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Exploring Consumer Valuation and Preference Heterogeneity for Functional Foods Using a Choice Experiment: A Case Study of Tomato Juice Containing Soy in Ohio

By

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Abstract

A discrete choice experiment is applied to examine consumer valuation of a new generation of functional foods. Data were collected from 1,704 households in Ohio through a mail survey. Results indicate health benefits and ingredient naturalness are positively valued but such preferences depend on individual's education, income, and food purchase behavior.

Keywords

Functional food, choice experiment, multiple health benefits, conditional and mixed logit

Introduction

Functional foods have become a topic of increasing importance for the food industry over the past decade. Despite the lack of a legal definition by the Food and Drug Administration (FDA), these foods are commonly described as products that provide additional health benefits beyond basic nutrients. The market for functional food has increased significantly over the past ten years (Heasman and Mellentin). Most early developments were foods fortified with vitamins and/or minerals such as vitamin C, vitamin E, folic acid, zinc, iron, and calcium (Sloan 2000). Next, the focus shifted to foods fortified with various micronutrients such as an omega-3 fatty acid, phytosterol, and soluble fiber with these micronutrients helping to promote good health or preventing diseases such as cancers (Hasler; Sloan 2002; Unnevehr and Hasler). More recently, food companies have taken further steps to develop food products that offer multiple health benefits in a single food as consumers become more interested in seeking information on a wider range of functional ingredients and demand more from the food they eat (Prepared Foods; Sloan 2004).

Because functional foods are emerging products that often require extensive research and development using innovative technology, food manufacturers want to ensure sufficient demand exists and that their return on investment will be justified. Such marketing decisions must be made under uncertainty. Assume a new functional food offers attributes (e.g., health benefits) not available in any existing products within the same product category. Food manufacturers must examine how consumers decide among items in a category, if they are likely to try this new offer, and how they will evaluate and select between conventional foods and this new functional food.

The objectives of this study are to examine consumer valuation of various attributes of

functional foods and to determine the effect of demographic and individual characteristics on consumers' choice decisions. This study uses tomato juice containing soy (still in a development stage), representing a new generation of functional foods; one that has multiple specific nutrient levels, which may (possibly in a synergistic way) help to reduce the risk of certain cancers and heart disease. Four attributes were included to assess their relative importance - health benefits, organic ingredients, source of nutrients, and price.

Even though the existing literature shows that consumers value and are willing to pay premium prices for health benefits (Maynard and Franklin; Poulsen), no study to our knowledge has compared consumer valuation between single and multiple health benefits of functional food. This is an important issue as the new generation of functional foods aims to offer multiple health benefits to consumers (IFIC; Sloan 2002). Several studies show that consumers relate organic and/or natural foods to functional foods (Ohr; Squires, Juric, and Cornwell). Many consumers perceived that organic and/or natural foods are healthier than conventional foods and thus are willing to pay premium prices for these products.

Since the functional food used in this study is a new venture, no secondary data from actual markets is available to estimate consumer demand. Therefore a stated preference technique, a choice experiment, is applied to examine trade-offs between food quality attributes. This technique is commonly applied in various disciplines to estimate values of non-market goods or of new products that are not yet introduced in the market. An experimental design was conducted to assign attributes in different choice sets. Data were collected from approximately 1,700 households in Ohio through a mail survey. A conditional logit model and a mixed logit model were then applied to assess consumer preferences and willingness to pay. The issue of taste heterogeneity among consumers was addressed by comparing responses from various

subgroups based on individual characteristics. The following sections lead with a literature review, then describe the methodology, present the results, and then provide a discussion.

Literature Review

Trade-Off Decisions among Product Attributes

Many studies have been conducted in recent years to examine consumer attitudes towards, and how consumers perceive different attributes of, functional foods. Schmidt reported results of a national phone survey in which more that 95% of consumers believed certain foods have benefits that go beyond basic nutrition and may reduce the risk of certain diseases or improve their overall health. Although consumers are aware of such health benefits, they still evaluate all other product attributes, based on their perceptions, of taste, naturalness, appearance, and price (Childs and Poryzees; Frewer, Scholderer, and Lambert).

Poulsen showed that certain consumers are willing to pay more for functional foods if they are aware of the associated health benefits. Maynard and Franklin applied a contingent valuation method and found that consumers are willing to pay premiums for certain health attributes (e.g., Conjugated linoleic acid (CLA)'s cancer fighting characteristic). However, the survey conducted by Jonas and Beckmann suggested that consumers expected the price of functional foods to be the same as that of conventional foods. No additional price for the claimed health effects was seen to be justified. They also found that taste and price are of greater importance than the product's functional benefits. Many consumers perceived that functional foods are unnatural or impure because of added nutrients used to meet the claim of health benefits; thus these consumers expressed strong reluctance toward modification and fortification of foods.

