sample: 20th Percentile

$$\frac{394}{394+209+37+22+(.702*47)} = \frac{394}{695}$$

56.7%

Poor Sample: 10th Percentile

$$\frac{174}{174+94+17+34+4+(.693*29)} = \frac{174}{343}$$

50.7%

Note: The adjusted response rate was calculated as follows:

$$\frac{completed}{completed + refused + away\ for\ duration + R\ not\ available + other + (adjusted)(no\ answer)} = .$$

Sample Composition

The 1,910 completed interviews consisted of 969 completions from a National sample frame, 187 completions from a Wisconsin sample frame, 186 completions from a Vermont sample frame, and 568 completions from a Poor sample frame. The states of Wisconsin and Vermont were oversampled because of their food labeling regulations on rbGH. Wisconsin has established voluntary labeling regulations of products from untreated herds, and Vermont has established mandatory labeling of products from both treated and untreated herd milk. Results from Grobe and Douthitt (1995) showed that low-income respondents were more apprehensive toward rbGH-treated herd milk; therefore, poor households were also oversampled to ensure sufficient degrees of freedom for multivariate analysis of their behavior.

National Sample. Nine hundred sixty-nine completed interviews were obtained from a National sample frame of telephone numbers purchased by LSSC from Nielsen Media Research. The adjusted response rate for the National sample was 54.2 percent (see Table 1). The sample is representative of currently working residential telephone numbers in the continental United States, including both listed and nonlisted numbers. Nielsen updates the sample three times a year. It is estimated that approximately 5 to 7 percent of U.S. households do not have telephones, and would therefore not be represented in the sample.

Nielsen Media Research begins with a file of all residential telephone numbers that are listed in published telephone directories. This file is, in effect, sorted by exchange and number within exchange. Next, within each exchange, ten thousand potential telephone numbers (XXX-0000 through XXX-9999) are generated and divided into one hundred blocks of one hundred consecutive numbers. If any of these blocks do not contain listed residential numbers, the block is eliminated. A sample is then drawn from the remaining numbers. Thus, the sample includes telephone numbers that are listed in the published directories, those that are unlisted, and numbers within those blocks that have been assigned

since the most recent issue of the telephone directory. Use of this sampling scheme is more efficient than a simple random digit-dialing procedure. The time and expense of making calls to blocks that do not have currently assigned numbers, or to blocks with nonexistent or nonresidential exchanges, is avoided.

Wisconsin Sample. One hundred and eighty-seven completions were acquired from the Wisconsin sample frame. LSSC purchased this sample frame of telephone numbers from Nielsen Media Research. The adjusted response rate for the Wisconsin sample was 65.3 percent (see Table 1). The same sampling strategy described above for the National sample frame was utilized by Nielsen Media Research to select the state of Wisconsin sample frame. The sample frame is representative of currently working listed and nonlisted residential telephone numbers in the state of Wisconsin.

Vermont Sample. One hundred and eighty-six completions were acquired from the Vermont sample frame. This sample frame was also purchased by LSSC from Nielsen Media Research. The adjusted response rate for the Vermont sample was 63.3 percent (see Table 1). Again, the same sampling strategy described in the section above for the National sample frame was utilized to select the state of Vermont sample frame. The sample frame is representative of currently working listed and nonlisted residential telephone numbers in the state of Vermont.

Poor Sample. Five hundred sixty-eight completions were acquired from the Poor sample frame. Two sample frames of telephone numbers were purchased by LSSC from Survey Sampling, Inc. (SSI). The samples targeted geographic areas in the continental United States where average household incomes fall below a specific level. One sample frame was drawn from exchanges within areas where the average household income was within the lowest 20 percent of U.S. household income, and the other was from exchanges where the average household income was within the lowest 10 percent of household income.[5] The response rate for the 20th percentile was 56.7 percent and 50.7 percent for the 10th percentile (see Table 1). In the low-income area sample frames, interviews were attempted with

all sample cases. Cases were not screened for meeting poverty guidelines before the interviews. The USDA poverty guidelines were used post-interview to determine the respondents' level of poverty.

SSI used the following selection process for random digit telephone samples: (1) identified all working telephone exchanges and working blocks (the first two digits after the exchange); (2) assigned each exchange to a single county; (3) stratified the sampling frame by exchange, and within exchange by working block; and (4) systematically selected the sample for the geographic area specified.

<u>Response Rates</u>

A total sample frame of 5,815 telephone numbers were used in this study. This resulted in:

1,910   Completed interviews

2,313   Non-sample (including not eligible, not working numbers, business numbers, etc.)

1,592   Non-response

      1,038 Refusals

        145 Away for duration of study

        156 Contact respondent not available

          5 Other non-response

        248 No answer

The response rate was adjusted[6] to compensate for the never answered numbers. The never-answered numbers consist of residential numbers that were never answered in any of twenty calls that were made. We assumed that the ratio of working residential numbers to other numbers in this subset is the same as for numbers that were answered (see Table 1 for specific calculations).

FINDINGS

Data Sets

The findings are reported by comparing combined survey samples and subsamples of the previously discussed survey samples. When analyzing national trends, all survey samples were combined; that data set will hereafter be referred to as the DGZ (Douthitt, Grobe, Zepeda) sample. It consists of the 1,910 completed surveys, including the National, Wisconsin, Vermont, and Poor (10th and 20th percentile) samples. The DGZ sample results are weighted to ensure findings are representative of the U.S. population. To analyze poor consumers' behavior, another data set was constructed, the Base-Level Poverty (BLP) sample. The BLP is a subsample of the 1,910 completed surveys. It includes all the respondents who qualified as poor under the February 9, 1995, USDA poverty guidelines.[7] The 217 respondents who met the USDA poverty guideline requirements make up the BLP sample.

Calculation of Weights for the DGZ Sample. The DGZ sample contained five separate samples that were combined by appropriate weighting: (1) a National random sample, (2) a Wisconsin random sample, (3) a Vermont random sample, (4) a sample drawn from low-income areas (20th percentile), and (5) a second sample drawn from low-income areas where average income is lower than in the first (10th percentile). Because the National and Poor samples were independent (that is, they were not mutually exclusive and exhaustive subsets of the total population), we assume that the low-income households in each of the three samples (National, 20th percentile, 10th percentile) represent low-income persons in general.

To combine the Poor samples with the random National sample, a weight was computed such that the income distribution of the random National sample was maintained (that is, depending on the reported income, Poor area cases were added to deflate or inflate the weight of all cases). Household income was divided into 13 categories and weights were computed.

To add the two state samples (Wisconsin and Vermont) to the National and Poor samples, weights were computed that make the Vermont oversample represent .0023 of the total sample and the Wisconsin cases (from both the state and the National samples) represent .0197 of the total sample.[8] According to recent Census Bureau state population estimates, Wisconsin includes 1.97 percent of U.S. households; Vermont includes 0.23 percent. The sum of the weights is then adjusted to 1,910, the total number of sample cases.

Demographic Characteristics

DGZ Sample. We compared the DGZ sample to U.S. Census household demographic characteristics to assess whether the DGZ sample was representative of U.S. households. Household data were taken from the *1990 Census of Population, General Population Characteristics of the United States.* Table 2 summarizes these comparisons. Almost 72 percent of the respondents were women, reflecting the screening question for primary household food purchaser. The DGZ sample was more educated than U.S. households, with mean age of householder a few years younger than U.S. households. Close to 60 percent of the DGZ respondents were married, with an average household size of 2.87; for U.S. households, the respective figures are 54.9 percent and 2.63. Median income was higher than the U.S. households figure. Eighty percent of the DGZ respondents were Caucasian, consistent with U.S. households, with approximate representation of other ethnic groups.

