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ABSTRACT

We surveyed specialty crop producers in Kansas and Missouri to determine producer willingness to pay for new active packaging technology that prevents postharvest loss and increases shelf life. The survey also asked demographic questions to determine the producer and operation traits for this growing segment of production agriculture. More than half of those surveyed were female, and 60% were under 50 years of age. Smaller operations tend to utilize direct marketing and social media activity more than larger operations. Parametric willingness to pay estimates are approximately $0.39 per cardboard flat to purchase the antifungal film that increases shelf life of strawberries with a nonparametric lower-bound estimate of $0.31.

KEYWORDS

postharvest loss, specialty crop, strawberries, willingness to pay, contingent valuation, double bounded dichotomous choice

INTRODUCTION

Agriculture in Kansas is traditionally known for grain and livestock production. However, there is increased interest in alternative or specialty crops.[1] A 2015 Kansas Department of Agriculture survey of specialty crop producers in Kansas found that 78% began operations after 2001. Of those surveyed, 35% have produced some variety of berries in the last three years. Nationally, among fresh fruits and vegetables, strawberries are popular with consumers (Hinson & Bruchhaus, 2008). Per capita consumption of fresh strawberries in the United States was 8.0 pound in 2016, which is a 31% increase over 2006 consumption (USDA ERS, 2017).

One of the challenges strawberry producers face is the crop's fragility and rapid postharvest decay (Chen, Liu, Yang, Lai, Cheng, Xin, et al., 2011; Correia et al., 2011; Aday, Temizkan, Büyükcan, & Caner, 2013). Postharvest losses in produce are a large source of food waste in the United States. In 2010, the amount of postharvest losses in fresh vegetables was 53.5 billion pounds, while processed vegetable waste was 37.6 billion pounds. This amount represents 19% ($30 billion) of the total food losses in the United States every year (Buzby, Farah-Wells, & Hyman, 2014). Implementing intervention technologies to mitigate postharvest loss is essential in beginning to reduce food loss.

Postharvest decay due to microbiological spoilage has multiple detrimental impacts. For example, shelf life is decreased (Wang, Hu, Ding, Ye, & Liu, 2018), reducing the time producers have to sell their product and increasing postharvest food losses. Further, appearance, taste, and nutritional quality decline due to postharvest decay (Correia et al., 2011; Wang et al., 2018), which decreases the attractiveness of the berries to potential consumers. Shelf life and appearance are important aspects for the profitability of berry sales. The 36% of Kansas specialty crop producers who sell at least some of their harvest at a farmers' market (Kansas Department of Agriculture, 2016) are solely responsible for finding ways to economically manage shelf life and product appearance.

One method of mitigating microbial decay in berries is to apply active packaging technologies that protect produce and improve shelf life and appearance, making produce more accessible and attractive to consumers. Active packaging incorporates additives into the packaging to extend shelf life, inhibit decay, or maintain quality of the fruit. Some successful solutions include the combination of edible coating with storing freshly picked berries at appropriate temperatures and humidity (Wang & Gao, 2013; Wang, Chen, & Yin, 2010; Wang, Wang, Yin, Parry, & Yu, 2007). A recent innovation in this area allows an antifungal packaging film to be placed in cardboard flats into which berries are placed during harvest. The coating can extend shelf life and freshness of the berries as they are stored and transported.

The objective of this research is to determine the willingness of Kansas and Missouri produce growers to pay for newly developed antifungal packaging and estimate the impact of relevant farm and producer traits on willingness to pay (WTP). We accomplished this objective by implementing a contingent valuation survey at producer meetings in 2018. Demographic data were also collected with the experiment. These data are used to achieve a second objective of providing insight into the characteristics of Kansas and Missouri produce growers, as little is known about this emerging group. Results show that producer mean WTP is about $0.39 per cardboard flat[2] (with a lower-bound WTP of $0.31) to purchase the antifungal film that increases shelf life of strawberries. However, we find no statistical relationship between producer or operation characteristics and WTP.