Heterogeneity in Consumer Preferences for Functional Foods

In recent years, many food manufacturers have developed and marketed functional foods in response to increasing consumer concern and interest in the link between diet and health (Hasler et al.; Singletary and Morganosky). The main characteristic of functional foods is the health benefit from one or more substances that may help prevent or treat certain diseases. Thus, various population groups may view functional foods differently with only a certain proportion interested in and willing to pay for these food products (Maynard and Franklin).

Certain demographic characteristics of consumers tend to have a significant influence on consumer perceptions about the importance of choosing a healthy diet. Maynard and Franklin found that households with children and health conscious consumers expressed higher willingness to pay for functional food products. Poulsen found that older respondents and women react more positively toward functional foods compared to other respondents. IFIC survey data identifies several consumer groups who are interested in functional food; these include 55-64 years old, college educated, high income, and users of dietary supplements (Pitman and Reinhardt; Schmidt and Pitman). Nayga and Capps examined the relationship between socio-demographic factors and an individual's perception of the importance of choosing healthy diets. They suggested that understanding such perceptions is an important step in changing dietary behaviors and in designing nutrition policies. Jayanti and Burns showed that people with different levels of health motivation react differently through their diet choices.

Applications of Choice Experiments

Choice experiments have been increasingly applied in the marketing, economics, and transportation literatures in recent years (Adamowicz et al.; Hanley, Wright, and Adamowicz;

Hensher; Hearne and Salinas; Massimiliano). The application of choice experiments has also been extended to agribusiness research with firms increasingly interested in producing and selling differentiated goods and services with values not currently established in well-functioning markets. Lusk and Fox examined the importance of different product attributes including price, marbling, tenderness, use of growth hormones, and use of GM feed in US consumer beef steak purchasing decisions. Hearne and Volcan elicited Costa Rican consumer preferences for different attributes of organic and conventional vegetables, including label, appearance, size, and price, in a hypothetical market. Other studies have applied this technique to examine consumer valuations of genetically modified (GM) products. Burton and Pearse identified consumer preferences for various hypothetical forms of genetic modifications in beer made from barley (conventional vs. GM) and yeast (conventional vs. GM) with different prices. Burton et al. and James and Burton examined conditions under which British and Australian consumers, respectively, are willing to purchase GM foods.

Currently, only a few studies have looked at consumer valuation for functional food. West et al. characterized consumers' attitudes, beliefs, knowledge, and willingness to pay for functional food, using a phone survey of approximately 1,000 Canadian households. They found that consumers believe in a strong relationship between food choice and disease prevention and consumers are willing to pay a price premium for food that offers a health benefit such as anti-cancer. Using the same dataset, Larue et al. reported that many consumers are not willing to pay more for GM and organic foods regardless of the presence of functional health properties. It still remains a question, however, how preferences for different types of foods vary across demographic and individual groups. Further studies are required to better understand consumer needs and attitudes, price-sensitivity, and individual preferences for these products.

Methodology

Hypothetical Product and Attributes

This study used tomato juice containing soy as an example of a new generation of functional foods. This product is in a development phase by a research team at The Ohio State University. Tomato and soy products, respectively, contain lycopene and isoflavones. It has been shown that these products, independently, may help prevent the risk of several diseases including prostate cancer and heart disease (Nguyen and Schwartz; Sirtori and Lovati). Giovannucci et al. conducted a longitudinal survey study spanning 1988 to 1998 with 51,529 U.S. male health professionals aged 40-75 years and reported that frequent consumption of tomato products was associated with a lower risk of prostate cancer. Brouns indicated the link between the consumption of soy isoflavones and the prevention of several diseases, including heart disease, type II diabetes, osteoporosis, and certain cancers. It is expected that the consumption of tomato products containing soy should help promote good health and/or reduce the risk of having these diseases, perhaps in a synergistic manner.

An attribute-screening study was conducted to obtain information about relevant attributes to be included in the choice experiment (Carlsson, and Martinsson; Fowkes and Wardman). Four characteristics were included to assess their relative importance (i.e., health benefits, organic ingredients, source of nutrients, and price), see table 1. Three levels of the "health benefits" were included and compared – no health benefit, single health benefit (i.e., rich in nutrients that may reduce the risk of prostate cancer), and multiple health benefits (i.e., rich in nutrients that may reduce the risk of prostate cancer and heart disease). Two levels were included for "organic" and "natural ingredient" attributes. For "organic", this study compared food that was *organically* produced (i.e., no use of synthetic chemicals such as pesticides and fertilizers)

and food that was *conventionally* produced (i.e., it may involve some pesticides or fertilizers when it is grown, handled, and/or processed). For "source of nutrient", this study compared nutrients that are from *natural sources* (e.g., use of a special type of tomato that has a high level of lycopene) and nutrients that are *fortified* (e.g., additional lycopene enriches the tomato juice). Four levels of price are included ranging from $3.00 to $4.50 for a pack of 6 8oz cans.