Base-Level Poverty Sample. Table 3 summarizes the BLP sample demographic characteristics compared to the U.S. poverty households. U.S. poverty household data were taken from U.S. Department of Housing and Urban Development and the Census Bureau (Grall 1994). Almost 80 percent of the primary household food purchasers in the BLP sample were female. The BLP sample

TABLE 2
Comparison of U.S. Household Demographics and DGZ Sample Demographics

	U.S. Households	DGZ Sample (N=1910)
Education	(1993)	
<= 8 years	9.3%	4.0%
1–3 years of high school	10.5%	6.2%
High school graduate	32.0%	21.2%
1–3 years of college	17.7%	23.5%
Associate	6.5%	15.2%
Bachelor's	15.0%	18.9%
Master's	5.6%	7.9%
Ph.D.	1.3%	1.2%
Professional	1.7%	1.9%
Marital Status	(1991)	
Married	54.9%	62.9%
Widowed	12.4%	8.5%
Divorced	13.2%	9.6%
Living with a partner	—	4.0%
Separated	4.0%	1.3%
Never married	15.3%	13.2%
Household Size	(1990)	
Average per household	2.63	2.87
Income	(1993)	
Median Income	$31,241	$40,000
Ethnic Background	(1990)	
Caucasian	80.0%	81.2%
African American	10.8%	10.4%
Native American	0.6%	1.0%
Asian	2.1%	1.5%
Hispanic[a]	6.5%	3.6%
other		2.5%
Age	(1993)	
Mean age of adult householder	48.2	45.6

Note: Parenthetical dates in the first column refer to the year of the most recent census data available for that category.

[a]For U.S. households, all races (Caucasian, African American, Native American, Asian) were asked whether they were of Hispanic origin, while for the DGZ sample only those who indicated they were Caucasian were also asked if they were of Hispanic origin (Mexican American, Latin American, Puerto Rican, or Cuban).

12

TABLE 3

**Comparison of U.S. Poverty Household Demographics
and Base-Level Poverty Sample Demographics**

	U.S. Poverty Households (1991)	Base-Level Poverty Sample (N=217)
Education		
<= 8 years	22.6%	20.4%
1–3 years of high school	21.4%	22.7%
High school graduate	34.9%	22.2%
1–3 years of college	12.9%	17.1%
College degree or more	7.9%	17.6%
Age		
Median age of adult householder	45.3	46
Household Size		
Median household size	2.1	2
Income		
Median income	$5,581	$9,800
Ethnic Background		
Caucasian	59.7%	65.1%
African American	25.2%	23.3%
Other Ethnic	4.8%	5.6%
Hispanic[a]	10.1%	6.0%

[a]For U.S. households, all races (Caucasian, African American, Native American, Asian) were asked whether they were of Hispanic origin, while for the DGZ sample only those who indicated they were Caucasian were also asked if they were of Hispanic origin (Mexican American, Latin American, Puerto Rican, or Cuban).

was more educated than U.S. poverty households, with median age of householder one year older than the U.S. poverty households. The median household size was 2.0, consistent with the median U.S. poverty household size of 2.1. Median income was higher than that of U.S. poverty households. Sixty-five percent of the BLP sample were Caucasian, approximating with the U.S. poverty households, with consistent representation of other ethnic groups.

Consumer Awareness, Knowledge, and Approval of Biotechnology, rpGH, and rbGH

Awareness. Respondents were asked about their awareness of biotechnology, recombinant porcine growth hormone (rpGH), and recombinant bovine growth hormone (rbGH) (see Table 4). They were asked whether they had heard of or read anything about each particular technology (see Figure 1 for question wording). Awareness of biotechnology and rbGH was high: approximately 60 percent of the DGZ sample were aware of biotechnology, and 66 percent were aware of rbGH. DGZ respondents were less familiar with rpGH: approximately 24 percent had either heard of or read anything about the use of rpGH.

The BLP sample respondents had significantly lower awareness levels regarding biotechnology (approximately 35 percent were aware) ($\chi^2_{1\,df} = 50.26$, p value .001)[9] and rbGH (54 percent were aware) ($\chi^2_{1\,df} = 17.96$, p value = .001), but had comparable awareness of rpGH (24 percent). The above results were similar for the total respondents of both samples, as well as among those expressing an opinion. Respondents who were not aware of rbGH or rpGH were read a brief information statement before proceeding to the next question (see Figure 1).

Knowledge. In addition to awareness of rbGH, respondents were read six different statements to acquire data on their knowledge of rbGH. They were asked to what extent they agreed or disagreed with each statement. Table 5 indicates that, among the entire DGZ sample, 60 percent disagreed with the statement that "rbGH-treated herd milk is the same as untreated herd milk;" 73 percent among

TABLE 4

Awareness of Biotechnology, rbGH, and rpGH

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
*Awareness of biotechnology***				
Yes	56.7%	56.9%	35.0%	35.5%
No	43.0%	43.1%	63.6%	64.5%
Don't know	0.4%		1.4%	
*Awareness of rbGH***				
Yes	63.7%	64.1%	53.9%	54.7%
No	35.7%	35.9%	44.7%	45.3%
Don't know	0.7%		1.4%	
Awareness of rpGH				
Yes	23.9%	24.0%	24.0%	24.3%
No	75.6%	76.0%	74.7%	75.7%
Don't know	0.5%		1.4%	

Note: ** p value < .01; chi-square analysis comparing DGZ sample and BLP sample respondents who expressed an opinion.

Figure 1

Wording of Question Items

Awareness
===

Biotechnology

As you may know, biotechnology refers to the use of technology to create new plant or animal species, or to create chemicals. In agriculture, biotechnology has been used to create new disease-resistant plants and to economically produce chemicals to increase farm production. Have you heard or read anything about agricultural use of biotechnology?

rpGH

Have you heard or read anything about the use of rpGH, a synthetic pork hormone used to stimulate the growth of hogs to produce leaner pork?

rbGH

Do you recall having heard or read anything about the use of a synthetic bovine growth hormone, commonly called bGH or bST, that is used by farmers to increase cows' milk production?

Information
===

rpGH

Porcine somatotropin, or rpGH, is a growth hormone, which when injected stimulates the growth rate of hogs. Its use causes reduced fat deposit and hence, leaner pork.

rbGH

Bovine somatotropin (rbGH) is a growth hormone, which when administered/injected in fully grown, lactating cows, increases their milk production, thereby improving dairy farm profits. The milk from cows given rbGH has the same product characteristics as the milk from untreated cows.

(figure continues)

Figure 1 *(continued)*

Health Risk

Current rpGH

Although scientists have not discovered any ill health effects for humans from eating pork treated with rpGH, some consumers believe that the meat from treated pigs is not safe. How about you, do you share such concerns, or not?
Would you say you are concerned only a little, moderately concerned, or very concerned?

Current rbGH

Although the U.S. Food and Drug Administration has stated that there are no ill health effects for humans associated with consuming dairy products made of milk from rbGH- treated cows, some consumers believe that rbGH-treated cows' milk is not safe. How about you, do you share such concerns, or not?
Would you say you are concerned only a little, moderately concerned, or very concerned?

Future rbGH

Some consumers are further concerned that although there are currently no known human ill health effects associated with consuming milk from rbGH-treated cows, that ill health effects may later be discovered. How about you, do you share such concerns, or not?
Would you say you are concerned only a little, moderately concerned, or very concerned?

Demand Response

Since February of 1994, it has been legal for farmers to increase their cows' milk production by administering/injecting them with rbGH. How, if at all, has the approval of rbGH's use influenced the amount of milk you buy?