ANTIFUNGAL FILM TECHNOLOGY

Among the explored antimicrobial molecules for active packaging applications, essential oils have been investigated for their ability to control and/or inhibit microbial contamination and reduce the phenomenon of lipid oxidation (Bevilacqua, Corbo, & Sinigaglia, 2010; Ribeiro-Santos, Andrade, de Melo, & Sanches-Silva, 2017). Essential oils are generally recognized as safe (GRAS) in food production. Previous work (McDaniel, Tonyali, Yucel, & Trinetta, 2018; Trinetta, Morgan, Coupland, & Yucel, 2017) demonstrated the ability to incorporate essential oils into packaging film to actively control microbial growth. In addition to the efficacy, the use of these food-grade ingredients and natural antimicrobial compounds, as opposed to other chemicals, is attractive to certain consumers (Trinetta et al., 2017).

Kansas State University food scientists have used the aforementioned research (Trinetta et al., 2017; McDaniel et al., 2018) to develop active packaging film to be used to improve the storage quality of freshly picked berries. The formulated packaging films exhibited antimicrobial effectiveness against microorganisms commonly associated with strawberry decay (*Alternaria spp., Aspergillus niger,* and *Rhizopus stolonifera).* Moreover, when the active systems were used in a field trial where freshly picked strawberries were stored in refrigerated conditions for 10 days, an improvement of 2 days' shelf life was reported as compared to control strawberries (without the active packaging pad). Figure 1 shows the difference in produce decay and appearance from use of the active packaging system. Based on preliminary

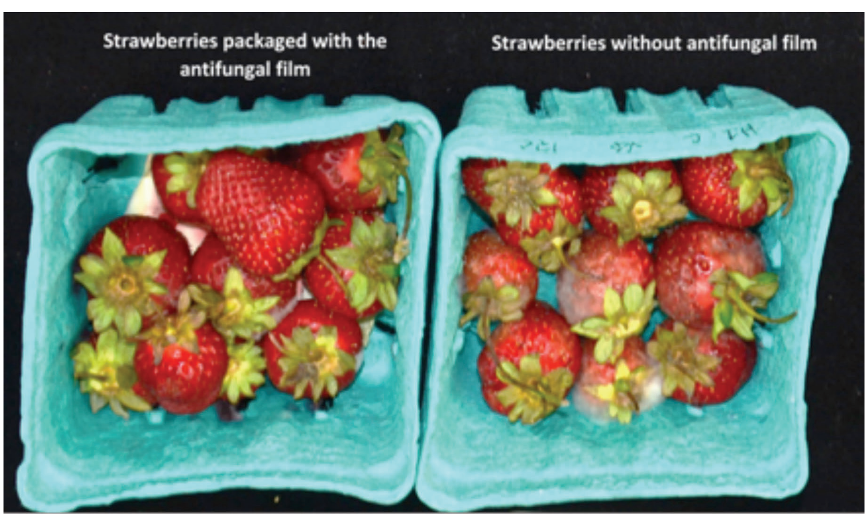

Figure 1. Strawberries with and without Antifungal Film after Eight Days of Storage

estimates, the cost of producing enough film to supply one cardboard flat is $0.28 per cardboard flat (see Figure 1).

METHODOLOGY

A relevant question for the antifungal film described earlier is how much producers will pay for it. That is, the technology is only helpful if berry producers are willing to buy it, and it will only be supplied in the marketplace if the price that producers pay makes it profitable for sellers of the antifungal film to market the product. However, since the film is not currently available for purchase, it is not possible to directly observe this WTP. In such cases, some form of the contingent valuation method can be used for nonmarket valuation of products, product attributes, or label attributes (Underhill & Figueroa, 1996; Hong, Gallardo, Silva, & Orozco, 2018; McCluskey & Loureiro, 2003). One method is the double-bounded dichotomous choice contingent evaluation (Hanemann, Loomis, & Kanninen, 1991; Tonsor, Schroeder, & Lusk, 2013), which is appropriate for application to novel food or agribusiness products (Lusk & Hudson, 2004). In this approach, the k^{th} participant is asked if he or she would purchase a specific product at some initial price ($P_{k,initial}$). If the answer is yes, the question is asked again at a higher price ($P_{k,high}$). If no, the question is asked again at a lower price ($P_{k,low}$). This approach does not yield a specific WTP but instead provides a range. There are four possible outcomes to the questions. These are yes-yes, yes-no, no-yes, and no-no. For example, in the yes-yes case it is revealed that the person will pay at least $P_{k,high}$, but the maximum WTP is unknown. In other words, $P_{k,high}$ is the WTP lower bound. Likewise, a no-no response yields an upper-bound WTP equal to $P_{k,low}$ but no lower bound. A response of yes-no provides a lower-bound WTP equal to $P_{k,low}$ and an upper bound equal to $P_{k,initial}$. Finally, a no-yes scenario yields a WTP interval between $P_{k,initial}$ and $P_{k,low}$. These outcomes are summarized in Table 1. Levels of initial price and product attributes can be varied across respondents to determine how sensitive WTP is to these factors. In our case, the possible extension of shelf life was varied across survey participants. The appendix contains our survey questions and the method for varying price levels.

