CONSUMER AND MARKET DEMAND

AGRICULTURAL POLICY RESEARCH NETWORK

The Role of Sensory Experiences and Information on the Willingness to Pay for Organic Wheat Bread

Peter Boxall, Sean Cash, Wendy V. Wismer, Vijay Muralidharan and Lisa E. Annett
Faculty of Agriculture, Forestry and Home Economics
University of Alberta

Research Project Number CMD-07-01

PROJECT REPORT

April 12, 2007

Department of Rural Economy
Faculty of Agriculture & Forestry,
and Home Economics
University of Alberta
Edmonton, Canada

The Role of Sensory Experiences and Information on the Willingness to Pay for Organic Wheat Bread

Peter C. Boxall, Sean Cash, Wendy V. Wismer,
Vijay Muralidharan and Lisa E. Annett
Faculty of Agriculture, Forestry and Home Economics
University of Alberta

Acknowledgements: Agriculture and Agri-Food Canada Consumer and Market Demand Agriculture Policy Research Network. This research was also supported by funding the Canadian Wheat Board through a graduate scholarship to L. Annett. We thank Ellen Goddard, Dean Spaner and the many student volunteers who helped with this research.

The Role of Sensory Attributes and Information on the Willingness to Pay for Organic Wheat Bread

This study examined the size and the determinants of the price premium a sample of Edmonton-area consumers was willing to pay for organic wheat bread. The development of these premiums included consideration of providing information on health or environmental advantages of organic production and consideration of sensory (taste) acceptance. To do this conventional and organic wheat was grown under similar conditions and milled and baked into 60% whole wheat bread under identical conditions. Samples of these breads were presented to consumers for sensory acceptance and a survey of their attitudes, behaviours and characteristics. The survey included a closed-ended contingent valuation question to examine consumers' willingness-to-pay (WTP) premiums for the organic bread. A trained sensory panel was used to quantify differences in the sensory characteristics of the two breads.

The results suggest that in the absence of taste information respondents' WTP when environmental information was provided was greater than WTP when health information was given. When sensory taste information was included, however, the WTP estimates under the health information treatment were about twice those under the environmental information. The trained sensory panel observed the two treatments of bread to differ in texture but not in flavor, aroma or colour characteristics.

The implications of these findings are that successful marketing of organic foods depends on circumstance – in the absence of sensory experience the environmental benefits of organic production appear to be more appealing than potential health benefits. Health claims are only viewed positively when the product can be tasted. Sensory scientists should use caution in interpreting WTP estimates in that they must take into account the type of information and placement of WTP questions in their study designs. We also found that sensory variables when included in the regression model had statistically significant effects on WTP estimates. The economic significance of including these variables in the logit model was limited, however. Nevertheless we feel that under some circumstances economists may find it advantageous to include sensory information in their models of food demand.

Keywords: Organic foods, price premium, willingness to pay, taste, health, environment

JEL Classification: Q13, Q18

Introduction

There is an emerging body of research regarding the assessment of consumers' willingness to pay (WTP) for organic food products. Yiridoe *et al*. (2005) conducted a review of studies investigating consumers' WTP price premiums for organic products over conventional products, and summarize that "most consumers are not willing to pay a price premium above 10-20%." They also note that studies of individual products have found premiums of 10 – 100% or more. Such estimates of consumers' WTP can be elicited from actual market transactions (i.e., revealed preferences) or from survey data (i.e., stated preferences). Stated preferences are evaluated by asking the consumer to make single or repeated choice of whether they would purchase a good at a given price. In contrast, more recent research has evaluated incentive-compatible estimates of WTP derived from real transactions in the form of an experimental Vickery auction (Wertenbroch & Skiera 2002). In research studies involving food products, WTP evaluations range from basic purchase intent questions in a consumer survey (Bower, Saadat, & Whitten 2003; Magnusson *et al*. 2003) to experimental Vickery auctions, with consumers bidding with real money to elicit their actual WTP (Lange *et al*. 2002; Stefani *et al*. 2006).

The current study combines the contingent valuation method (CVM), a stated preference technique frequently applied in the valuation of environmental goods and services, with sensory evaluation of both organic and conventional wheat bread products. As described below, the two bread samples used were produced and baked under circumstances that were as identical as possible beyond the differences related to organic vs. conventional production methods. This combined approach is fairly novel in the economic literature. For example, McCluskey *et al*. (2006) evaluated consumers' WTP for apples with respect to sensory attributes, and observed that firmer and sweeter apples increased consumers' WTP. Ara (2003) used combinations of "eating quality" variables to describe the sensory characteristics of rice, such as softness, white colour, smell, and purity. If none of the characteristics were present, rice was considered of 'bad' eating quality, whereas a combination of one or more of the variables was considered 'fair' or 'good' quality. Rice with all 4 sensory variables was considered 'excellent' eating quality. The researchers observed that when "eating quality" was decreased from 'good' to 'bad', there was a decrease in WTP, whereas when "eating quality" was increased from 'bad' or 'fair' to 'excellent', WTP increased (Ara 2003). These two studies demonstrate that sensory variables can play a significant role in the stated willingness to pay for food products. To date, we know of no

studies that investigate the relationship between stated WTP and sensory perception with regards to organic products.

The limited use of combined economic and sensory approaches in food WTP studies to date is perhaps surprising, given the obvious importance of sensory experiences in repeated consumer choice for food products. Moreover, consumer studies frequently use demographic variables to proxy for underlying differences in preference. In the case of sensory attributes, there is a well-developed methodological toolbox for assessing such preferences at the individual level, as well as objectively quantifying sensory characteristics. Finally, the use of taste tests provide context for the stated purchase decision that may reduce the hypothetical biases that often accompany such methods. The use of such measures in WTP studies would therefore seem to have both theoretical and practical appeal.