Note that even though product taste is often perceived to be the most important attribute consumers consider when making choice decisions, it is difficult to vary taste across product alternatives in a hypothetical choice set due to its subjective perception. Thus, taste is not included as one of product attributes in this study. This best reflects the situation when consumers encounter a new product that they have never tried. Their purchase decision (without trial) relies on other attributes of the product and price.

Choice Experiment Design

This study followed the computerized construction of efficient choice design, suggested by Zwerina, Huber, and Kuhfeld. Four alternatives, including an opt-out option, were selected for each choice set. The first alternative is called a *conventional tomato juice*, which does not claim any health benefit. The second alternative is called *tomato juice plus*, which offers an additional health benefit from higher levels of lycopene. The third alternative is called *tomato juice plus with soy*, which offers further (potentially synergistic) health benefits of lycopene and isoflavones. The last alternative is the opt-out option (i.e., respondents can choose none of these alternatives).

With four attributes (3, 2, 2, and 4 levels, respectively), there were 48 combinations of the product. An orthogonal array (i.e., 100 percent efficient design) is available for 24 and 48

choice sets. However, asking respondents to complete 24 or 48 choice sets was seen to be too intensive of a task likely to result in consumer fatigue (Hensher, Stopher, and Louviere). Further, there was a constraint in terms of number of choice sets that could be included in the mail survey instrument. Thus, a total of eight choice sets were selected. Considering these attribute levels and constraints on the number of choice sets, an optimal design was derived with a goal of obtaining an efficient number of choice sets with minimum variance among parameter estimates. This was achieved by applying a SAS Macro Program (Kuhfeld; Kuhfeld, Tobias, and Garratt).

The optimal design of choice sets is shown in table 2. It is noted that certain alternatives may not be realistic (i.e., the conventional product with no health benefit and fortified nutrient). Louviere suggested that such "implausible" alternatives (i.e., alternatives containing levels of attributes that may be counter-intuitive to most respondents) should still be included in the choice set in order to satisfy properties of the optimal design and to confirm whether respondents carefully assess choice tasks.

These eight choice sets were randomly assigned into two versions. Each version has four choice sets and every survey respondent received one of the two versions. A round of expert review, a focus group, and a pretest were employed to evaluate and review each choice design (Alpizar, Carlsson, and Martinsson; Blamey et al.; Rolfe and Bennett). First, the draft of the choice set design was reviewed by a team of experts from various disciplines, including physicians, nutritionists, and food scientists, who were affiliated with the overall project. Following this, a focus group, using eight graduate students as participants, was conducted to clarify and simplify instructions, question wording, and format of choice questions to ensure all texts could be easily understood and followed by the general public. Finally, the revised design was pre-tested using 68 undergraduate students. Results suggested that respondents were able to

understand and follow the instructions and complete the choice tasks. One version of the choice set design is shown in the Appendix.

Econometric Models

The random utility model represents the fundamental approach for the econometric analysis of consumer choice within a discrete choice multi-dimensional environment. It is based on the hypothesis that individuals make choices according to attributes of alternatives along with some degree of randomness (Adamowicz, Louviere, and Williams; Massimiliano; McFadden 1986; McFadden 2001). Different discrete choice models can be obtained from various specifications and assumptions of the distribution of the unobserved portion of utility (Batsell and Louviere). In this study, two specific models are applied and estimation results compared – a conditional logit model and a mixed logit model.

The conditional logit model is a standard multinomial logit model that has been traditionally applied to analyze discrete choice data. It is a restricted model as it imposes independence of irrelevant alternatives (IIA) and assumes that the coefficients of variables are the same for all people (Ben-Akiva and Lerman; McFadden 1986; Haaijer and Wedel). These restrictions can be unrealistic in many settings (Brownstone and Train). The mixed logit model is a generalization of the standard multinomial logit model that does not exhibit the restrictive IIA property and explicitly accounts for correlation in unobserved utility over repeated choices by each respondent (Revelt and Train; Train). Consumer heterogeneity is an important issue in food marketing, particularly when firms focus on specialized niche products for which target consumers' preferences are quite different from the aggregate market. It is important to relax the IIA assumption because opinions about food attributes are expected to vary greatly among

respondents (Larue et al.; Lusk and Hudson). As each survey respondent was presented with 4 choice sets we are able to apply a mixed logit model and compare the precision of the results to a conditional logit benchmark.