TABLE 5

Knowledge of rbGH

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
*rbGH-treated herd milk is the same as untreated herd milk**				
Disagree strongly	38.2%	46.8%	39.6%	48.6%
Disagree somewhat	21.6%	26.5%	19.8%	24.3%
Neither agree nor disagree	9.9%	12.2%	8.8%	10.7%
Agree somewhat	8.5%	10.4%	6.9%	8.5%
Agree strongly	3.4%	4.1%	6.5%	7.9%
Don't know	18.4%		18.4%	
*The long-run health implications of rbGH are not known***				
Disagree strongly	3.5%	4.2%	6.0%	7.7%
Disagree somewhat	7.0%	8.3%	13.0%	16.7%
Neither agree nor disagree	8.4%	9.9%	7.4%	9.5%
Agree somewhat	19.8%	23.5%	17.1%	22.0%
Agree strongly	45.5%	54.1%	34.3%	44.0%
Don't know	15.8%		22.2%	
*Increasing milk production by farmers using rbGH has benefitted consumers**				
Disagree strongly	27.3%	32.9%	27.3%	33.9%
Disagree somewhat	20.5%	24.8%	20.8%	25.9%
Neither agree nor disagree	12.6%	15.2%	8.3%	10.3%
Agree somewhat	17.4%	21.0%	14.8%	18.4%
Agree strongly	5.1%	6.2%	9.3%	11.5%
Don't know	17.2%		19.4%	

(table continues)

TABLE 5, continued

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
bGH is naturally found in milk*				
Disagree strongly	25.9%	38.7%	22.1%	32.7%
Disagree somewhat	16.1%	24.0%	18.9%	27.9%
Neither agree nor disagree	13.6%	20.3%	10.1%	15.0%
Agree somewhat	8.4%	12.5%	12.9%	19.0%
Agree strongly	3.0%	4.5%	3.7%	5.4%
Don't know	33.0%		32.3%	
rbGH use is not harmful to cows**				
Disagree strongly	23.8%	33.0%	32.3%	46.7%
Disagree somewhat	20.7%	28.8%	14.7%	21.3%
Neither agree nor disagree	14.4%	20.0%	9.7%	14.0%
Agree somewhat	10.7%	14.8%	10.6%	15.3%
Agree strongly	2.5%	3.4%	1.8%	2.7%
Don't know	28.0%		30.9%	
rbGH use has had negative effects on small dairy farms				
Disagree strongly	7.0%	10.2%	6.9%	10.2%
Disagree somewhat	11.4%	16.7%	14.3%	21.1%
Neither agree nor disagree	14.8%	21.7%	11.1%	16.3%
Agree somewhat	20.9%	30.6%	20.7%	30.6%
Agree strongly	14.2%	20.8%	14.7%	21.8%
Don't know	31.7%		32.3%	

* p value < .05; ** p value < .01; chi-square analysis comparing DGZ sample and BLP sample respondents who expressed an opinion.

those expressing an opinion disagreed. Two-thirds of the DGZ respondents agreed with the statement that "the long run health implications of rbGH are not known," and almost half disagreed that "increasing milk production by farmers using rbGH has benefitted consumers." Among those expressing an opinion, 77 percent agreed that we do not know rbGH's long-run health implications, and 27 percent agreed that "rbGH's use has benefitted consumers." These differences between all respondents and those expressing an opinion are reflected in the "don't know" responses, which ranged from 15 percent to 18 percent for the first three statements. The respondents were even more unsure of the final three statements, as "don't know" responses escalated to around 30 percent. The majority of the DGZ sample who did express an opinion disagreed with the statements "bGH is naturally found in milk," and "treating cows with rbGH is not harmful to them," while tending to agree more than disagree that "rbGH use has had negative economic effects on small dairy farms." BLP sample respondents who expressed an opinion had statistically different results for knowledge of rbGH than the DGZ sample respondents (see Table 5 for χ^2 results). However, among those who expressed an opinion, BLP respondents were more likely than DGZ respondents to express disagreement with the statement "the long-run health implications of rbGH are not known."

Approval. To get an idea of consumers' overall approval of biotechnology and rbGH, we asked, "Overall, do you or do you not approve of agricultural uses of biotechnology?" and "Overall, what is your opinion about treating cows with rbGH to increase their milk production?" The results in Table 6 show varying approval opinions between biotechnology and rbGH. Over half of the total DGZ respondents approved of biotechnology uses, whereas over half of the total DGZ respondents felt the use of rbGH was a poor idea, with 30 percent feeling it was a fair idea. Of those DGZ respondents who expressed an opinion, 60 percent approved of biotechnology uses, and the same percentage felt rbGH was a poor idea. These results are somewhat different, but not significantly different for the BLP respondents, of whom 45 percent approved of biotechnology uses and 60 percent felt rbGH was a poor

TABLE 6

Overall Approval of Biotechnology and rbGH

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Overall approval of biotechnology				
Approve	53.8%	59.9%	44.7%	50.7%
Disapprove	36.0%	40.1%	43.4%	49.3%
Don't know	10.1%		11.8%	
Overall opinion of rbGH				
Poor idea	53.8%	58.3%	59.4%	66.5%
Fair idea	27.1%	29.4%	19.4%	21.6%
Good idea	8.9%	9.7%	7.8%	8.8%
Excellent idea	2.5%	2.7%	2.8%	3.1%
Don't know	7.7%		10.6%	

idea, with an additional 20 percent rating rbGH as a fair idea. Fifty percent of the BLP respondents

expressing an opinion approved of biotechnology uses, and 66 percent felt rbGH was a poor idea.

Overall opinions toward rpGH were not asked because the product is not currently approved for

commercial use. However, the respondents were asked if they would consider purchasing rpGH-treated

pork if it were approved by the FDA. Table 7 shows that 50 percent of the total DGZ and BLP samples

would purchase pork produced with rpGH, and approximately 60 percent of those expressing an

opinion in the two samples would purchase pork produced with rpGH if approved by the FDA.

Consumers' Perceived Concern for Discovery of Human Ill Health Effects

Previous research has explored the long-run risk perceptions of rbGH; that is, whether

consumers were concerned that human health risks would be discovered in the future (Grobe and

Douthitt 1995). However, additional work was needed to evaluate current consumer risk perception.

Consumers may or may not have as great a concern for risks in the short run as they appear to have in

the long run. This survey evaluated both current concern for health risks and future discovery of health

risks associated with rbGH, and only the current concern of health risks associated with rpGH, given

rpGH's stage of product development (see Figure 1 for question wording).

Current Health Risks. Table 8 presents the results where over 75 percent of the respondents

from both samples acknowledged some level of concern for current human ill health effects associated

with rpGH and rbGH. Two-thirds of those respondents were moderately to very concerned, while

approximately 20 percent had no concern about current health risks from either of these

biotechnologies. These results were similar regardless of whether all respondents or only respondents

expressing an opinion (excluding don't knows) were considered. The BLP sample respondents were

equally concerned with rpGH, and those expressing an opinion were significantly more likely ($\chi^2_{3\,df}=$

TABLE 7

Respondents' Willingness to Purchase rpGH-Treated Pork If Approved by the FDA

| | DGZ Sample (N=1910) | | BLP Sample (N=217) | |
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Purchase rpGH-treated pork if approved by FDA				
Yes	50.1%	56.4%	49.7%	59.3%
No	38.8%	43.6%	34.1%	40.7%
Don't know	11.1%		16.2%	

TABLE 8

Concerns about Current Human Ill Health Effects Associated with rpGH and rbGH

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Current health concern				
rpGH				
No concern	23.8%	23.9%	22.9%	22.9%
Concerned a little	9.8%	9.8%	10.9%	10.9%
Moderately concerned	29.7%	29.8%	24.5%	24.5%
Very concerned	36.5%	36.6%	41.7%	41.7%
Don't know	0.2%		—	
rbGH**				
No concern	21.4%	22.5%	16.6%	18.0%
Concerned a little	8.4%	8.9%	7.8%	8.5%
Moderately concerned	30.1%	31.7%	19.8%	21.5%
Very concerned	35.0%	36.9%	47.9%	52.0%
Don't know	5.0%		7.8%	

* p value < .05; ** p value < .01; chi-square analysis comparing DGZ sample and BLP sample respondents who expressed an opinion.

16.78, p value = .001) to be concerned about the current safety of rbGH with respect to human ill health effects (82 percent), compared to the DGZ respondents.

Future Health Risks. Respondents had greater concern for the discovery of human ill health effects associated with rbGH than with current human health effects (see Table 9). Eighty-five percent of all the DGZ respondents and of those expressing an opinion acknowledged some level of concern, with over 70 percent indicating their level of concern as moderate or very concerned. The BLP respondents expressing an opinion were significantly more likely ($\chi^2_{3\,df} = 12.6$, p value = .006) to be concerned about the future discovery of human ill health effects than the DGZ respondents.