Table 1. Possible Double Bounded Dichotomous Choice Survey Outcomes

First Answer	Second Answer	Lower-Bound WTP	Upper-Bound WTP
Yes	Yes	Higher price	.
Yes	No	Initial price	Higher price
No	Yes	Lower price	Initial price
No	No	.	Lower price

Notes: Survey participants are asked if they would pay initial price for a product. If they answer yes, the question is repeated with higher price. If they answer no regarding initial price, then the question is repeated using lower price.

We use results from the above survey design to specify an interval-data model (Cameron, 1988; Cameron & Quiggin, 1994; Tonsor et al., 2013). First, assume the actual WTP^* of producer k for antifungal film j (which, as shown in the appendix, includes a predicted impact on shelf life compared to using no film) is

$$WTP^*_{k,j} = X_k\beta_j + \varepsilon_{k,j}, \tag{1}$$

where X_k is a vector of explanatory variables describing the k^{th} producer and her operation, β_j, is a vector of corresponding coefficients and $\varepsilon_{k,j}$ is an iid error term with standard deviation equal to $\sigma_{k,j}$. Therefore, a producer will agree to purchase the j^{th} product at price $P_{k,j.}$ if $P_{k,j} \leq WTP^*_{k,j}$ and will refuse otherwise. As explained, producers must respond to two prices, and the second price is dependent on the response to the first price. Let d^{yy}, d^{yn}, d^{ny}, and d^{nn} be binary indicators of the choices yes-yes, yes-no, no-yes, and no-no, respectively. Each binary variable is equal to 1 if a choice set occurs and zero otherwise. The probability of the occurrence of each possible choice set can be represented as the probability that actual WTP lies in a certain range:

$$\begin{aligned}
\Pr(d^{yy}=1) &= \Pr(WTP^* > P_{k,initial}, WTP^* \geq P_{k,high}) \\
\Pr(d^{yn}=1) &= \Pr(P_{k,initial} < WTP^* \leq P_{k,high}) \\
\Pr(d^{ny}=1) &= \Pr(P_{k,low} \leq WTP^* < P_{k,initial}) \\
\Pr(d^{nn}=1) &= \Pr(WTP^* < P_{k,initial}, WTP^* \leq P_{k,low})
\end{aligned} \tag{2}$$

This information, along with the assumption from equation 1, can be used to build a log likelihood function based on the interval-censored survey data (Hanemann et al., 1991):[3]

$$\text{(3)}\quad \text{LLN} = \sum_j \begin{bmatrix} d_j^{yy} \ln\left(\Phi\left(\dfrac{X_k\beta_j - P_{k,high}}{\sigma_{k,j}}\right)\right) \\ + d_j^{yn} \ln\left(\begin{array}{l}\Phi\left(\dfrac{X_k\beta_j - P_{k,initial}}{\sigma_{k,j}}\right) \\ +\Phi\left(\dfrac{X_k\beta_j - P_{k,high}}{\sigma_{k,j}}\right)\end{array}\right) \\ + d_j^{ny} \ln\left(\begin{array}{l}\Phi\left(\dfrac{X_k\beta_j - P_{k,low}}{\sigma_{k,j}}\right) \\ +\Phi\left(\dfrac{X_k\beta_j - P_{k,initial}}{\sigma_{k,j}}\right)\end{array}\right) \\ + d_j^{nn} \ln\left(1-\Phi\left(\dfrac{X_k\beta_j - P_{k,low}}{\sigma_{k,j}}\right)\right) \end{bmatrix}$$