Methods

This study involved the administration of a survey and sensory taste evaluations in an in-person intercept setting in Edmonton, Alberta, Canada during October and November 2005. Potential participants were screened to select regular consumers of wheat bread products at a local farmers' market, organic grocery stores, shopping centres and public venues in Edmonton and surrounding communities (Sherwood Park, St. Albert, and Red Deer), as well as the University of Alberta Campus in Edmonton. These locations were selected to ensure a well-distributed sample of consumers of varying age, income and education levels who habitually purchase either organically or conventionally produced food products.

Product Preparation and Sensory Evaluation Methods

Canadian spring wheat variety Park, representing 114 years of wheat breeding, was grown under paired organic and conventional farming regimes. The grain was grown at University of Alberta production plots approximately 1 km apart during the year 2005. The resulting wheat grains were milled into 60% whole wheat flour and baked into bread under identical conditions at the Leduc Food Processing Development Centre in Leduc, Alberta. The bread loaves were stored at -20 C. two hours after baking and were thawed prior to conducting taste evaluations. A manual bread slicer and serrated knife were used to cut thirteen 1.4cm thick slices from each 454g loaf.

Trained Panel Sensory Evaluation

Nine panelists were recruited from the University of Alberta campus in Edmonton, AB, Canada, to participate in the descriptive analysis sensory panel. Descriptive analysis training and evaluation used for this panel were based on the generic descriptive analysis methods described by Lawless and Heymann (1998). The training phase consisted of 10-one hour sessions over 3 consecutive weeks to develop and refine terminology to describe the key sensory attributes of whole wheat bread and develop reference standards. Fourteen descriptive terms covering appearance, aroma, texture and flavor attributes of whole wheat bread were evaluated on 15 cm unstructured line scales with endpoint labels of "Not at all" on the left to "Very" on the right for each attribute.

The panelists evaluated 3 treatments of 60% whole wheat bread; organic wheat bread, conventional wheat bread, and commercial wheat bread. The commercial 60% whole wheat bread was obtained from a local grocery store, and was held in the same conditions as the experimental loaves (described above). The commercial loaves were included to provide an experimental comparison to the 60% whole wheat breads that are available in the consumer market.

Samples were presented to panelists on 6 inch Styrofoam plates covered with plastic wrap and labeled with randomized 3-digit codes to represent each treatment. Filtered water was given to panelists as a palate cleanser during evaluation. A balanced block design was used to evaluate each of the 3 treatments in triplicate. Data from each panelist was collected using a computerized data acquisition system (Compusense *five*, version 4.2, Compusense Inc., Guelph, ON, Canada) for sensory evaluation.

Consumer Panel Sensory Evaluation

Samples were presented to consumers in separate self-sealing plastic sandwich size bags labelled with either randomized 3-digit codes or "organic" and "conventional" to represent each treatment. Sensory acceptance of the two bread samples was evaluated on the 9-point hedonic scale, which is a typical procedure used by food scientists in examining the sensory qualities of foods (Lawless *et al.* 1998). The verbal anchors on the 9-point hedonic scale ranged from "dislike extremely" (1), to "neither like nor dislike" (5) as a midpoint, to "like extremely" (9). Thus, higher ratings on the scale indicated the respondents' higher liking for the product. Respondents were required to smell, feel and taste the bread and were

asked to rate each slice following written instructions on the survey. Filtered water was provided as a palate cleanser between samples during the sensory evaluation.

Components of the Questionnaire

The consumer questionnaire was designed in two parts. In part A demographics (age, gender, household income, education level, and membership in environmental organizations) and information on brand loyalty, frequency of purchase and servings per day of whole wheat bread was collected. This was followed by a blind taste evaluation using the 9-point hedonic scale and a series of questions on attitudes towards health and environmental issues. These questions are described in more detail below.

In part B, short paragraphs of information on health or environmental aspects of organic production were presented, followed by a second taste evaluation in which the type of bread product (conventional or organic) was revealed to the consumer. In addition, a closed–ended contingent valuation question attempting to elicit their willingness to pay for organic bread was administered. As described in more detail below, the sequence of presentation of the information, CVM question and second sensory evaluation were varied. The questionnaire ended with several questions regarding the consumption and purchases of organic foods, and reasons that might prevent purchase of organic foods.

Attitudes

Consumers' attitudes towards health and environmental issues were assessed using two attitude scales shown in the Appendix. The health attitudes questions were adapted from the Health Locus of control scale developed by Houts and Warland (1989). Five questions were asked regarding their level of concern for their own health with possible responses from "Not at All" (score of 1) to "A Lot" (score of 5). The environmental attitudinal questions were adapted from the environmental concern attitudes scale developed by Clarke *et al.* (2000). The original 15-question scale was reduced to 8 questions for ease of respondent completion. Possible responses ranged from "Strongly Disagree" to "Strongly Agree".

Pre-testing of both attitude scales was completed with approximately 700 undergraduate students from the University of Alberta. The values of Cronbach's α for each scale were well above the threshold value of 0.70, confirming that they were assessing a single dimension within each attitudinal scale (Santos, 1999). This allowed the ratings for each item (statement) in each scale to be summed to provide an overall measure of views on health or the environment.

Information on Organic Foods and Production

Information statements provided to consumers regarding organic production involved short paragraphs of targeted information on human health or environmental aspects of organic production methods (as shown in Figure 1). The health information was reported in two segments. The first reported health benefits from organic food consumption that may be gained due to the increased presence of antioxidants in the products as a result of organic production methods (Yu *et al.* 2004). The benefits reported were with respect to the reduced incidence of heart disease and some cancers due to the increased presence of antioxidants. The second segment informed respondents of the Canadian National Standards for organic agriculture and the United Kingdom Food Standards Agency definitions and stated benefits related to organic farming systems.