Data Collection

A mail survey of nearly 3,500 randomly selected Ohio households was conducted in June 2004. The purpose of the survey was to assess Ohioans' attitudes and behavior with regard to various issues related to food, agriculture, and the environment. Of interest for this study are measures of food choice decisions, consumer attitudes and behavior toward health and diet, and demographic characteristics. Given the sample of 3,500 households and 245 undeliverable surveys, the total response rate was 54.7 percent. Out of the returned surveys (1,781), 77 households did not respond to the choice set questions and are excluded from the data set. The adjusted data set provides information from 1,704 households (52.4% response rate). Demographic and other individual characteristics of respondents are shown in tables 3 and 4.

To assess the representativeness of the sample, demographic characteristics of survey respondents were compared to 2000 census statistics for Ohio and the US population, see table 3. The characteristics of survey respondents are similar to Ohio and US populations in terms of gender, marital status, education, and household income. The sample is somewhat older and included a smaller proportion of African American respondents compared to the statewide population and less Hispanic/ Latino and Asian respondents compared to the US population. Another difference between the sample and more general populations is that a larger proportion of sample respondents reported residing in owner-occupied housing units.

Other individual characteristics measured included attitude and behavior toward health

and diet (see table 4). Respondents have relatively high self-rated scores on their awareness and interest about healthy foods. Approximately 50 percent of respondents reported a family history with heart disease and cancer. More than half reported that they have never or seldom purchased organic or natural foods, whereas more than 70 percent reported that they have occasionally or frequently purchased foods that provide health-promoting or disease-fighting benefits beyond basic nutrition.

Results

Consumer Valuation and Willingness to Pay (WTP) Estimates

Table 5 presents WTP estimates from both the conditional logit and mixed logit models. It is shown that WTP estimates for each product attribute differ across discrete choice models; this indicates that model selection is important and tends to have a significant effect on the implications of parameter estimates. Results from the mixed logit model suggest that, on average, respondents are willing to pay $0.93 more for the *single health benefit*, $0.28 more for *multiple health benefits*, and $0.41 more for *naturalness* when the base product is regular tomato juice priced at $3.00 per pack (6 cans, 8 fl. oz. /can). It is noted that the standard deviations of the WTP estimates are relatively high (i.e., the variation in coefficients is fairly substantial), implying that people tend to respond quite differently and are considerably heterogeneous in preferences and valuations for these attributes.

Even though the mean WTP for *single health benefit* is higher than that for *multiple health benefits*, there are certain groups of respondents who place higher value on, and are willing to pay more for, *multiple health benefits* as shown by higher estimates of the standard deviation. Meanwhile, the WTP estimate for *organic* characteristics ranges from -$2.07 to $1.86.

It is shown that more than two-thirds of respondents place a positive value on *single health benefit* and *naturalness*, whereas about half of respondents place a positive value on *multiple health benefits* and *organic* characteristics.

Effects of Demographic and Individual Characteristics

To examine the effect of consumer characteristics on choice decisions and consumer preferences, the data is divided into different subgroups based on demographic and other individual information (i.e., gender, age, education, income, family disease history, and food consumption patterns) with a mixed logit model estimated for each subgroup. Using the test outlined by Swait and Louviere, see table 6, results lead to the rejection of a set of hypotheses that each subgroup share the same coefficient estimates. This implies that preference and attribute valuation are heterogeneous and vary across demographic groups. The only exception is the family history of cancer, where parameter estimates are not statistically significant ($p > 0.05$) between respondents whose family members have been diagnosed with cancer and respondents with no family members diagnosed with cancer.

Table 7 shows WTP estimates for various demographic and individual characteristic groups. Comparing male and female respondents, all male respondents placed a positive value on *single health benefit*, *multiple health benefits*, and *naturalness*. They were a very homogeneous group (i.e., small standard deviation) and they were willing to pay a $0.40 - $0.70 premium for these attributes. However, data reveal that male respondents did not want to pay more for *organic ingredients*. In comparison, the range of WTP estimates for females is much broader, which implies that their preferences for these attributes are more heterogeneous. Differences in attribute valuation may be due to the potential health benefits of this product (i.e., to reduce the

risk of prostate cancer) being more relevant to male respondents. However, of those female respondents who responded positively, they were more willing to pay more for such attributes. In addition, results from this study are consistent with previous studies that found female respondents are more concerned with pesticide residues and are more likely to purchase organic or natural produces even if they cost more (Schmidt and Pitman; Thompson).