where Φ is the cumulative standard normal distribution function. The likelihood of one choice set occurring is represented as the likelihood that predicted WTP ($X_k B_j$) lies in the relevant range. Note that one respondent will only contribute one of the four parts of the likelihood function depending on the choices made. If the model is estimated with only a constant, that constant term is an estimate of expected WTP (Cameron & Quiggin, 1994; Tonsor et al., 2013). Expanding the model to include producer and operation characteristics as independent variables allows estimating the impact of these factors on expected WTP.

SURVEY DATA AND RESULTS

The survey used in this research was designed to gather demographic and operational data regarding strawberry producers in Kansas and Missouri and to specifically elicit their WTP for the antifungal film described earlier. We constructed the survey to be as brief as possible but gather useful information. To prioritize relevant questions, we relied on authors' experience working with fruit and berry producers. We also consulted with other food scientists and extension professionals. Demographic questions were limited to age and gender. Farm-level questions included total farm sales, whether the operation was certified organic, and if it was certified in certified in Good Agricultural Practices (GAP). Organic certification can be a way to attract consumers and differentiate berries (Patterson 2006), and GAP may qualify producers for certain retail or food-away-from-home outlets. Understanding how producers use or do not use these options is important to know. We also asked about use of the Internet and social media for business purposes. This was to understand how proactive producers are being in marketing their products. Similarly, we asked about direct sales. Farmers markets and other outlets for local produce are popular among consumers (Hinson & Bruchhaus, 2008; Patterson, 2006) and could offer an avenue for smaller operations to harvest more of the final sale price of their produce. It is informative to know if Kansas and Missouri berry producers are active in direct sales. Since proper storage and handling postharvest is one of the most effective ways to mitigate postharvest loss and decay (Gustavsson, Cederberg, & Sonesson, 2011), we asked survey participants who were currently growing strawberries to choose among a list of common refrigeration regimes to identify their current practice. This question was based on the suggestion of food science extension professionals who thought that knowing this about berry producers would be helpful in future educational efforts.

Surveys were administered from May to July 2018 in Kansas and Missouri. Venues included a produce safety workshop in Independence, Missouri; Food Safety Modernization Act grower trainings in Jefferson City, Missouri, and Olathe and Salina, Kansas; Kansas City Food Hub Meeting in Kansas City, Missouri; and the Produce Safety/High Tunnel Bus Tour in Olathe, Kansas. All of these events attracted experienced producers who are interested in berry production.

Fifty-two usable surveys were collected. Table 2 reports the summary statistics of the survey results. Sixty percent of the respondents were under 50 years of age, and 56% were female. Demographics of this subset of producers differ slightly from 2017 agricultural census data for Kansas producers. This is not surprising, as the state-level data are for all producers, and we target specialty crop producers. In 2017, 34% of Kansas producers were female and 64% were under the age of 65 (USDA NASS, 2017). Several respondents represented sizable operations, with 23% indicating an annual revenue of more than $250,000. In Kansas, 26% of all farms have sales of more than $100,000 (USDA NASS, 2017), so the group of producers surveyed represents some relatively large operations. Direct sales and Internet usage were relatively common among respondents. Sixty-three percent of the producers reported marketing more than a quarter of their produce via

Table 2. Variable Definitions and Descriptive Statistics

Variable Name	Definition	Mean	St Dev	N
Age50	= 1 if respondent was older than 50	0.40	0.50	52
Female	= 1 if respondent was female	0.56	0.50	52
Rev250	= 1 if respondent reported annual revenue of more than $250,000	0.23	0.43	52
Organic	= 1 if respondent's operation is certified organic	0.25	0.44	52
GAP	= 1 if respondent's operation is GAP certified	0.10	0.30	51
Business Internet	= 1 if respondent indicated using Internet or social media for business purposes "often" or "some"	0.55	0.50	51
Direct25	= 1 if respondent sells at least 25% of produce via direct sales	0.63	0.49	51
Direct75	= 1 if respondent sells at least 75% of produce via direct sales	0.40	0.50	51
Strawberries	= 1 if respondent is currently growing strawberries	0.50	0.50	52