The environmental information informed respondents about sustainability and the harmony that may co-exist with the environment due to the practice of organic farming. The recommendations of the Canadian General Standards Board on the protection of environment, minimization of soil degradation, decreased pollution, and the requirements of the National Standards of Canada for Organic Agriculture, were also mentioned.

Assessment of Willingness to Pay

The respondents' WTP for organic products was investigated using a discrete choice CVM approach. The actual question is shown in Figure 2. The approach involved a "take it or leave it" question conditional on the presentation of one of seven randomly assigned price premiums. Participants were asked if they would be willing to purchase a loaf of 60% whole

Figure 1. The information on health and environmental benefits and practices provided to respondents regarding organic food and farming.[a]

Health Information:

Fruits, vegetables and grains grown under organic farming practices tend to contain higher levels of antioxidants compared to their conventional counterparts. According to recent research, a high antioxidant intake has been associated with a lower incidence of heart disease and some cancers.

Antioxidants are naturally made by a plant when it is attacked by insects. The National Standards of Canada for Organic Agriculture prohibit the use of most synthetic pesticides and fertilizers on crops and soil. Since pesticides are not allowed, the plants produce more antioxidants to discourage insects. This also results in fewer synthetic chemical residues in food.

Organic food products may also contain fewer food additives. For example, in the United Kingdom, the UK Food Standards Agency restricts certain ingredients and additives in processed organic foods such as:

artificial colourings and artificial sweeteners
MSG (monosodium glutamate)
Hydrogenated fats

In each case their use has been restricted because of evidence that they may be damaging to health.

Environmental Information:

The basic idea of organic food production is to ensure that the organic farm is sustainable and operates in a manner harmonious with the environment. Voluntary guidelines for organic agriculture have been set up by the Canadian General Standards Board. They recommend that organic farmers:

Protect the environment
Minimize soil degradation and erosion
Decrease pollution
Optimize biological productivity
Promote a sound state of human, animal and environmental health
Recycle materials and resources when possible
Maintain the integrity of organic foods and processed products from initial handling to point of sale

The National Standards of Canada for Organic Agriculture prohibit the use of most synthetic pesticides and fertilizers on crops and soil. This results in less harm to the environment. Organic farmers must use other management methods and selected varieties to prevent diseases and resist pests.

[a] Note that each respondent was presented with one of these information summaries – i.e. each only saw the health or the environmental information.

Figure 2. The closed–ended CVM question employed to understand the willingness to pay price premiums for 60% whole wheat bread.

We are about to ask you if you would purchase an organic product at a certain price. Previous surveys of this nature find that the amount of money people SAY they are willing to pay is sometimes higher than the amount they would ACTUALLY pay for this product. For this reason, as you read the following question, please imagine that you would ACTUALLY have to pay this amount keeping in mind what you normally pay for groceries for you and your family.

Assume that the cost of conventional bread on average is $1.50/loaf at the store where you usually shop. On your next shopping trip assume you need to buy one loaf of bread. If organic bread were available for purchase, would you purchase this organic bread if it cost ($0.25 to $3.25)/ loaf more than the conventional product, in other words if the total price of the organic bread was ($1.75 to $4.75)/ loaf?

Yes □ No □

If you answered "yes" to the question above, how certain are you of your answer?

Very Certain	Somewhat Certain	Unsure	Somewhat Uncertain	Very Uncertain
□	□	□	□	□

If you answered "NO" to question 1, would you buy this loaf of organic bread if the price was the same as the average price of conventional bread?

Yes □ No □

wheat organic bread at a price above a baseline price ($1.50) for a similar type of conventional bread, with premiums chosen at random from a uniform distribution of seven bid levels ranging from $0.25 to $3.25 in $0.50 intervals. The premiums were developed from an informal survey of relative prices for bread loaves at various supermarkets and organic specialty stores in Edmonton and included several premiums above the highest observed premium in the market.

The preamble to the CVM question (see Fig. 2) involved presentation of a brief cheap talk script. Empirical findings suggest that CVM can induce overstatement of real economic value due to hypothetical biases (List and Gallet 2001; Murphy *et al.* 2005). Research by Cummings and Taylor (1999) suggest that incorporation of detailed "cheap talk" scripts can reduce this hypothetical bias. Other studies suggest that similar effects can be achieved with briefer cheap talk scripts (e.g. Murphy *et al.* 2005). Thus, due to the mode of administration of the questionnaire and the requirement for sensory evaluation, this brief approach was utilized. The script informed respondents about overestimation issues that have occurred in

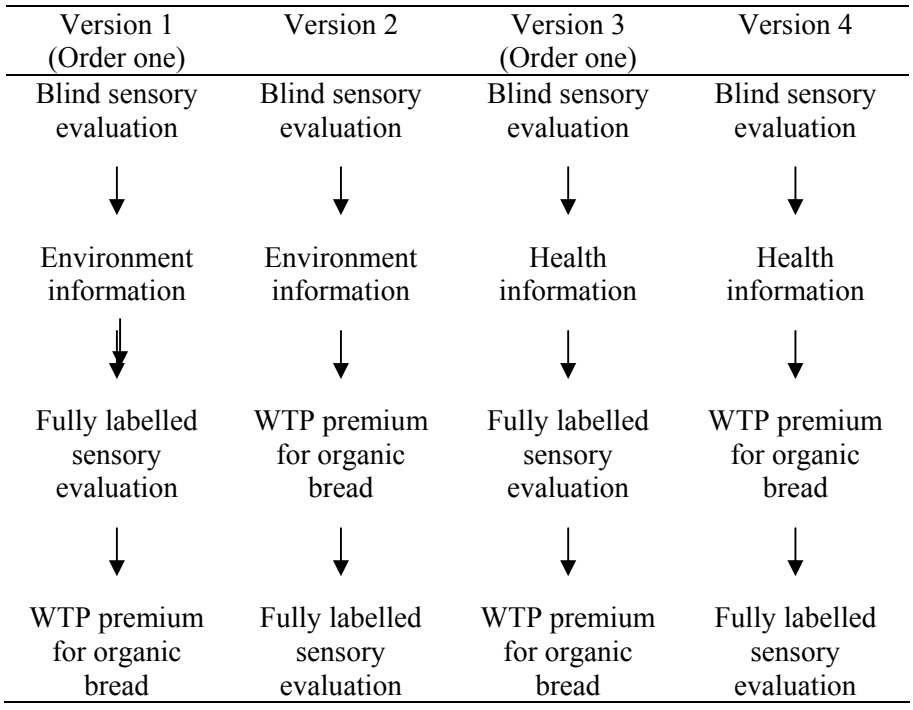
similar consumer studies and urged respondents to keep "real world" concerns in mind as they responded to the organic price premium question.