Risk Perception Factors

In order to understand the differences in risk perception, we compared the respondents who were concerned to those who were not concerned about the future discovery of health risks for both samples (DGZ and BLP) (Tables 10–14). Those respondents who acknowledged some level of concern about the future discovery of current health risks were compared with the respondents with no concern. Some of the variables believed to influence risk perceptions are beliefs about milk, trustworthiness of information sources, knowledge of rbGH and non-rbGH treated herd milk, locus of control, and group affiliation. We discuss our findings for each variable for the DGZ and the BLP respondents.

Beliefs about Milk. Researchers have suggested that one must consider the central role of beliefs in shaping how consumers perceive risk (Groth 1990). Thus, this survey explored respondents' beliefs about milk. They were asked to state the extent to which they agreed or disagreed with four statements. The majority of both groups (no concern and concerned) for both samples agreed with the first two statements, "children must have milk for proper growth and development" and "milk is nutritious" (see Table 10). When asked whether they agreed or disagreed with the statement that "milk is a natural product," significantly more of the not concerned group for both samples (around 80

TABLE 9

Concern with the Future Discovery of Human Ill Health Effects Associated with rbGH

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Future health concern				
rbGH**				
No concern	12.2%	12.5%	14.7%	15.7%
Concerned a little	11.0%	11.3%	12.9%	13.7%
Moderately concerned	31.9%	32.7%	19.4%	20.6%
Very concerned	42.3%	43.5%	47.0%	50.0%
Don't know	2.6%		6.0%	

* p value < .05; ** p value < .01; chi-square analysis comparing DGZ sample and BLP sample respondents who expressed an opinion.

TABLE 10

Respondent Milk Beliefs by Those Who Are Not Concerned and Those Who Are Concerned with Future Discovery of Health Risks Associated with rbGH

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
Children must have milk				
Disagree strongly	1.2%	4.2%	3.1%	3.5%
Disagree somewhat	6.0%	9.1%	3.1%	4.1%
Neither agree nor disagree	2.8%	2.6%	—	2.9%
Agree somewhat	18.6%	22.9%	28.1%	17.4%
Agree strongly	71.4%	61.2%	65.6%	72.1%
Milk is nutritious				
Disagree strongly	1.9%	1.5%	3.1%	1.2%
Disagree somewhat	2.3%	5.6%	—	6.0%
Neither agree nor disagree	2.4%	2.8%	—	1.8%
Agree somewhat	30.0%	34.5%	43.8%	29.2%
Agree strongly	63.3%	55.5%	53.1%	61.9%
*Milk is a natural product***				
Disagree strongly	2.9%	8.5%	3.1%	16.6%
Disagree somewhat	11.5%	18.9%	15.6%	17.2%
Neither agree nor disagree	3.0%	3.6%	3.1%	2.4%
Agree somewhat	38.4%	37.7%	37.5%	33.1%
Agree strongly	44.2%	31.3%	40.6%	30.8%
*Milk is a pure product***				
Disagree strongly	5.8%	13.7%	9.7%	16.8%
Disagree somewhat	17.7%	29.0%	9.7%	19.8%
Neither agree nor disagree	11.2%	5.5%	6.5%	6.6%
Agree somewhat	40.5%	34.1%	38.7%	30.5%
Agree strongly	24.8%	17.7%	35.5%	26.3%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

percent) agreed with the statement, compared with the concerned groups (approximately 66 percent) ($\chi^2_{4\ df}$ = 24.8, p value = .0001). Approximately half of the concerned respondents from both samples agreed with the final statement, "milk is a pure product," and less than half (40 percent) disagreed with the statement, significantly different from the no concern respondents ($\chi^2_{4\ df}$ = 34.17, p value = .0001). More than 65 percent of the no concern respondents from both samples agreed with the statement.

Trustworthiness of Information Sources. Respondents were asked about the trustworthiness of various food-related information sources (see Table 11). In both samples, the group with no health risk concerns tended to believe in the trustworthiness of the FDA, significantly more so than the concerned groups, who rated the FDA as only somewhat trustworthy ($\chi^2_{3\ df}$ = 32.66, p value= .0001). Similar results were also found on the USDA's trustworthiness as a food-related information source. Each group in both samples rated farmers' organizations, nutritional information labels, and journalists as somewhat trustworthy. Both groups, especially in the DGZ sample, rated physicians as being very trustworthy. Advertisements received the least trustworthy rating: approximately 60 percent of both groups in the DGZ sample stated they were not very to not at all trustworthy. Of the BLP sample, 40 percent of the no concern and 50 percent of the concerned rated advertisements as not very to not at all trustworthy. Furthermore, food and drug businesses were rated by approximately 60 percent of each group in both samples as somewhat trustworthy, with almost a quarter regarding food and drug business as not very to not at all trustworthy.

A comparison of DGZ and BLP respondents' rankings of food-related information sources is found in Table 12. Physicians were ranked the highest by the DGZ respondents, as 89.8 percent of the respondents felt physicians were a "somewhat" to "very" trustworthy source of information. The DGZ respondents ranked the USDA as second, followed by the FDA. Conversely, the BLP sample ranked

TABLE 11

Respondent Trustworthiness in Information Sources by Those Who Are Not Concerned and Those Who Are Concerned with the Future Discovery of Health Risks Associated with rbGH

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
FDA**				
Very trustworthy	37.9%	21.7%	36.0%	20.7%
Somewhat trustworthy	54.5%	66.0%	52.0%	62.0%
Not very trustworthy	5.5%	9.6%	12.0%	11.3%
Not at all trustworthy	2.1%	2.7%	—	6.0%
Farmers' Organizations				
Very trustworthy	16.9%	20.1%	19.2%	25.8%
Somewhat trustworthy	71.4%	63.9%	65.4%	58.9%
Not very trustworthy	10.3%	13.8%	7.7%	10.5%
Not at all trustworthy	1.4%	2.3%	7.7%	4.8%
Physicians*				
Very trustworthy	45.7%	41.2%	32.1%	39.8%
Somewhat trustworthy	48.4%	47.8%	60.7%	39.8%
Not very trustworthy	5.4%	8.4%	3.6%	13.7%
Not at all trustworthy	0.6%	2.6%	3.6%	6.8%
Advertisements				
Very trustworthy	5.5%	3.2%	7.4%	9.8%
Somewhat trustworthy	36.0%	36.1%	51.9%	36.6%
Not very trustworthy	41.5%	39.2%	22.2%	26.8%
Not at all trustworthy	17.0%	21.5%	18.5%	26.8%
Nutrition Information Labels				
Very trustworthy	35.3%	31.7%	37.9%	33.1%
Somewhat trustworthy	52.4%	55.1%	51.7%	46.5%
Not very trustworthy	8.3%	11.1%	3.4%	15.9%
Not at all trustworthy	4.0%	2.1%	6.9%	4.5%

(table continues)

TABLE 11, continued

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
Journalists*				
Very trustworthy	10.2%	10.1%	3.6%	8.1%
Somewhat trustworthy	50.3%	61.1%	57.1%	56.1%
Not very trustworthy	29.3%	20.6%	14.3%	26.4%
Not at all trustworthy	10.2%	8.2%	25.0%	9.5%
Food and Drug Business*				
Very trustworthy	11.0%	8.1%	10.3%	16.8%
Somewhat trustworthy	63.4%	61.1%	72.4%	57.7%
Not very trustworthy	21.9%	21.4%	10.3%	16.1%
Not at all trustworthy	3.7%	9.4%	6.9%	9.4%
USDA				
Very trustworthy	32.4%	25.2%	34.5%	34.4%
Somewhat trustworthy	57.7%	63.3%	51.7%	54.5%
Not very trustworthy	7.7%	8.4%	6.9%	6.5%
Not at all trustworthy	2.2%	3.1%	6.9%	4.5%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

TABLE 12

Respondents' Ranking of the Trustworthiness of Food-Related Information Sources

DGZ Sample (N=1910)		BLP Sample (N=217)	
Physicians	89.8%	USDA	88.0%
USDA	88.7%	Farmers' Organizations	84.3%
FDA	88.4%	FDA	84.0%
Nutrition Information Labels	87.0%	Physicians	81.9%
Farmers' Organizations	84.4%	Nutrition Information Labels	81.0%
Journalists	69.8%	Food & Drug Business	75.6%
Food & Drug Business	69.7%	Journalists	64.3%
Advertisements	39.8%	Advertisements	49.0%

Note: Percentages represent the respondents who indicated that a particular food-related information source was somewhat to very trustworthy.

the USDA as first, followed by farmers' organizations and the FDA. Both samples ranked

advertisements as the least trustworthy food-related information source.