It has been suggested that respondents in different age groups and other social groups have different preferences for many food attributes (see Pitman and Reinhardt; Poulsen; Schmidt and Pitman). Younger respondents (i.e., less than 35 years old and between 35 and 60 years old) are willing to pay more for *single health benefit*, *multiple health benefits*, and *organic ingredients*, whereas older respondents (i.e., over 60 years old) are willing to pay more for the *naturalness* attribute. The range of WTP estimates is much broader for the older respondents for all food attributes. Results imply that the concept of food with added health benefits is more readily accepted by younger respondents. In order to maintain good health and/or prevent the risk of diseases, they are more open to try food products with novel functional attributes. Meanwhile, older respondents are also concerned about their own health and take preventative roles in their food purchase decisions, but they tend to choose products that offer health benefits from natural sources, rather than buying functional food products (Childs; Gilbert).

Education and income level also tends to affect preferences and food selections. Respondents with higher education levels are willing to pay more for these product attributes. Also, respondents with higher income levels tend to be willing to pay more, although the range of WTP estimates is relatively broad for all income levels. These findings are similar to previous studies that suggest people with higher education and income are more aware of the benefits of functional food or organic food and are willing to pay more for these types of foods (Childs and

Poryzees; Schifferstein and Ophuis; Schmidt and Pitman).

It is also shown that people who are more health conscious and regularly purchase foods from natural or health food stores tend to be a target market for functional foods or organic foods (Gilbert; Schmidt; Squires, Juric, and Cornwell). However, the data reveal that a family history of cancer does not affect consumers' choice decisions, whereas a family history of heart disease has a negative impact on consumer valuation of product attributes. Results are rather surprising as respondents whose family members have been diagnosed with cancer and/or heart disease should have a higher awareness/interest and should react more positively to foods that may help prevent these diseases. Perhaps this is evidence of the need for further consumer education regarding the role of diet in cancer prevention and risk management. It is also suggested that respondents who occasionally or frequently purchase functional foods, organic food, or natural food are willing to pay more for this hypothetical product, as compared to respondents who never or rarely purchase these food groups. Thus, product familiarity and consumption patterns tend to have a significant effect on how consumers evaluate and value these attributes.

Conclusions

Results from this study suggest that consumer preferences for an example new generation functional food vary considerably. A choice experiment with an appropriate design linked to an econometric model is applied to evaluate consumer preferences and valuations for an emerging concept in the food industry. A mixed logit model is used to examine this preference heterogeneity for multiple attributes of a still hypothetical functional food product. More than half of respondents place positive values and are willing to pay a premium price for health benefits and for a natural functional tomato juice. This finding is consistent with Childs and

Poryzees, who suggested that consumers prefer more natural means of delivery for nutritional enhancements. Meanwhile, respondents do not perceive organic ingredients to be a key element of this new concept of tomato juice. This information is important for firms in deciding which attributes to include in their new products during the research and development phase.

It is surprising to find that respondents (on average) prefer *single health benefit*, which offers a potential cancer-fighting benefit, to *multiple health benefits*, which may jointly provide heart disease-fighting and cancer-fighting benefits. This does not necessarily imply that all consumers will always value a product with a single health benefit more than a product with multiple health benefits. Instead, consumers may perceive that tomato and soy is not a good combination for a juice product. Therefore, it is too soon to simply draw a conclusion that consumers would turn down this new product concept. Consumers may not be familiar with the product or be too concerned about taste of this tomato juice with soy, as shown by low valuation relative to other tomato juices. This result posts a common challenge for all researchers developing new generation functional food products with ever more unusual combinations of bioactive ingredients - they will need to communicate multiple health benefits yet also offer good taste and other key attributes that are important to consumers.

It was expected that different demographic groups would react differently to this functional food. People who are more interested in this product tend to have higher education and income levels; this result is consistent with other studies (Childs; Pitman and Reinhardt; Schmidt and Pitman). Results here also indicate that product familiarity plays a significant role in consumers' food choices. Consumers who regularly purchase food groups such as functional foods, organic foods, and food with natural ingredients react more positively and are more interested in this product, as compared to those who never purchase these types of food. Male

respondents tended to have similar preferences, whereas female respondents' preferences were more heterogeneous. Women were willing to pay higher premium prices for health benefits and naturalness of this product. It is quite surprising to find that younger respondents place higher value for these attributes and are willing to pay more for them even though older respondents tended to have similar taste preferences with regard to this product concept.