Table 3. Marketing Practices of Surveyed Produce Growers by Size of Operation

Annual Revenue	Certified Organic	GAP Certified	Uses Social Media for Business	Markets > 25% of Produce Directly
$0–$25,000	1	0	12	14
$25,000–$250,000	10	1	11	17
$250,000–$500,000	0	2	2	1
> $500,000	2	2	1	0
Not Currently Farming	0	0	2	0
Total	13	5	28	32

Notes: GAP certification requires a voluntary audit to verify fruits and vegetables are harvested, handled, and stored in a way to minimize microbial food safety risk. N=51.

direct sales, and 55% said they use social media or the Internet for business purposes. Only 25% were certified organic, but another 23% reported being in the process of achieving the certification. It is here that the producers differ markedly from all Kansas farms. Only 3% of all Kansas farms sell direct to consumers, and less than 1% farm organically (USDA NASS, 2017). The percentage of producers who were GAP certified was 10%. This is likely connected to the fact that many (42%) have annual revenues below $25,000. As shown in Table 3, none of these smaller operations were GAP certified. GAP certification is typically required by entities such as grocery stores and wholesalers who often source produce from larger operations. Therefore, the cost of GAP certification likely outweighs the benefit for smaller operations whose customers do not require it. On the contrary, it seems that smaller operations attempt to capitalize on using social media and direct marketing more than larger operations (see Table 3).

Results from this question are reported in Table 4. Half (n=26) of the survey participants reported that they currently were growing strawberries, with an additional five respondents saying they did not currently grow strawberries but planned to in the future. Twenty-three survey participants who reported growing strawberries

Table 4. Postharvest Storage Practices of Strawberry Producers

Place Strawberries in Refrigeration	Number of Producers
At 32–37°F, within 1 hour of harvest	11
At 38–45°F, within 1 hour of harvest	2
At 46–70°F, within 1 hour of harvest	7
Longer than 1 hour after harvest	2
Never	1

Note: This question specified that only respondents currently growing strawberries should respond. Twenty-three of the 26 farmers reporting that they currently grow strawberries responded.

responded to the question about refrigeration. Eleven of those producers engage in the most aggressive regime choice offered: refrigerating at 32 to 37 degrees Fahrenheit within an hour of harvest. Only one strawberry producer indicated no refrigeration. Refrigeration can be expensive and logistically challenging for growers, but most of those responding to this survey understood the key benefits of refrigeration for strawberries.

In the final section of the survey, we presented producers with a double-bounded dichotomous question regarding WTP for the antifungal film to be used in cardboard flats at harvest. See the appendix for a detailed explanation of the survey question design. Responses were used, as explained in the methodology section, to estimate WTP. Model results are shown in Table 5. Mean WTP for the film is estimated to be \$0.393 per cardboard flat. This is an encouraging result for the feasibility of making the film commercially available, as it is greater than estimated cost of production. Since increase in shelf life is the most important benefit of the technology, Model 2 includes the additional days of shelf life that was associated with each survey choice as an explanatory variable. Surprisingly, days of shelf life improvement has no statistical impact on WTP. As a result, the mean WTP[4] is basically unchanged and equal to \$0.397. Results from Model 3, which also includes the variables from Table 2 on the right-hand side, are similar. None of the impacts of the explanatory variables are statistically significant, and estimated mean WTP is \$0.393.