Following this choice question involving the price premium respondents were asked how certain they were of their answer and to answer one additional question regarding purchase of organic bread if its price was the same as conventional bread. This information is typically added to CVM designs to assess the accuracy of the respondent's answer and to elicit more information about their preferences.

Survey Versions

While the first part of the survey (part A) was common to all respondents, one of four versions of part B was randomly assigned to each participant in order to investigate information and sequencing effects. This second part contained either health or environment information and a further treatment split was made regarding the ordering of the fully labelled sensory evaluation of the two bread samples and the respondents' WTP decision for the organic wheat bread conditioned on randomly assigned price premiums. A summary of this experimental design is illustrated in Figure 3. The respondents were aware of the issue, nature and content of the bread while they performed the sensory evaluation for the fully labelled bread samples. In this case, the respondents enjoyed more product information then they did under the blind evaluation exercise while answering part A of the survey.

Figure 3. A diagrammatic summary of the study design.



Random assignment of the seven bid levels within each of the four versions described above means that there were actually 28 different surveys that were administered to participants. Appropriate measures were taken to guarantee that the bid levels and versions were equally distributed across survey times and locations.

Survey Administration

The consumers who participated in this study were recruited via face-to-face intercept in shopping malls, supermarkets and organic specialty stores in Edmonton and Red Deer, Alberta, as well as on the University of Alberta campus. The spatial coverage of survey locations was selected to gain responses from consumers who are frequent organic consumers as well as those who may not be familiar with organic food. While no claim can be made that the final sample is representative of all Edmonton consumers, we believe that the breadth of locations surveyed allows the results from this study to be useful in understanding the potential factors influencing the willingness to pay premiums for organic wheat breads.

Each survey session at a location lasted for about seven hours (approximate) from morning to evening. The survey location was well advertised and shoppers visited the stall with genuine interest during the survey session. Each respondent was given general information about the purpose of the survey and were asked to complete a consent form (conforming to University of Alberta Human Research Ethics Board requirements) prior to participating. Respondents were permitted to participate only if they did not have any allergy concerns related to bread ingredients. Each respondent took about 20 minutes to complete the two sensory evaluations and the survey.

Exactly 392 individuals participated in this study, of which two responses were incomplete and were subsequently dropped, resulting in 390 completed surveys. Some of the characteristics of the respondents are shown in Table 1. The sample contained more females than males; their ages fell in the two youngest age categories, and their income levels were in the lower half of the distribution of income levels employed.

Table 1. A summary of respondent characteristics as a percentage of the total surveyed sample or location were surveys were administered.

Characteristic	Percentage of total			
	Total surveyed	GEL[1] consumers	OML[2] consumers	SCL[3] consumers
Gender				
Male	36	35	34	39
Female	64	65	66	61
Age (years)				
18-24	27	45	24	12
25-34	28	34	25	24
35-44	13	8	11	20
45-54	13	5	16	18
55-64	12	6	18	11
65-74	5	1	5	8
75+	3	1	1	7
Education				
Some high school	6	2	3	13
High school graduate	9	6	7	14
Some university or college	26	37	21	21
College diploma/degree	18	13	14	27
University undergraduate degree	21	16	30	18
Some post graduate university study	9	12	11	5
Post graduate university degree	10	14	13	2
Income[4]				
< $36,600	35	52	29	23
$36,601- $71,000	28	24	34	27
$71,001 - $115,000	24	16	27	27
> $115,001	9	6	5	14
Environmental group membership				
Yes	11	6	19	6
No	89	94	81	94
Total	384	141	146	97

[1]General Edmonton locations (GEL) refers to consumers from Edmonton shopping malls, public venues and the University of Alberta Campus; [2]Organic market locations (OML) involves consumers from a farmer's market and local organic grocery stores; [3]Surrounding community locations (SCL) refers consumers from smaller communities of Red Deer, Sherwood Park, and St. Albert; [4]16 people did not provide their income. Percentages may not add up to 100% due to rounding.

Results and Discussion

Sensory Evaluation

Trained Sensory Panel Evaluation

The treatments differed ($p<0.05$) for 13 of the 14 attributes evaluated by the panelists (Table 2). However, organic and conventional bread only differed for 2 of the sensory attributes; surface texture and density. Organic bread had a darker crust ($p \leq 0.05$) and stronger "overall wheat bread aroma" in the crumb ($p \leq 0.05$) than commercial bread.

Organic and conventional bread did not differ ($p > 0.05$) for "toasted aroma" of the crust, but were higher ($p \leq 0.05$) than commercial bread. Organic and conventional bread did not differ ($p > 0.05$) for "dryness", "cohesiveness of mass", and "graininess of mass". Organic bread was more "dense" ($p \leq 0.05$) than conventional bread and had a more compact crumb and smaller loaf volume.

Panelists found no difference ($p > 0.05$) between organic and conventional breads for "wheaty", "sweet", or "salty" flavors in the crumb, as well as "toasted flavor" in the crust. Commercial bread had lower "wheaty" flavor and higher "sweet" and "salty" flavor in the crumb, and lower "toasted flavor" in the crust than organic and conventional. Organic had a higher "yeasty" flavour ($p \leq 0.05$) than commercial.