Knowledge of rbGH. To measure consumer knowledge about rbGH, this survey asked

respondents to what extent they agreed or disagreed with six statements. The overall results in Table 13

show that, for both samples, the concerned group has significantly stronger opinions (that is, agree

strongly or disagree strongly) toward the statements than those who are not concerned. Additionally,

"don't know" responses were high, especially for the last three statements.

Almost 65 percent of the concerned group in both samples disagreed with the statement that

"milk from cows treated with rbGH is just like milk from untreated cows." Thirty-two percent of the

not concerned DGZ sample and 43 percent of the BLP sample disagreed, and 38 percent and 22 percent

agreed with the statement, respectively. A greater percentage of the concerned group in both samples

disagreed that rbGH benefits consumers. Furthermore, 70 percent of the DGZ concerned group and 57

percent of the BLP concerned group agreed with the statement, "the long-run health implications of

rbGH are not known," compared to 44 percent of the DGZ and 32 percent of the BLP no concern

group.

Nearly half of the concerned respondents in both samples disagreed that "bGH is naturally

found in milk," and approximately 30 percent did not know. Similar results were found for the

statement, "treating cows with rbGH is not harmful to them." Fifty percent of the concerned groups

disagreed, while about 25 percent of the no concern groups disagreed. Finally, results were

approximately equally divided between the agree and disagree responses for both groups and samples

concerning the statement, "rbGH use has had negative economic effects on small dairy farms."

Locus of Control. "Locus of control" refers to a person's sense of control over life events.

Questions to ascertain respondents' locus of control were (a) "I worry about the future that today's

children are facing," and (b) "More and more, I feel helpless in the face of what's happening in the

TABLE 13

**Respondent Knowledge of rbGH by Those Who Are Not Concerned and Those Who Are
Concerned with the Future Discovery of Health Risks Associated with rbGH**

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
*Milk from rbGH-treated herds is the same as from untreated herds**				
Disagree strongly	12.4%	42.8%	12.5%	45.9%
Disagree somewhat	19.9%	22.2%	31.3%	18.6%
Neither agree nor disagree	11.7%	9.9%	6.3%	9.9%
Agree somewhat	22.1%	6.5%	9.4%	5.8%
Agree strongly	15.8%	1.7%	12.5%	5.8%
Don't know	18.0%	16.8%	28.1%	14.0%
*Don't know rbGH's long-run health implications**				
Disagree strongly	5.3%	3.3%	6.5%	5.8%
Disagree somewhat	17.8%	5.6%	25.8%	11.0%
Neither agree nor disagree	14.9%	7.5%	9.7%	7.6%
Agree somewhat	25.0%	19.2%	25.8%	15.1%
Agree strongly	19.3%	50.5%	6.5%	41.9%
Don't know	17.7%	13.9%	25.8%	18.6%
*rbGH's use has benefitted consumers**				
Disagree strongly	11.4%	30.1%	6.5%	32.0%
Disagree somewhat	14.7%	21.9%	32.3%	19.8%
Neither agree nor disagree	17.0%	12.2%	12.9%	8.1%
Agree somewhat	34.4%	15.3%	16.1%	14.5%
Agree strongly	11.0%	4.4%	6.5%	10.5%
Don't know	11.4%	16.2%	25.8%	15.1%

(table continues)

TABLE 13, continued

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
bGH is naturally found in milk**				
Disagree strongly	15.3%	28.0%	9.4%	25.6%
Disagree somewhat	15.4%	16.4%	34.4%	16.3%
Neither agree nor disagree	15.0%	13.8%	6.3%	11.6%
Agree somewhat	13.2%	7.9%	9.4%	13.4%
Agree strongly	6.6%	2.4%	3.1%	4.1%
Don't know	34.5%	31.5%	37.5%	29.1%
rbGH use is not harmful to cows**				
Disagree strongly	9.4%	26.3%	15.6%	36.6%
Disagree somewhat	14.7%	22.2%	15.6%	15.7%
Neither agree nor disagree	16.0%	14.4%	9.4%	10.5%
Agree somewhat	24.1%	8.9%	18.8%	9.3%
Agree strongly	7.8%	1.8%	3.1%	1.7%
Don't know	28.1%	26.3%	37.5%	26.2%
rbGH use has had negative effects on small dairy farms**				
Disagree strongly	9.3%	6.8%	6.3%	7.0%
Disagree somewhat	16.2%	11.0%	15.6%	15.1%
Neither agree nor disagree	20.6%	14.4%	12.5%	11.6%
Agree somewhat	23.1%	21.1%	25.0%	20.9%
Agree strongly	6.4%	15.5%	6.3%	16.9%
Don't know	24.4%	31.1%	34.4%	28.5%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

world today." Interestingly, although the majority of both groups for the two samples felt less in

control, the respondents with concerns about the safety of rbGH had significantly stronger agreement

with both statements ($\chi^2_{3\,df}$ = 104.2, p value = .0001; χ^2_{3df} = 52.541, p value = .0001, respectively),

especially when asked about feeling helpless in the world today (see Table 14). Nearly all (97.3

percent) concerned respondents from both samples agreed with the first statement, and 80 percent

agreed with the second. For the not concerned group in each sample, about 86 percent and 65 percent

agreed with the first and second locus-of-control questions, respectively.

Group Affiliation. To gain insight into the relationship between technology acceptance and the

respondents' group affiliation, questions were asked to determine whether or not the respondent

identified with the following groups: (1) "environmentalists, those who wish to protect our natural

resources," (2) "religious groups, who believe in a strict interpretation of the Bible," and (3) "animal

rights groups, those who oppose using animals in experimental studies." A greater percentage of the

concerned groups for each sample were significantly more likely to identify with environmentalists and

animal rights groups ($\chi^2_{2\,df}$ = 56.0, p value = .0001; χ^2_{2df} = 51.2, p value = .0001, respectively) (see

Table 15). The concerned BLP respondents had a larger percentage of strong identification with all

three groups compared to the concerned DGZ respondents. Religious affiliation was unrelated to safety

concerns.

Consumers' Demand Response

An essential question of interest to the study was "How, if at all, has the approval of rbGH's

use influenced the amount of milk you buy?" The respondents demand response was either (a)

increased the amount of milk they purchase, (b) no change in their milk purchase, (c) decreased the

amount of milk they purchase, or (d) stopped buying milk altogether. The majority (approximately 90

percent) of the total DGZ and BLP respondents stated they made no change in the amount of milk they

TABLE 14

Respondent Locus of Control by Those Who Are Not Concerned and Those Who Are Concerned with Future Discovery of Health Risks Associated with rbGH

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
*Worry about future for kids***				
Strongly agree	51.7%	75.4%	48.4%	75.6%
Agree	33.3%	21.5%	38.7%	23.8%
Disagree	10.2%	2.2%	9.7%	0.6%
Strongly disagree	4.8%	0.8%	3.2%	—
*Feel helpless in the world***				
Strongly agree	32.6%	48.2%	38.7%	57.4%
Agree	28.2%	31.6%	29.0%	27.2%
Disagree	29.0%	16.2%	22.6%	10.1%
Strongly disagree	10.2%	4.0%	9.7%	5.3%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

TABLE 15

Respondent Group Affiliation by Those Who Are Not Concerned and Those Who Are Concerned with Future Discovery of Health Risks Associated with rbGH

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
*Identify with environmentalists***				
Not at all	19.0%	6.3%	22.6%	7.1%
Somewhat	58.4%	55.6%	38.7%	39.6%
Strongly	22.6%	38.1%	38.7%	53.3%
Identify with religious groups				
Not at all	36.4%	36.2%	25.8%	26.2%
Somewhat	39.2%	41.4%	35.5%	37.8%
Strongly	24.4%	22.4%	38.7%	36.0%
*Identify with animal rights groups***				
Not at all	49.3%	28.0%	44.8%	28.4%
Somewhat	40.3%	46.3%	41.4%	35.2%
Strongly	10.4%	25.6%	13.8%	36.4%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

bought since the FDA approved rbGH (see Table 16). However, of the respondents who have not changed the amount of milk they buy, 8 percent of the DGZ respondents and 13.7 percent of the BLP respondents usually purchased milk identified as coming from nontreated cows.