These results indicate that our WTP estimates are not explained by farm characteristics, producer traits, or expected shelf life improvement. There are at least two reasons for this. First, of the 38 respondents, 29 answered yes to both WTP questions. In this case, we only know a lower bound for their WTP. Only 7 respondents answered no then yes or yes then No. Therefore, we only have an interval around WTP for these 7 producers. Second, surveys such as this one are known to be subject to hypothetical bias. That is, participants are more likely to indicate a willingness to purchase a product if there is no cost to doing so. In cases such as this, nonparametric estimation of WTP can offer

Table 5. Interval Data Model Results: Willingness to Pay

Parameter	Constant Only Model	Model 2	Model 3
Constant	0.393**	0.303**	0.245*
	(0.048)	(0.114)	(0.148)
Shelf life Improvement		0.031	0.032
		(0.039)	(0.039)
Age50			0.128
			(0.079)
Female			–0.009
			(0.061)
Rev250			0.001
			(0.079)
Organic			–0.052
			(0.063)
GAP			0.071
			(0.103)
Business Internet			–0.010
			(0.071)
Direct75			0.040
			(0.060)
Strawberries			0.020
			(0.074)
Log (Sigma)	–2.006**	–1.994**	–2.170**
	(0.322)	(0.322)	(0.325)
N	38	38	37
Log Likelihood	–31.872	–31.523	–28.480

Note: Numbers in parentheses are standard errors. Statistical significance at the 0.10 and 0.05 levels is shown by * and **, respectively. See Table 1 for variable definitions.

Table 6. Turnbull Nonparametric CDF and Kaplan-Meier Mean Willingness to Pay Estimate

Lower-Bound Price	Upper-Bound Price	Cumulative Percentage of Those Responding Yes in Each Price Range
$0.24	$0.36	0.753
$0.22	$0.24	0.864
$0	$0.22	0.935
	$0	1.000
Kaplan-Meier Mean WTP Estimate		$0.31

Note: The CDF is a step-function based entirely only the survey response data.
No variables other than price are considered.

a useful complement to the WTP based on an interval model analysis.[5] Specifically, the Kaplan-Meier-Turnball method is based entirely on the data, and the resulting WTP is considered a lower-bound WTP (Boman, Bostedt, & Kriström, 1999). Turnbull (1976) presented a method of determining the cumulative distribution function (CDF) of response data to focus on survivability analysis. The method has since been widely applied in WTP analysis (Boman et al., 1999; Deng, Munn, Coble, & Yao, 2015). The Turnbull CDF is a step-wise function, and WTP is the area under that function (Boman et al., 1999). Table 6 shows the Turnbull CDF based on our survey data, along with the mean WTP estimate of $0.31. As expected, this WTP is less than $0.39 of the base interval data model.

IMPLICATIONS

This research surveyed Kansas and Missouri produce growers regarding operation characteristics, producer traits, and WTP for a new antifungal packaging film technology that has the potential to extend shelf life of strawberries and decrease loss due to postharvest decay. Results show that produce growers are often young farmers, with 60% of the sample below 50 years of age. Many (56%) are also female. Direct marketing and social media are strategies mainly used by smaller operations.

Understanding the characteristics of this growing population can shape future education and extension efforts. For example, with more than half the producers using social media for business purposes, instruction on how to manage risks and be effective in that space would be useful. Organic certification, which might grant access to niche markets, is not utilized by smaller operations. Of the 22 farms that reported revenue less than $25,000, only one was certified organic. This would be worth exploring. It might simply be that the cost and initial investment into certification is too much for such operations. However, a more detailed examination of why these smaller operations are reluctant to try for the organic label is needed. This would include estimating the costs and benefits that a farm experiences with organic certification.

Our estimates of WTP for antifungal packaging film are encouraging in that they are above the cost of production of the film. This indicates at least the potential of commercializing the product. However, results should be treated with a measure of caution, as scale of film production by a potential manufacturer is not considered here. Further, we find no relationship between the days of potential improvement of shelf life and WTP. This indicates a potential misunderstanding of those surveyed as to how the technology would or would not benefit their respective operations. However, the fact many of the producers surveyed use aggressive refrigeration regimes (see Table 4) suggests that postharvest decay is a risk that they recognize and attempt to manage. Likewise, the high proportion of producers who answered yes to both WTP questions (29 of 38) indicates an interest in mitigating the effects of postharvest loss. Our parametric WTP estimates, which are near $0.39, are likely biased upward. The nonparametric WTP estimate of $0.31 serves as a lower-bound estimate. Further research is needed to improve the precision of the estimates, but this a strong indication of producer interest in the technology.