A review completed by "The Soil Association" reported that organically grown foods "tasted better" than conventionally grown foods (Heaton 2001). As we observed no difference in the intensity of any of the flavor or aroma attributes, we can not confirm a more flavorful product or what may be interpreted as "superior taste" qualities. The results of this research reveal that differences in the sensory profiles of organic and conventionally grown grain manufactured into bread are limited to the textural attributes alone, evaluated visually or physically discernable by hand.

Consumer Panel Sensory Evaluation

The ratings on the 9-point hedonic scale of the sensory evaluations of the two breads are shown in Table 3. On average, organic bread rated significantly higher than conventional bread when the identity of the samples was unknown under the unlabelled condition. After information on organic production was presented and the identity of the bread sample was revealed, organic bread was still rated significantly higher than the conventional samples. It is noteworthy that the difference in mean ratings between the organic and conventional bread slices widened after the identity of the bread products was revealed (0.36 – 0.86). Although

Table 2. Mean ratings for sensory attributes of organic and conventional wheat grain baked into 60% whole wheat bread (9 assessors; 3 replications) on a 15cm line scale.

	Mean ratings[1]		
Sensory attribute	**Organic**	**Conventional**	**Commercial**
Appearance			
Color intensity of crumb	5.44a (0.17)	5.13a (0.18)	4.94a (0.18)
Color intensity of crust	11.72a (0.13)	11.43ab (0.13)	11.12b (0.13)
Surface texture	10.01a (0.13)	9.29b (0.13)	5.10c (0.12)
Aroma			
Overall intensity of wheat bread aroma	9.96a (0.24)	9.48ab (0.24)	7.21b (0.25)
Toasted (crust)	9.10a (0.08)	8.87a (0.08)	8.08b (0.08)
Texture			
Denseness	9.90a (0.14)	9.26b (0.13)	5.39c (0.14)
Dryness	7.46a (0.29)	8.04a (0.26)	4.85b (0.26)
Cohesiveness of mass	7.69a (0.23)	7.78a (0.24)	9.94b (0.23)
Graininess of mass	8.32a (0.18)	8.26a (0.17)	6.12b (0.17)
Flavor			
Wheaty	9.44a (0.10)	9.33a (0.10)	6.44b (0.10)
Sweet	1.43a (0.08)	1.34a (0.09)	3.18b (0.08)
Salty	1.08a (0.10)	1.13a (0.09)	1.42b (0.09)
Yeasty	4.71a (0.25)	4.23ab (0.25)	3.86b (0.25)
Toasted (crust)	9.45a (0.09)	9.31a (0.09)	8.65b (0.09)

[1]Means in each row not followed by the same letter are significantly different ($p \leq 0.05$); numbers in parentheses are standard error of the mean

Table 3. Mean values for sensory evaluation on a 9-point hedonic scale[a] of 60% whole wheat breads under blind and labeled conditions (n=384).

Treatment	Mean (SD) sensory rating of bread types		P value of differences of means between treatments [b]	Difference between means
	Conventional	Organic		
Unlabelled	6.37 (1.6)	6.73 (1.5)	0.0001	0.36
Labelled	6.34 (1.5)	6.86 (1.3)	0.0001	0.86
P value of differences between bread types [b]	0.666	0.041		

[a] Ratings on the 9-point scale ranged from 'dislike extremely' (1) to 'like extremely' (9).

[b] Paired mean *t*-tests.

the difference in differences in these means over the sample is not significantly different than 0, there is considerable variation in the sample shown by the large standard deviation of this measure in the last row of Table 3. This suggests that for at least some individuals in the sample the taste ratings were influenced by their perceptions of organic production.[1]

Econometric Results

Due to the binary nature of the CVM responses (Yes, No) we utilized binary logit models to estimate the effect of influential variables on the probability of a respondent choosing "Yes" in the CVM question. The dependent variable in this regression takes the value '1' if the respondent answered Yes to the purchase decision '0' otherwise. This econometric approach is commonly used to analyze CVM responses (Haab and McConnell 2002.

[1] Although not reported here the type of information provided to the respondent had no impact on the revealed ratings. The mean conventional ratings remained similar after information was presented and identity of the breads was revealed. This suggests that information on the possible advantages of organic production positively affected sensory assessments of organic bread. Annett (2006) note that while comparisons of the mean ratings of these breads exhibited statistical significance, all mean there is little practical significance as the ratings fall within "like slightly" (6.0) to "like moderately" (7.0) on the 9-point hedonic scale.

Table 4. A description of the variables used in the logit models.

Variable	Description	Mean (SD)
Price premium	One of the seven different organic price premiums ranging between \$0.25 and \$3.25 for each respondent. The reference price was \$1.50 per loaf for the conventionally grown bread	1.750 (1.005)
Health information	A dummy taking the value 1 if a respondent received the health information on organic production. A value of 0 was given if the environmental information was received.	0.501 (0.501)
Male	A dummy taking the value of 1 if the respondent was a male.	0.359 (0.481)
HSENWTP	An interaction term consisting of the product of Order one and Health information. Essentially this variable captures version 3 in which the treatment sequence was: Health info → sensory rating → WTP question.	0.252 (0.435)
Order one	A dummy taking the value of 1 if the version of the questionnaire provided information followed by the revealed sensory evaluation then the WTP questions. This represented versions 1 and 3.	0.488 (0.500)
Graduate degree	A dummy taking the value of 1 if the respondent held a postgraduate university degree (e.g. Master's or Ph.D.).	0.105 (0.307)
Health attitude	The sum of the five Likert scale responses for the attitudinal statements on health.	4.153 (0.521)
Environmental attitude	The sum of the seven Likert scale responses for the attitudinal statements on the environment.	4.193 (0.646)
Revealed organic sensory rating	The rating on the nine point hedonic scale given by the respondent after tasting the labeled organic bread sample.	6.856 (1.349)
Difference in unlabeled ratings	The difference in the respondent's sensory rating of the organic and the conventional bread samples under the unlabelled tasting conditions. The conventional rating was subtracted from the organic rating for each respondent.	0.341 (1.639)
Difference in labeled ratings	The difference in the respondent's sensory ratings between organic and conventional bread samples under the labeled tasting conditions. The conventional rating was subtracted from the organic rating for each respondent.	0.522 (1.429)
Difference in differences	The subtraction of the difference in unlabelled ratings from the difference in labeled ratings. The unlabeled rating difference was subtracted from the labeled rating difference for each respondent.	0.184 (1.96)