Understanding factors that consumers consider when selecting food is important in forming optimal strategies to encourage improvement in consumer eating habits. More precise forecasts of the demand for functional foods will also help food manufacturers decide whether further research and development is justified. In addition, food manufacturers need to understand the underlying decision making processes of consumers to most effectively segment and market these products. This study illustrated that consumers value health attributes of functional foods and that consumers are willing to pay more for these products. Such results provide a good incentive for food manufacturers to develop and introduce healthy products into the market despite the challenges in developing products that meet consumer needs (e.g., price, good taste and multiple health benefits) and being able to communicate such benefits to consumers. It also identifies characteristics of consumers who are more interested and more likely to purchase these products. As suggested by Unnevehr, Villamil, and Hasler, consumers whose health endowment leads them to value health benefits are more likely to demand and be willing to pay for health benefits from new food products. It would be interesting to employ similar techniques to consider additional product attributes and ask consumers to complete more choice sets to enable further precision. Such an extension to this research would provide more information about consumer preferences and help better understand their decision-making processes.

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Table 1: Attributes and levels for the choice experiment

Attributes	Levels
Health Benefits	1. No health benefit 2. Single health benefit - Rich in nutrients that may reduce the risk of prostate cancer 3. Multiple health benefits - Rich in nutrients that may reduce the risk of prostate cancer and heart disease
Organic	1. Conventional ingredients 2. Organic ingredients
Source of Nutrients	1. Natural 2. Fortified nutrients
Price	1. $3.00 2. $3.50 3. $4.00 4. $4.50

Table 2: Optimal Choice Set Design

Choice Set	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1	No Health Benefit Conventional ingredients Fortified nutrients $4.50	Single Health Benefit Conventional ingredients Natural $3.50	Multiple Health Benefits Organic ingredients Fortified nutrients $4.00	None of these products
2	No Health Benefit Conventional ingredients Natural $3.00	Single Health Benefit Organic ingredients Natural $4.50	Multiple Health Benefits Conventional ingredients Fortified nutrients $3.50	None of these products
3	No Health Benefit Organic ingredients Natural $3.50	Single Health Benefit Conventional ingredients Fortified nutrients $4.00	Multiple Health Benefits Organic ingredients Natural $4.50	None of these products
4	No Health Benefit Organic ingredients Fortified nutrients $3.50	Single Health Benefit Organic ingredients Fortified nutrients $3.00	Multiple Health Benefits Conventional ingredients Natural $4.00	None of these products
5	No Health Benefit Organic ingredients Natural $4.00	Single Health Benefit Organic ingredients Fortified nutrients $4.50	Multiple Health Benefits Conventional ingredients Natural $3.00	None of these products
6	No Health Benefit Conventional ingredients Fortified nutrients $4.00	Single Health Benefit Conventional ingredients Natural $3.00	Multiple Health Benefits Organic ingredients Natural $3.50	None of these products
7	No Health Benefit Conventional ingredients Natural $4.50	Single Health Benefit Conventional ingredients Fortified nutrients $3.50	Multiple Health Benefits Organic ingredients Fortified nutrients $3.00	None of these products
8	No Health Benefit Organic ingredients Fortified nutrients $3.00	Single Health Benefit Organic ingredients Natural $4.00	Multiple Health Benefits Conventional ingredients Fortified nutrients $4.50	None of these products

Table 3: Demographic characteristics of respondents compared to Ohio and US populations

Variable	Respondents from Survey	Ohio	United States
Gender			
Female	51.2%	51.4%	50.9%
Male	47.8%	48.6%	49.1%
Age			
Less than 35 years old	18.6%	48.1%	49.5%
Between 35 and 60 years old	54.2%	34.6%	34.2%
More than 60 years old	27.2%	17.4%	16.2%
Education			
High school or less	48.3%	53.2%	48.2%
College degree or some college	36.7%	39.5%	42.8%
Graduate degree or higher	15.0%	7.4%	8.9%
Ethnic Background			
African American	4.2%	11.5%	12.3%
Asian	0.9%	1.2%	3.6%
Hispanic/ Latino	0.6%	1.9%	12.5%
Indian American	0.7%	0.2%	0.9%
White	90.2%	85.0%	75.1%
Marital Status			
Now Married	65.8%	54.5%	54.4%
Never Married	14.9%	26.2%	27.1%
Divorced/ Separated	10.6%	12.2%	11.9%
Widowed/ Widower	7.0%	7.1%	6.6%
Household Annual Income Level			
Less than $35,000	36.5%	42.5%	41.4%
Between $35,000 and $50,000	18.9%	17.3%	16.5%
Between $50,000 and $75,000	22.8%	20.4%	19.5%
More than $75,000	21.8%	19.8%	22.5%
Residential Status			
Own	81.0%	69.1%	66.2%
Rent	19.0%	30.9%	33.8%

Note: Demographic characteristics of Ohio and the United States are from U.S. Census Bureau, Census 2000.