As more midwestern farmers consider specialty crops, as an addition to or replacement for traditional crops, research and extension efforts need to adapt. This study offers a starting point for understanding midwestern strawberry producers and suggests that education regarding marketing methods and calculating costs of production would likely be helpful. Further, results specific to the antifungal packaging film are promising in that producers are interested, but field tests and refined survey methods are needed to help producers understand potential financial benefits of using the technology and thus arrive at more precise WTP measures.

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NOTES

1. The legal USDA definition of specialty crop is "fruits and vegetables, tree nuts, dried fruits and horticulture and nursery crops, including floriculture" that are cultivated for food, medicinal purposes or aesthetic gratification.

2. Cardboard flats are used by many Kansas producers at harvest to store berries. Given this situation, we framed willingness to pay questions around cardboard flats rather than weight of produce.

3. Haneman et al. (1991) provide a detailed derivation of the likelihood function. For a step-by-step explanation of the likelihood function and Stata estimation example, see Lopez-Feldman (2012).

4. In this case, mean WTP is the constant term plus the products of each coefficient and the sample mean of the relevant variable.

5. We thank an anonymous reviewer for helpfully suggesting the addition of nonparametric analysis.

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APPENDIX: WILLINGNESS TO PAY QUESTION DESIGN

Figure A1 contains the instructions and questions that were presented to each survey participant.

Variation across Surveys

Bracketed terms were varied to arrive at six different combinations. First , we chose six values for $P_{M,j}$ between \$0.20 and \$0.30. This range was suggested by developers of this technology as a reasonable estimate of its cost of production. In every case, $P_{M,j}$ was adjusted by +/– 20% to arrive at the low and high prices, such that $P_{L,j}$ = (0.80) $P_{M,j}$ and $P_{H,j}$ = (1.20) $P_{M,j}$. Impact on shelf life in days (D_i) was varied over three levels—2, 3, and 4—and paired with $P_{M,j}$. We used each shelf life value twice, and the pairing of D_i and $P_{M,j}$ was random. The six resulting scenarios are listed in Table A1. This approach varies both the initial price and subsequent prices, allowing for estimation of an average WTP across participants.

Figure A1. Willingness to Pay Survey Instructions and Question

Instructions

Please answer the following questions regarding whether you would purchase the packaging film described earlier, given the conditions in the question. You should only answer two questions.

Notes: We estimate the shelf life of strawberries (without the film) to be 6–7 days when stored under optimum conditions (stored at 40°F or less within 1 hour of harvest). Note also that we plan to test this film on other types of produce in the future, but have currently only tested it on strawberries so have asked these questions related to strawberries. If you do not currently raise strawberries or sell all your strawberries through U-pick (and thus do not pick the strawberries that you sell), please complete these questions as if you did sell strawberries and pick them into a flat to sell them.

Would you pay an additional {$P_{M,j}$} per cardboard flat to add a packaging film that is expected to improve the shelf life of strawberries stored in the flat by {D_i} days when they are stored at 40°F or less?

☐ **Yes**

If you answered __Yes__, answer the following:

Would you pay an additional {$P_{H,j}$}per cardboard flat for a packaging film which is expected to improve the shelf life of strawberries stored in the flat (at 40°F or less) by {D_i}days?

☐ Yes ☐ No

☐ **No**

If you answered __No__, answer the following:

Would you pay an additional {PL,j}per cardboard flat for a packaging film which is expected to improve the shelf life of strawberries stored in the flat (at 40°F or less) by {Di}days?

☐ Yes ☐ No

Table A1. Interval Combinations for the Willingness to Pay Question

Combinations (j)	$P_{M,j}$	$P_{H,j}$	$P_{L,j}$	D_i	i
1	$0.30	$0.36	$0.24	2	1
2	$0.24	$0.29	$0.19	3	2
3	$0.27	$0.32	$0.22	4	3
4	$0.22	$0.26	$0.18	2	1
5	$0.20	$0.24	$0.16	3	2
6	$0.23	$0.28	$0.18	4	3