The following equation provides guidance regarding various specifications of the logit models we employed: Pr(Y=1) = *f* (size of premium, design variables, individual characteristics). The premium size was the bid level a respondent faced in the questionnaire. The design variables could be specified in a number of ways, but we chose to utilize a dummy variable (ORDER1) for the two versions (1 and 2, Fig. 3) in which the WTP question followed the labeled sensory test, a dummy variable for the two versions (3 and 4, Fig. 3) in which health information was provided, and HSENWTP in which a dummy variable was used to identify version 3 only. This combination of variables permits isolation of various design elements of interest, while holding others constant. Finally while the influence of various individual specific characteristics was assessed, we report only those that were robust across specifications. These include the health and environmental attitude measures, education at the graduate level, and whether the respondent was male. All of the independent

variables used in the reported regressions are described in Table 4 along with some summary statistics.

Table 5 provides parameter estimates for various logit models that examine the influence of the design variables, individual specific characteristics, the size of the premium and sensory taste variables on the probability of acceptance of price premiums for loaves of whole wheat organic bread. Across all five model specifications respondents were sensitive to the size of the premium presented to them – increasing premiums reduced the probability of purchasing organic bread as expected.

Table 5. Maximum likelihood estimates of parameters from logit models used to assess the probability of acceptance of the organic premium for a loaf of organic whole wheat bread.

Variable Name	Parameter (standard error)				
	Model A	Model B1	Model B2	Model B3	Model B4
Constant	-5.261** (1.283)	-5.962** (1.368)	-5.326** (1.288)	-5.347** (1.307)	-5.176** (1,285)
Price premium	-0.865** (0.131)	-0.883** (0.133)	-0.851** (0.132)	-0.901** (0.137)	-0.883** (0.134)
Order one	-0.571* (0.343)	-0.589* (0.343)	-0.598* (0.345)	-0.562 (0.350)	-0.579* (0.345)
Health Information	-0.582* (0.343)	-0.567[a] (0.342)	-0.588* (0.344)	-0.600* (0.356)	-0.586** (0.347)
HSENWTP	1.055** (0.485)	1.065** (0.487)	1.098** (0.487)	1.132** (0.499)	1.069** (0.490)
Health attitude	0.590** (0.249)	0.569** (0.252)	0.606** (0.249)	0.565** (0.257)	0.581** (0.254)
Environmental attitude	0.948** (0.215)	0.900** (0.217)	0.936** (0.215)	0.951** (0.226)	0.942** (0.221)
Graduate School	0.895** (0.377)	0.867** (0.380)	0.846** (0.380)	0.927** (0.388)	0.875** (0.388)
Male	-0.366 (0.263)	-0.349 (0.264)	-0.342 (0.267)	-0.335 (0.269)	-0.441[a] (0.269)
Labelled organic sensory rating		0.148 [a] (0.091)			
Difference in unlabeled ratings			0.063 (0.076)		
Difference in labeled ratings				0.342** (0.091)	
Difference in differences					0.135** (0.063)
Log Likelihood	-206.204	-204.670	-205.460	-197.949	-202.882
McFadden R^2	0.183	0.188	0.183	0.212	0.189

** Significant at P<0.05; * significant at P<0.10; [a] significant at P<0.11

The first model (A) examines the additional influence of the design variables and individual specific variables on acceptance of the premiums. The results suggest that the type and order in which information was provided to respondents affected WTP. Providing a sensory experience prior to asking the WTP question had a negative effect on acceptance of the premium regardless of whether information on health or environmental advantages of organic production was provided (i.e. order 1 parameter <0). However, this negative effect was significantly reduced when the parameters on the version with health information (Health information and HSENWTP) are included. It would appear that for this sample of consumers and product that health benefits may be important when taste is introduced into the product choice decision. However, relative to environmental information on organic production, health information had a negative influence ($p<0.10$) on bid acceptance.

The parameters on health and environmental attitudes are both positive and significant, suggesting that more positive attitudes to either health or the environment have a positive influence on WTP for organic bread. However, the parameter on environmental attitudes is almost twice that of health attitudes, indicating that environmental attitudes may be more important than health attitudes in purchasing organic products.[2]

Earning a degree at the graduate level had a significant positive influence on acceptance of the organic premium. This finding may be related to the fact that consumers with graduate degrees may have higher income levels. We could not include income in the model due to the fact that there were numerous missing responses from individuals in the sample. The face-to-face interview setting in which the information was collected may have influenced the level of item non-response for the income variable.

Finally, if the respondent was male there was a lower probability of accepting the price premium (everything else held constant). However, this result is not statistically significant across model specifications.

The remaining models in Table 5 are similar to model A except that each contains a variable derived from the sensory experiments. The sign and size of the parameters assessing the design variables, individual specific characteristics, and the size of the premium are generally similar across all models. Model B1 includes the respondent's rating of the labeled organic bread. The parameter is positive, suggesting that higher sensory ratings of this bread

[2] Note that the magnitudes and units of measurement of the attitudinal measures were the same for each attitudinal construct (Table 2) and thus their parameter estimates can be compared directly.

increased the acceptance of the premium. However, this parameter is only significant at the 11% level.