Table 4: Summary statistics of individual characteristics

Variable	Mean	Std. Dev.
Health-Diet Awareness/Interest Index	3.70	0.66
My eating habits are healthier than others I know		
I consider myself health conscious		
I am interested in using food to maintain good health		
I am interested in using food to prevent disease		
I am knowledgeable of the health benefits of foods I eat		
I usually look for health information when I buy food products		
Disease - Family History		
Heart Disease (1= Yes; 0 = No)	0.50	0.50
Cancer (1= Yes; 0 = No)	0.51	0.50
Frequency of Purchase - Organic Food		
Never	0.18	0.38
Seldom	0.43	0.49
Occasionally	0.33	0.47
Frequently	0.07	0.25
Frequency of Purchase - Food that provide health-promoting or disease-fighting benefits beyond basic nutrition		
Never	0.05	0.22
Seldom	0.20	0.40
Occasionally	0.48	0.50
Frequently	0.27	0.44
Frequency of Purchase - Natural Food		
Never	0.36	0.48
Seldom	0.35	0.48
Occasionally	0.20	0.40
Frequently	0.09	0.28

Notes:

1. Total observations = 1,704.
2. Health-diet awareness/interest index is calculated from the mean score of six five-point-scale items (strongly disagree – strongly agree).

Table 5: Estimated willingness to pay (WTP) for different product attributes

Product Attributes	Estimated WTP from Conditional Logit Model	Estimated WTP from Mixed Logit Model			
		Mean	Std. Dev.	Min	Max
Single Health Benefit	$0.71	$0.93	$1.85	-$3.03	$3.48
Multiple Health Benefits	$0.67	$0.28	$3.30	-$5.93	$5.97
Organic Ingredient	-$0.05	-$0.09	$0.71	-$2.07	$1.86
Naturalness	$0.44	$0.41	$0.48	-$0.63	$1.50

Table 6: Comparing coefficient estimates for various groups of respondents

	Log Likelihood Function	Chi-Square Statistics	Results
Pooled Data	-5755.92		
Gender			
Male	-3264.52	-1017.74	Reject *Ho*
Female	-3000.27		
Age			
Less than 35 years old	-996.28	101.71	Reject *Ho*
Between 35 and 60 years old	-3153.46		
More than 60 years old	-1555.32		
Education			
High school or less	-2753.49	127.82	Reject *Ho*
Some college degree	-2113.91		
Graduate degree	-824.61		
Income Level			
Less than $35,000	-1983.29	954.12	Reject *Ho*
$35,000 - $50,000	-952.68		
$50,000 - $75,000	-1251.44		
More than $75,000	-1091.45		
Family History - Cancer			
Yes	-2858.40	12.09	Fail to reject Ho
No	-2891.47		
Family History - Heart Disease			
Yes	-2750.83	-992.30	Reject *Ho*
No	-3501.24		
Frequency of Purchase - Functional Food			
Never or seldom purchase	-1304.14	100.93	Reject *Ho*
Occationally or frequently purchase	-4401.32		
Frequency of Purchase - Organic Food			
Never or seldom purchase	-3911.31	-1046.20	Reject *Ho*
Occationally or frequently purchase	-2367.71		
Frequency of Purchase - Natural Food			
Never or seldom purchase	-4668.31	-1288.07	Reject *Ho*
Occationally or frequently purchase	-1731.65		

Note: The null hypothesis is that coefficient estimates are not different between subgroups

and $\chi 2\ (20) = 67.50$ at 95% confident level.

$$-2\,[Ln\,(pooled\ \ data) - Ln\,(subgroup\ 1) - Ln\,(subgroup\ 2)]\ \sim\ \chi 2(\#\,Parameter\ Estimates)$$

Table 7: Comparing estimated WTP for respondent with different demographic and individual characteristics