For the DGZ respondents who usually purchase milk from nontreated cows, 52 percent know it was milk from untreated herds because it was a store policy, 60.7 percent because it was labeled untreated, 65.9 percent because it was a brand policy, and 26 percent because it was labeled organic (see Table 17). For the BLP respondents, 65.5 percent knew because it was a store policy, 58.6 percent because it was labeled untreated, 65.5 percent because it was a brand policy, and 34.5 percent because it was labeled organic. For this study, respondents who stated they were buying milk identified as coming from nontreated herds made up 10.6 percent total fluid milk consumption.

Five percent of the total DGZ respondents decreased the amount of milk they bought, and 0.3 percent stopped buying milk altogether. Of the DGZ respondents who have decreased or stopped buying milk, 50 percent have substituted other products for milk. Similar results were found for the BLP respondents. Five percent decreased their consumption, and 0.5 percent stopped buying milk. Of these respondents, 39 percent have substituted other products for cow's milk.

Another question of interest was whether or not concern for future discovery of health effects influenced demand response. Table 18 shows that the concerned group for both samples were more likely to decrease or stop buying milk, compared to the no concern group. The results also show that a smaller percentage of the concerned group for both samples indicated no change in their demand response.

Consumers' Preference for Treated versus Untreated Milk

A series of questions were asked to see if consumers have a preference for milk from an untreated or treated herd. First, respondents were asked, "Do you have a preference for whether the

TABLE 16

Influence of rbGH's Approval on Consumers' Demand Response

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Demand Response				
Increase	0.6%	0.6%	0.9%	1.0%
No change	91.4%	93.7%	87.1%	92.6%
Decrease	5.4%	5.5%	5.5%	5.9%
Stop buying milk	0.3%	0.3%	0.5%	0.5%
Don't know	2.4%		6.0%	

TABLE 17

Consumers Who Usually Purchase Milk Identified as Coming from Untreated Herds

	DGZ Sample (N=165)	BLP Sample (N=29)
Respondent knew milk was from untreated herd because of		
Store policy	52.0%	65.5%
Milk was labeled untreated	60.7%	58.6%
Policy of the brand	65.9%	65.5%
Milk was labeled organic	26.0%	34.5%

TABLE 18

Respondent Demand Response by Those Who Are Not Concerned and Those Who Are Concerned

with Future Discovery of Health Risks Associated with rbGH

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
*Demand response***				
Increase	0.5%	0.6%	—	1.2%
No change	97.1%	90.9%	90.6%	86.6%
Decrease	0.6%	6.2%	6.3%	5.8%
Stop buying milk	—	0.3%	—	0.6%
Don't know	1.8%	2.0%	3.1%	5.8%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

milk you buy comes from rbGH-treated cows, or not?" If so, they were asked, "Which do you prefer, milk from the treated or untreated cows?" Many (68.7 percent and 60.8 percent) of the total DGZ and BLP samples, respectively, preferred milk from untreated herds (see Table 19). The DGZ sample was significantly different from the BLP sample ($\chi^2_{2\,df}$ = 22.82, p value = .0001). Of the total DGZ sample, only 1 percent preferred milk from treated cows and 29 percent had no preference while almost 4 percent of the total BLP sample preferred milk from treated cows and 34 percent had no preference. Of those who preferred untreated herd milk, 60 percent from the total DGZ sample and 70 percent from the total BLP sample indicated they usually purchase milk identified as coming from untreated herds.

The results in Table 20 show the concerned groups have a significantly different milk preference than the no concern groups (χ^2 = 263.4, p value = .0001). The concerned group in both samples prefer untreated herd milk, and more of the no concern group has no preference between treated or untreated herd milk. Similar results were found when exploring whether or not preferences influence demand response (see Table 21). Those respondents who stated no preference or who preferred treated herd milk indicated a demand response of no change or an increase in the amount of milk they bought. Respondents with a preference for untreated herd milk were more likely to state they had decreased or stopped buying milk than those who had no preference or preferred treated herd milk.

Consumer Support for Labeling Policy

Another interesting result was the percentage of respondents answering "yes" to the question, "Do you think milk should be labeled in such a way that you could distinguish between milk from treated and untreated cows?" Ninety-four percent of the total DGZ sample and 93.5 percent of the total BLP sample responded "yes" to this question on labeling (see Table 22). Only 4.4 percent of the total

TABLE 19

Consumers' Preference for Treated versus Untreated Milk

| | DGZ Sample (N=1910) | | BLP Sample (N=217) | |
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
*Milk preference***				
No preference	29.6%	29.8%	34.4%	34.8%
Prefer treated	1.1%	1.1%	3.8%	3.8%
Prefer untreated	68.7%	69.1%	60.8%	61.4%
Don't know	0.6%		1.1%	

* p value < .05; ** p value < .01; chi-square analysis comparing DGZ sample and the BLP sample respondents who expressed an opinion.

TABLE 20

Respondent Preference for Treated versus Untreated Milk by Those Who Are Not Concerned and Those Who Are Concerned with Future Discovery of Health Risks Associated with rbGH

	DGZ Sample		BLP Sample	
	No Concern (N=233)	Concerned (N=1628)	No Concern (N=32)	Concerned (N=172)
*Milk preference***				
No preference	76.0%	22.8%	63.0%	28.3%
Prefer treated herd milk	1.7%	0.9%	7.4%	2.0%
Prefer untreated herd milk	21.7%	75.7%	25.9%	69.1%
Don't know	0.6%	0.6%	3.7%	0.7%

* p value < .05; ** p value < .01; chi-square analysis comparing respondents who are concerned and those who are not concerned with future discovery of health effects. Analysis comparing the DGZ sample and the BLP sample was not performed.

TABLE 21

Respondents' Demand Response by Preference for Treated versus Untreated Herd Milk

	DGZ Sample (N=1765)		BLP Sample (N=184)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
No preference demand response				
Increase	1.0%	1.0%	1.6%	1.7%
No change	96.7%	98.3%	89.1%	96.6%
Decrease	0.7%	0.7%	1.6%	1.7%
Stop buying milk	—	—	—	—
Don't know	1.6%		7.8%	
Prefer treated herd milk demand response				
Increase	6.0%	6.6%	—	—
No change	84.6%	93.4%	100%	100%
Decrease	—	—	—	—
Stop buying milk	—	—	—	—
Don't know	9.4%		—	
Prefer untreated herd milk demand response				
Increase	0.3%	0.3%	0.9%	0.9%
No change	90.0%	91.3%	87.6%	90.0%
Decrease	7.8%	7.9%	8.0%	8.2%
Stop buying milk	0.4%	0.4%	0.9%	0.9%
Don't know	1.4%		2.7%	

TABLE 22

**Consumer Support for Labeling that Distinguishes between Milk
from rbGH-Treated versus Untreated Herds**

	DGZ Sample (N=1910)		BLP Sample (N=217)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Should there be labels to distinguish between milk from treated and untreated cows?				
Yes	94.2%	95.5%	93.5%	94.4%
No	4.4%	4.5%	5.5%	5.6%
Don't know	1.3%		0.9%	

DGZ sample and 5.5 percent of the total BLP sample said there should not be labels to distinguish milk from treated and untreated cows. Similar results were found among those expressing an opinion.