Model B2 includes the difference between the organic and conventional bread samples in the unlabelled sensory tests for each respondent. This variable was included to assess perhaps a "true" measure of sensory preference for the organic product. A positive parameter estimate would suggest sensory preference for the unlabelled organic product would increase the probability of bid acceptance. The result in Table 4 is indeed positive, but statistically insignificant.

Model B3 includes the difference in the labeled ratings. This variable might assess the influence of sensory preference for the organic product once known. Once again, a positive parameter estimate would suggest this measure of sensory preference increases the probability of bid acceptance. The resulting parameter is positive and significantly different than 0 and its magnitude is much larger than the sensory variable in Model B2. This suggests that this sensory variable had an influence on bid acceptance. However, its inclusion in the model did not have a significant effect on the other variables in the choice model, with the possible exception of the ORDER1 and NSENWTP variables. The ORDER1 parameter became insignificant and the magnitude of the HSENWTP parameter increased. These findings, although not strong, serve to highlight the relationship between taste and health information mentioned above.

The last model, Model B4, includes the respondent's difference between the differences in ratings between the organic and conventional bread samples under the labeled and unlabelled sensory tests. The positive parameter estimate suggests that the change in rating once a respondent knew the identity of the products he/she tasted positively affected their acceptance of the premium. This could be related to the fact that those individuals who positively changed their sensory rating once the organic product was identified may have a positive perception of organically produced products and as a result were willing to pay more for the organic bread. In other words, this positive perception could have been picked up by the sensory ratings and the inclusion of the difference in differences rating may be capturing this perception in their preferences.

Assessments of Willingness to Pay

Measures of the implied premiums respondents were willing to pay were generated from the logit model results using the procedures described in Hanneman (1984) for

assessing the median WTP. These estimates are reported as the mean WTP for each version and were generated with the design variables set at the appropriate values for each version, and the respondent specific variables set at their mean values across the sample. An additional median WTP was estimated for all variables set at their sample mean values. The parameter vector and covariance matrix from Model B4 was used for this purpose because we felt that the sensory variable included in this model captured positive perceptions of organic production held by some respondents as described above. However, the results are virtually identical across the five specifications reported in Table 5.

The resulting WTP measures are reported in Table 6. The mean premium at the sample mean values was about $0.95 per loaf suggesting that overall there was acceptance or a willingness to pay an organic premium. However, estimates of the premium varied across the versions of the survey. Versions 1 and 4 had the lowest estimates of the premium and the WTP measures were the similar for each version at about $0.63/loaf. The premium for version 2 was the highest at $1.295/loaf, while the premium for version 3 was somewhat lower than this at about $1.19/loaf.

Estimates of the variance in the WTP measures were generated using the delta method and are shown in Table 5. This information was used to assess the significance of the differences in welfare measures across the versions. While all of the comparisons are not significantly different at the 5% level, some are at the 10% level. The WTP for versions 1 and 2 are significantly different at the 10% levels as are the WTP measures for versions 2 and 4.

The differences in the welfare measures across versions, although statistically insignificant at the conventional 95% level (as investigated by delta method confidence intervals around paired differences in the WTP measures, not shown here), still have important practical significance. To put these in perspective, we provide estimates of the premium consumers are willing to pay as a percentage of the price of a loaf of conventional bread (Table 6). We suggest, for example, that the type of information used to market organic products can have a significant effect on consumers' WTP premiums. In an absence of sensory information, it appears that environmental information may have greater influence on the WTP a premium than health information. This conclusion can be drawn from comparison of the welfare measures from versions 2 and 4 where the estimated premium for version 2 is 86% of the price of a conventional loaf while the same premium for version 4 is 42%. In addition, when environmental information was provided, it appeared that our respondents overstated their willingness to pay as the premium as a percentage of the price of a

Table 6. Estimates of the median willingness to pay a premium for a loaf of organic whole wheat bread by a sample of consumers from Edmonton, Alberta.

	Median premium ($CDN) per loaf (Standard error)	Premium as % of conventional price
At variable means	0.947 (0.168)	63.1
Version 1	0.639 (0.312)	42.6
Version 2	1.295 (0.271)	86.3
Version 3	1.185 (0.274)	79.0
Version 4	0.631 (0.319)	42.1

conventional loaf prior to sensory tasting was 86.3% (version 2) while after tasting was about 43% (version 1).

Finally, although the differences in the WTP measures between versions 3 and 4 are not statistically significant the magnitudes of the differences in the average measures are nonetheless large. In this comparison it appears that the sensory experience could have a different effect on the WTP measures when health information was provided. The premium as a percentage of the conventional price was 42% prior to tasting, and this increased to 79% after tasting. The direction of the difference here is the opposite of that of the environmental information treatments.

Conclusions

Both the influence of respondents' characteristics and the calculated price premiums in this study are in line with the findings of previous studies on other organic products reported in Yiridoe *et al*. (2005). What is unique in this study, however, is the combination of organic and sensory evaluation of an organic product vis-a-vis a conventional counterpart. Moreover, by varying the order in which the "revealed" (i.e., fully labelled) taste test and CVM question were presented to participants, this study investigated the effect that providing a sensory experience has on stated WTP measures.

We did not find that providing a fully labelled taste test before the CVM question either raised or lowered the stated WTP measures across all respondents. Instead, we found that the effect varied notably on the basis of the type of information provided regarding organic practices. In the absence of a labelled taste test, the WTP estimates were much

higher for the respondents who had received environmental information; when the labelled taste test was provided first, it was the health information that elicited higher price premiums. This finding could be due to the perception that health benefits are more important and desirable when consumers have had the opportunity to confirm that the product has desirable sensory characteristics. This may be due to an initial expectation that "healthy" food will be less tasty than other similar products. We feel that this is an important observation that can be investigated further in future studies that explicitly investigate consumer expectations regarding taste attributes before providing a sensory experience. In addition, a trained sensory panel confirmed that there were no differences in taste or aroma between the two products.