	Single Health Benefit		Multiple Health Benefits		Organic Ingredient		Naturalness	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Gender								
Male	$0.68	$0.01	$0.55	$0.04	-$0.02	$0.00	$0.39	$0.06
Female	$1.03	$2.06	$0.35	$3.97	-$0.10	$1.02	$0.45	$0.57
Age								
Less than 35 Years Old	$0.84	$0.90	$0.54	$1.78	$0.07	$0.72	$0.23	$0.36
Between 35 and 60 years old	$1.14	$1.71	$0.40	$3.38	$0.03	$0.54	$0.39	$0.45
More than 60 years old	$0.55	$3.13	-$0.48	$5.56	-$0.53	$1.17	$0.64	$0.60
Education								
High School	$0.75	$2.28	-$0.45	$4.33	-$0.39	$1.06	$0.52	$0.35
College Degree	$0.92	$1.46	$0.48	$2.65	$0.05	$0.49	$0.26	$0.51
Graduate Degree	$1.09	$1.25	$0.99	$2.21	$0.21	$0.46	$0.43	$0.54
Annual Income								
Less than $35,000	$0.66	$1.78	$0.00	$3.27	-$0.29	$0.72	$0.47	$0.37
Between $35,000 and $50,000	$1.04	$1.76	$0.27	$3.11	$0.06	$0.73	$0.38	$0.45
Between $50,000 and $75,000	$1.12	$1.66	$0.57	$3.10	-$0.02	$0.76	$0.32	$0.56
More than $75,000	$1.12	$1.64	$0.80	$2.88	$0.12	$0.50	$0.33	$0.47
Family History of Cancer								
Yes	$0.95	$2.12	$0.45	$4.03	-$0.16	$0.75	$0.55	$0.52
No	$0.97	$1.55	$0.19	$2.86	$0.05	$0.65	$0.29	$0.45
Family History of Heart Disease								
Yes	$1.02	$2.01	$0.24	$3.56	-$0.08	$0.67	$0.44	$0.44
No	$0.65	$0.05	$0.69	$0.41	-$0.06	$0.32	$0.42	$0.20
Frequency of Purchase - Functional Food								
Seldom or Never	$0.42	$1.48	-$0.43	$2.54	-$0.28	$0.38	$0.54	$0.41
Occasionally or Frequently	$1.07	$1.96	$0.52	$3.51	-$0.04	$0.77	$0.37	$0.48
Frequency of Purchase - Organic Foods								
Seldom or Never	$0.53	$0.13	$0.32	$0.02	-$0.34	$0.25	$0.40	$0.17
Occasionally or Frequently	$1.38	$2.35	$1.14	$4.10	$0.40	$0.76	$0.42	$0.58
Frequency of Purchase - Natural Food								
Seldom or Never	$0.56	$0.05	$0.42	$0.36	-$0.15	$0.19	$0.36	$0.14
Occasionally or Frequently	$1.44	$2.90	$1.20	$4.54	$0.18	$1.10	$0.65	$0.59

Appendix: Food Choice Experiment in Ohio Survey

The following questions relate to how you make food purchasing decisions. More and more food products are designed to offer health benefits beyond basic nutrients, such as calcium fortified orange juice or high fiber cereal. Currently, researchers at The Ohio State University are studying a new product that contains tomato and soy. Scientific studies show that nutrients in tomato and soy may reduce the risk of prostate cancer and heart disease.

Imagine you are at your local supermarket shopping for tomato juice and find several different tomato juice products are available. Some of the juices are made from **organic** ingredients. Most nutrients are **naturally** found in the products (tomato and soy) but for some products additional nutrients require **fortification**.

Please choose between the three products in each of the four scenarios below. All products are the same size (6 packs of 8oz. cans) but the price varies depending on the ingredients used. Please look at the characteristic of each product and <u>check only the box above the product you most prefer in each scenario</u>.

Scenario 1: Check the box above the product you most prefer

☐	☐	☐	☐
Conventional Tomato Juice Organic ingredients Natural $4.00	**Tomato Juice Plus** Rich in nutrients that may reduce the risk of prostate cancer Organic ingredients Fortified nutrients $4.50	**Tomato Juice Plus With Soy** Rich in nutrients that may reduce the risk of prostate cancer and heart disease Conventional ingredients Natural $3.00	I prefer none of these products

Scenario 2: Check the box above the product you most prefer

☐	☐	☐	☐
Conventional Tomato Juice Conventional ingredients Fortified nutrients $4.00	**Tomato Juice Plus** Rich in nutrients that may reduce the risk of prostate cancer Conventional ingredients Natural $3.00	**Tomato Juice Plus With Soy** Rich in nutrients that may reduce the risk of prostate cancer and heart disease Organic ingredients Natural $3.50	I prefer none of these products

Scenario 3: Check the box above the product you most prefer

☐	☐	☐	☐
Conventional Tomato Juice Conventional ingredients Natural $4.50	**Tomato Juice Plus** Rich in nutrients that may reduce the risk of prostate cancer Conventional ingredients Fortified nutrients $3.50	**Tomato Juice Plus With Soy** Rich in nutrients that may reduce the risk of prostate cancer and heart disease Organic ingredients Fortified nutrients $3.00	I prefer none of these products

Scenario 4: Check the box above the product you most prefer

☐	☐	☐	☐
Conventional Tomato Juice Organic ingredients Fortified nutrients $3.00	**Tomato Juice Plus** Rich in nutrients that may reduce the risk of prostate cancer Organic ingredients Natural $4.00	**Tomato Juice Plus With Soy** Rich in nutrients that may reduce the risk of prostate cancer and heart disease Conventional ingredients Fortified nutrients $4.50	I prefer none of these products