Gender Comparison Regarding Food-Related Biotechnologies

Several patterns emerged when the data were examined according to gender (see Table 23). A significantly larger percentage of males were aware of biotechnology and rbGH than females ($\chi^2_{1\,df}$ = 31.33, p value = .0001; $\chi^2_{1\,df}$ = 10.64, p value = .001, respectively). Two-thirds of the men were aware of biotechnology, whereas just over half of the females were aware. Females were more aware of rbGH (61 percent) than they were of biotechnology (52.6 percent), but less aware than males (69.3 percent) regarding rbGH. Awareness of rbGH was similar for both males and females.

Among the males expressing an opinion, over 70 percent approved of biotechnology; 50 percent of females approved. Of those who expressed their opinions, a significantly larger percentage of females than males felt rbGH was a poor idea (61.3 percent and 50.6 percent, respectively) ($\chi^2_{3\,df}$ = 49.16, p value = .0001), while more than half of both males and females said they would purchase pork produced with rpGH if it were approved by the FDA.

More females than males said they were "very concerned" about current health effects and the future discovery of human ill health effects associated with rbGH. Eighty percent of females and around 60 percent of males expressed some level of concern about current human ill health effects associated with rpGH and rbGH ($\chi^2_{3\,df}$ = 52.7, p value = .0001; $\chi^2_{3\,df}$ = 77.76, p value = .001, respectively). Furthermore, a significantly larger percentage of females (87.8 percent) expressed a concern for the future discovery of human ill health effects ($\chi^2_{3\,df}$ = 44.26, p value = .0001).

Males and females had similar demand responses, with women more likely to believe there should be labels to distinguish between milk from untreated and treated herds ($\chi^2_{1\,df}$ = 21.23, p value = .0001). Further, a significantly greater percentage of females preferred milk from untreated herds

TABLE 23
Gender Comparison Regarding Food-Related Biotechnologies

	Male (N=539)		Female (N=1371)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
Awareness				
Awareness of Biotechnology**				
Yes	67.0%	67.0%	52.6%	52.9%
No	33.0%	33.0%	46.9%	47.1%
Don't know	—		0.5%	
Awareness of rbGH**				
Yes	69.3%	69.8%	61.5%	61.9%
No	29.9%	30.2%	37.9%	38.1%
Don't know	0.8%		0.6%	
Awareness of rpGH				
Yes	25.6%	25.8%	23.2%	23.3%
No	73.8%	74.2%	76.3%	76.7%
Don't know	0.5%		0.5%	
Approval				
Overall approval of biotechnology**				
Approve	66.6%	72.1%	47.4%	53.5%
Disapprove	25.7%	27.9%	41.2%	46.5%
Don't know	7.7%		11.4%	
Overall opinion of rbGH**				
Poor idea	47.1%	50.6%	56.4%	61.3%
Fair idea	27.1%	29.1%	27.1%	29.5%
Good idea	13.6%	14.6%	7.1%	7.7%
Excellent idea	5.4%	5.7%	1.4%	1.5%
Don't know	6.9%		8.0%	
Purchase rpGH treated-pork if approved by FDA*				
Yes	56.5%	60.7%	47.5%	54.5%
No	36.5%	39.3%	39.7%	45.5%
Don't know	6.9%		12.8%	

(table continues)

48

TABLE 23, continued

	Male (N=539)		Female (N=1371)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion

Current Health Concern

*rpGH***
No concern	35.8%	35.8%	19.2%	19.2%
Concerned a little	8.9%	8.9%	10.1%	10.2%
Moderately concerned	25.0%	25.0%	31.5%	31.6%
Very concerned	30.3%	30.3%	38.9%	39.0%
Don't know	—		0.2%	

*rbGH***
No concern	34.6%	36.1%	16.1%	17.1%
Concerned a little	6.8%	7.1%	9.0%	9.6%
Moderately concerned	26.4%	27.6%	31.6%	33.4%
Very concerned	28.0%	29.2%	37.8%	40.0%
Don't know	4.1%		5.4%	

Future Health Concern

*rbGH***
No concern	18.5%	19.0%	9.7%	10.0%
Concerned a little	13.8%	14.2%	9.9%	10.2%
Moderately concerned	31.5%	32.4%	32.0%	32.8%
Very concerned	33.4%	34.3%	45.9%	47.0%
Don't know	2.8%		2.5%	

Demand response
Increase	0.5%	0.5%	0.6%	0.6%
No change	92.3%	94.7%	91.1%	93.2%
Decrease	4.2%	4.3%	5.8%	6.0%
Stop buying milk	0.4%	0.4%	0.2%	0.2%
Don't know	2.6%		2.3%	

*Milk preference***
No preference	40.3%	40.3%	25.4%	25.6%
Prefer treated	0.6%	0.6%	1.3%	1.3%
Prefer untreated	59.1%	59.1%	72.5%	73.0%
Don't know	—		0.8%	

(table continues)

TABLE 23, continued

	Male (N=539)		Female (N=1371)	
	Total	Among Those Expressing Opinion	Total	Among Those Expressing Opinion
*Should there be labels to distinguish between milk from treated and untreated cows?***				
Yes	90.5%	92.0%	95.7%	96.9%
No	7.9%	8.0%	3.1%	3.1%
Don't know	1.6%		1.2%	

* p value < .05; ** p value < .01; chi-square analysis comparing males and females for those respondents who expressed an opinion.

than males (around 73 percent and 60 percent, respectively) ($\chi^2_{\,2\,df} = 37.83$, p value = .0001). Forty

percent of the males had no preference, compared to a quarter of the females.

CONCLUSIONS

The primary goal of this study was to understand what factors influence risk perception

associated with rbGH and rpGH, and whether these perceptions differ by income. Previous research has

shown inconsistencies on the effect of income in discussing consumers' risk perceptions toward rbGH-

treated herd milk (McGuirk, Preston, and Jones 1992; Grobe and Douthitt 1995). Results from

McGuirk, Preston, and Jones (1992) found that individuals with incomes in the $20,000–$50,000 range

were the most worried about the long-term health effects of milk from cows treated with rbGH, and

those individuals with incomes over $30,000 were most skeptical of the government's ability to ensure

that milk supplies are safe. In a previous study (1990), they also found that individuals with annual

incomes of $10,000–$20,000 wanted approval of rbGH. Conversely, Grobe and Douthitt (1995) found

low-income respondents to be more apprehensive toward rbGH-treated herd milk. This report

compared the differences between a national sample (DGZ sample) and a poverty sample (BLP

sample). The results indicate a significant difference between the national and poverty samples

concerning awareness of biotechnology and rbGH, knowledge of rbGH, current concern for rbGH's

health effects, concern for the future discovery of rbGH health effects, and preference for milk from

treated or untreated herds.

Compared to the DGZ respondents, the BLP respondents had lower awareness levels of

biotechnology and rbGH. Fewer BLP respondents approved of biotechnology than those from the DGZ

sample (45 percent compared to 50 percent, respectively), and more felt rbGH was a poor idea (60

percent) than the DGZ sample (50 percent). Thus, these results do not confirm either of the McGuirk,

Preston, and Jones studies (1990, 1992).

More of the BLP respondents were "very concerned" with the current health effects and future discovery of health effects associated with rbGH than the DGZ sample. The BLP respondents were less approving of biotechnology in general than the DGZ respondents (45 percent versus 50 percent, respectively) and were more likely than the DGZ respondents (60 percent versus 50 percent) to believe that rbGH was a poor idea.

The supporting objectives were to analyze the correlates to consumer risk perception and the impact of commercial use of rbGH on consumer demand for fluid milk, one year after rbGH's approval by the FDA. The findings presented in this report reflect that most consumers are aware of agricultural uses of biotechnology and rbGH, but less aware of rpGH. These awareness levels are much higher than those found by Hoban (1994), who also conducted a national survey of households after the FDA approved rbGH for commercial use. Hoban found only 4 percent of the respondents had read or heard a lot about bST, 15 percent had heard something, and 62 percent had heard nothing at all. But in its 1990 nationwide survey, the National Dairy Board found that 62 percent of their respondents were aware of rbGH, a finding similar to that of this study (Smith and Warland 1992).