The different price premium estimates that resulted from varying the study order and information treatment indicate that sensory experience can influence the practical implications that decision makers in government and industry might draw from stated preference studies. As noted above, taste is an important component of repeated consumer choice of food products, and sensory evaluation methods can provide information that fit in well with existing economic frameworks. While providing sensory experience in stated preference experiments necessarily adds difficulty and expense to such studies, it is an approach that can illuminate some of the complexities in consumer choice that have not yet been adequately addressed by applied economists.

References

Annett, L.E. 2006. Sensory profiles and consumer acceptance of organic and conventionally grown wheat grain when baked as bread. MSc Thesis, Department of Agricultural, Food and Nutritional Science, University of Alberta.

Ara, S. 2003. Consumer willingness to pay for multiple attributes of organic rice: A case study in the Philippines. Paper presented at the 25th International Conference of Agricultural Economists, Durban, South Africa, August 16-22, 2003.

Bower, J.A., M.A. Saadat, and C. Whitten. 2003. Effect of liking, information and consumer characteristics on purchase intention and willingness to pay more for a fat spread with a proven health benefit. *Food Quality and Preference* 14(1):65-74.

Clarke, A., M.L. Harvey, and D.J. Kane. 2000. Attitudes and behaviour: Are produce consumers influenced by eco-labels? Presented at the International Institute of Fisheries Economics and Trade (IIFET) Conference, Corvallis, Oregon, July 10-15, 2000. www.ssi.nrcs.usda.gov/ssienvpsy/nrcs/research.html

Cummings, R. G. and L. O. Taylor. 1999. Unbiased value estimates for environmental goods: A cheap talk design for the contingent valuation method. *American Economic Review* 89(3):649–665.

Haab, T.C. & K.E. McConnell, 2002. *Valuing Environmental and Natural Resources: The Econometrics of Non-market Valuation.* Edward Elgar Publishing.

Hanemann, W.M. 1984. Welfare evaluations in contingent valuation experiments with discrete responses. *American Journal of Agricultural Economics* 66:332-341.

Heaton, S. 2001. *Organic Farming, Food Quality and Human Health: A Review of the Evidence.* Bristol: Soil Association.

Houts S., and R. Warland. 1989. Rotter's social learning theory of personality and dietary behaviour. *Journal of Nutrition Education* 21(4):172-179.

Lange, C., Martin, C. Chabanet, P. Combris, and S. Issanchou. 2002. Impact of the information provided to consumers on their willingness to pay for champagne: comparison with hedonic scores. *Food Quality and Preference* 13(7/8):597-608.

Lawless, H.T and H. Heymann. 1998. *Sensory Evaluation of Food: Principles and Practices* 1st edition. New York: Chapman and Hall.

List, J. A. and C. Gallet. 2001. What experimental protocol influence disparities between actual and hypothetical stated values? *Environmental and Resource Economics* 20:241–254.

Magnusson, M. K., A. Arvola, U.K.K. Hursti, L. Aberg, and P.O. Sjoden. 2003. Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour. *Appetite* 40:109-117.

McCluskey, J. J., R.C. Mittelhammer, A.B. Marin, and K.S. Wright. 2006. Effect of eating-quality characteristics on consumers' willingness to pay for Gala apples. *Canadian Journal of Agricultural Economics* 55:217-231.

Murphy, J.J., T. Stevens and D. Weatherhead. 2005. Is cheap talk effective at eliminating hypothetical bias in a provision point mechanism? *Environmental and Resource Economics* 30:327-343

Santos, J.R.A. 1999. Cronbach's alpha: A tool for assessing the reliability of scales. *Journal of Extension*, 37(2). http://www.joe.org/joe/1999april/tt3.html

Stefani, G., D. Romano, and A. Cavicchi. 2006. Consumer expectations, liking, and willingness to pay for specialty foods: Do sensory characteristics tell the whole story? *Food Quality and Preference* 17:53-62.

Wertenbroch, K., and B. Skiera. 2002. Measuring consumers' willingness to pay at the point of purchase. *Journal of Marketing Research* 39(2):228-24.

Yiridoe, E. K., S, Bonti-Ankomah, and R.C Martin. 2005. Comparison of consumer perceptions and preference toward organic versus conventionally produced foods: A review and update of the literature. *Renewable Agriculture and Food Systems* 20(4):193-205.

Yu, L. and K. Zhou. 2004. Antioxidants properties of bran extracts from Platte wheat grown at different locations. *Food Chemistry* 90:311-316.

Appendix:

The questions used to measure attitudes toward health and the environment.

Health Questions:

(Each question was assessed on a five-point Likert scale using the following statements: Not At All, Not Very Much, Somewhat, Very Much, A Lot.)

1. How much of an effect do you feel what you eat will have on your future health?
2. To what extent do you feel your health depends on how you take care of yourself?
3. Some people feel that if they are going to be sick, they will be. How much do you feel it is possible to prevent sickness?
4. If qualified health professionals recommend eating certain foods, how likely are you to try them?
5. How much more are you concerned about what you eat then you used to be?

Environment Questions:

(Each question was assessed on a five-point Likert scale using the following statements: Strongly Agree, Somewhat Disagree, Neither Agree or Disagree, Somewhat Agree, Strongly Agree.)

1. It makes me sad to see natural environments destroyed
2. Unique environments should be protected at all costs.
3. One of the most important reasons to conserve is to preserve wild areas
4. Wild plants and animals have a right to live unmolested by humans
5. We must prevent any type of animal from becoming extinct, even if it means sacrificing some things for ourselves.
6. I am willing to make personal sacrifices for the sake of slowing down pollution even though the immediate results may not seem significant
7. Natural ecosystems have a right to exist for their own sake, regardless of human concerns and uses.