More of the consumers surveyed approved of the agricultural uses of biotechnology than approved treating cows with rbGH. Additionally, even though rpGH is not currently approved for commercial use, consumers were more positive about purchasing pork products treated with it, if it is approved, than they were about rbGH. These results suggest that consumers are not adverse to biotechnology applications in general, but exhibit responses specific to each application.

A large percentage of consumers surveyed were also concerned about the discovery of human ill health effects. To further explore these concerns, several variables thought to influence risk perceptions were evaluated for those who were concerned and those who were not concerned. Concerned consumers seemed to believe that milk is nutritious and important for the growth and development of children. Yet they did not have the same strong opinions about milk being a natural and

pure product. It has been suggested that the trustworthiness of information sources might be a factor in

consumers' risk perceptions (van Ravenswaay 1995). However, the results of our survey showed that

the two groups had similar responses about the trustworthiness of information sources. Both the

concerned and no concern groups found the FDA, nutrition information labels, and the USDA as

somewhat to very trustworthy. The DGZ sample ranked physicians as their most trustworthy food-

related information source, followed by the USDA and FDA, while the BLP sample ranked the USDA

as being the most trustworthy, followed by farmers' organizations and the FDA. Both samples ranked

advertisements as being the least trustworthy food-related information source. Other research findings

on the trustworthiness of information sources has been mixed (van Ravenswaay 1995).

The two groups expresses divergent knowledge of rbGH and non-rbGH milk. The concerned

group felt there is a difference between rbGH and non-rbGH milk, that rbGH's health implications are

not known, and that rbGH does not benefit consumers. All respondents seemed to be less confident

answering the statements on whether bGH occurs naturally in milk, the cows' health effects, and the

economic effects on farmers. This was evident by the high number of "don't know" responses.

The greatest diversity between the concerned and not concerned group was their locus of

control and group affiliation. The concerned group more strongly agreed that they were worried about

the future of children and that they felt helpless in the world. They also more strongly identified with

environmentalists and animal rights groups.

But consumers' demand for milk since rbGH's commercial adoption has remained largely the

same. Only a small proportion of consumers have decided to reduce or stop buying milk and to replace

cow's milk with other substitutes. However, 8 percent of the DGZ respondents said that they now

usually only buy milk identified as coming from nontreated cows. This represents 10.6 percent of the

total fluid milk consumption by DGZ respondent households. Further, a large percentage (69 percent)

of the DGZ respondents who expressed an opinion, would prefer milk from non-rbGH treated herds. Of

the BLP respondents expressing an opinion, 61 percent would prefer milk from untreated herds. This is also indicated by the result that almost all the consumers surveyed would like to see milk labeled in a way that would distinguish between milk from treated versus untreated herds. Consumers have expressed that they would like a choice in their milk purchase decision.

Endnotes

[1]See Grobe, Douthitt, and Zepeda. Forthcoming 1996a. "Exploring Consumers' Risk Perceptions Toward Recombinant Bovine Growth Hormone (rbGH) and Recombinant Porcine Growth Hormone (rpGH) by Income and Gender: A Focus Group Study." Mimeo. Available from Institute for Research on Poverty, University of Wisconsin–Madison.

[2]See the Survey Instrument for further information on the randomization sequence, Grobe, Douthitt, and Zepeda. Forthcoming 1996b. "Survey Instrument: Measuring Consumer Knowledge and Risk Perception of Food-Related Biotechnologies." Mimeo. Available from Institute for Research on Poverty, University of Wisconsin–Madison.

[3]See the Survey Instrument for variables IBGH and DRES.

[4]See the Survey Instrument for the rpGH block of questions APGH through PPRK and the rbGH block of questions ABGH through SCON.

[5]To select a random digit "Targeted Income Sample," SSI computes an average of the income predictor score at the household level for each telephone exchange. Survey sampling uses a sophisticated income predictor to select samples that target households within a specified income range. The income predictor is derived from a multiple regression analysis of both individual household data and Census data at the block group level. The individual household data included information such as automobile ownership, length of residency, and type of dwelling unit; the Census data are based on over two hundred variables related to income from the U.S. Census. Then the exchanges are ranked by predicted income. Once a geographic definition has been determined (for this project it was defined as the continental United States), a particular income level was specified. The sample was selected only from those exchanges where the average of the income predictor scores was calculated to be at that level or lower.

[6]Adjusted response rate = (completed + total non-response) / (completed + total non-response +

total non-sample).

[7]Annual update of the U.S. Department of Health and Human Services Poverty Guidelines. *Federal Register* 60, no. 27 (Thursday, February 9, 1995): 7772–7774.

[8]There were, by chance, no Vermont cases in the National sample, although there were Wisconsin cases in the National sample.

[9]In complying with the independence assumption, the DGZ sample needed to be separated so that the BLP sample would no longer be a subsample. Thus, the two groups of comparison were the BLP Sample (N=217) and the DGZ sample (subtracting out the BLP respondents) (N=1693), for those respondents who expressed an opinion.

References

Bureau of the Census. 1992. *1990 Census of Population, General Population Characteristics of the United States.* Washington, D.C.: U.S. Department of Commerce (CP-1-1).

Eom, Y. S. 1993. "Self-Protection, Risk Information, and Ex Ante Values of Food Safety and Nutrition." Paper presented at the conference Valuing Food Safety and Nutrition, Alexandria, VA, June 2–4, 1995.

Grall, T. A. 1994. *Households at Risk: Their Housing Situation*. (Current Housing Reports, H121/94-2). Washington, D.C.: U.S. Department of Housing and Urban Development.

Grobe, D., and R. Douthitt.1995. "Consumer Acceptance of Recombinant Bovine Growth Hormone: Interplay between Beliefs and Perceived Risks." *Journal of Consumer Affairs* 29 (1): 128–143.

Groth, E. 1991. "Communicating with Consumers on Food Safety and Risk Issues." *Food Technology* 45 (May): 32–34.

Hadden, S. G. 1989. *A Citizen's Right to Know: Risk Communication and Public Policy*. Boulder, CO: Westview Press.

Hoban, T. J. 1994. *Consumer Awareness and Acceptance of Bovine Somatotropin.* Washington, D.C.: Grocery Manufacturers of America.

McGuirk, A. M., W. P. Preston, and G. M. Jones. 1990. "Biotechnology and the Consumer: The Case of Bovine Somatotropin." Department of Agricultural Economics, Virginia Polytechnic and State University. Blacksburg, VA. Staff paper 90-6.

McGuirk, A. M., W. P. Preston, and G. M. Jones. 1992. "Biotechnology and the Consumer: The Case of Bovine Somatotropin." *American Journal of Agricultural Economics* 72(5): 1344–1354.

Research Alliance. 1990. "Consumer Reactions to the Use of bST in Dairy Cows." Report prepared for the National Dairy Promotion and Counseling Service.

Senauer, B., E. Asp, and J. Kinsey. 1991. *Food Trends and the Changing Consumer*. St. Paul, MN: Eagan Press.

Slusher, B. J. 1990. "Consumer Acceptance of Food Production Innovations: An Empirical Focus on Biotechnology and BST." In *Enhancing Consumer Choice: Proceedings of the Second International Conference on Research in the Consumer Interest,* pp. 105–106.

Smith, B. J., and R. H. Warland. 1992. "Consumer Responses to Milk from bST-Supplemented Cows." In *Bovine Somatotropin and Emerging Issues*, ed. M. C. Hallberg, pp. 243–264. Boulder, CO: Westview Press.

Sterngold, A., R. Warland, and R. Hermann. 1994. "Do Surveys Overstate Public Concerns?" *Public Opinion Quarterly* 58: 255–263.

Van Ravenswaay, E. 1995. *Public Perceptions of Agrichemicals* (Task Force Report no. 123). Ames, IA: Council for Agricultural Science and Technology.