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Consumer Preferences for Low Pesticide Produce:

A Choice Experiment in Missouri

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Consumer Preferences for Low Pesticide Produce: A Choice Experiment in Missouri

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Introduction

Eating fresh vegetables and fruits has become an important part of healthy diets (Jennifer Cook, 2020). However, this has also raised concerns about possible exposure to harmful pesticide residues. In the United States, pesticides were found in 87.4% of fresh fruits, and 52.1% of vegetables (FDA, 2019). While the FDA indicates the levels of these chemicals are acceptable in most cases, there may be demand for low pesticide produce, which may also reduce negative environmental impacts.

Organic produce has very little pesticide residue, but it is not always an option because of its high price (Garcia & Teixeira, 2017). Reduced pesticide production for vegetables and fruits may have potential as a compromise between conventional (lower cost, higher risk) and organic (higher cost, lower risk) methods.

Source: Shutterstock (https://www.eatthis.com/clean-eating-plan/)

Analysis of demand for vegetable and fruit production methods has been largely devoted to organic and sustainable food (e.g., Li & Kallas, 2021). Consumers generally prefer and are willing to pay (WTP) a premium for organic and sustainable labels. Among sustainable claims (except organic), reduced pesticides has the highest value (Chen et al., 2018, strawberry). However, the premium differs across studies depending on the product attributes. To date, there have been few studies using reduced pesticides as an attribute to compare with preferences for organic and conventional production methods.

This study investigates consumer preferences for tomato production methods and estimates WTP for 50% reduced pesticide use (versus conventional and organic) using choice experiment data from tomato consumers in Missouri collected in spring of 2022. Other attributes relate to where the tomatoes are produced and by whom. The study adds to the scarce literature on pesticide use from the consumer perspective and has implications for policy makers and farmers regarding potential markets for reduced pesticide produce.

Experimental Design

Discrete Choice Experiment (D-Efficiency: 98.6%): Consumers were asked to choose a hypothetical option for fresh tomatoes given 4 following attributes:

- **Production method**: Organic, 50% reduced pesticide, Conventional
- **Origin**: Local, Missouri Grown, and None of these labels
- **Producer**: Small family farm, Large family farm, and Large Corporation
- **Price**: $1.99/lb, $2.99/lb, and $3.99/lb

There were 9 scenarios with 3 alternatives and an opt-out option for each scenario.

Table 1. Example of Scenario Design

	Option A	Option B	Option C
Method	**Conventional**	**50% Reduced pesticide**	**Organic**
Label	**Missouri Grown**	**Local**	**No Local or Missouri Grown**
Farm	**Small & medium family**	**Large Corporation**	**Large Corporation**
Price	**$3.99/lb**	**$2.99/lb**	**$3.99/lb**

Which choice for buying tomatoes would you prefer?

○ Option A ○ Option B ○ Option C ○ None of them

Data

Survey: 530 Missouri's respondents participated in the experiment on Amazon's Mechanical Turk (MTurk), an online platform for collecting choice data remotely. Mturk samples are found to be robust alternatives to common samples for healthy eating messages (Ouyang & Sharma, 2019) and for grocery shopping behaviors during and post COVID-19 (Grashuis, Skevas, & Segovia, 2020).

Sample: 343 respondents served as tomato consumers for the study. Since there were 9 choice sets, the total number of unique choice observations for the full sample is 343 * 9 = 3,087. The dataset also included relevant demographic data.

Table 2. Demographic summary statistics

Demographic Characteristics	Sample (%)	Demographic Characteristics	Sample (%)
Gender		Income	
Male	43.2%	*Less than $25,000*	12.0%
Female	56.0%	*$25,000-$50,000*	32.7%
Prefer not to say	0.8%	*$50,000-$75,000*	21.9%
Age		*$75,000-$100,000*	16.1%
Under 34	36.7%	*$100,000 and above*	17.3%
34-54	45.5%	House location	
Above 54	17.8%	*Rural*	25.1%
Education		*Suburban*	41.7%
High school and less	21.0%	*Urban*	33.2%
2 year / Associate's degree	13.1%	Children	
4 year / Bachelor's degree	41.7%	*No children*	51.5%
Graduate or professional degree	24.2%	*At least 1 child*	48.5%

Comparing table 2 to census data indicates sample respondents are younger and more educated than Missouri's adult population (Missouri Census Data, 2020). This is typical for internet surveys.

Empirical Model

Consumer preference and WTP for the tomato attributes in the DCE are analyzed using a random utility model (McFadden, 1974), which can be described as follows:

$$Utility\ (choice) = OptOut + \beta_1 Price + \beta_2 Organic + \beta_3 50\%ReducedPesticide + \beta_4 Local + \beta_5 MissouriGrown + \beta_6 SmallFamily + \beta_7 LargeFamily + \varepsilon$$

Where *OptOut* is an intercept term that captures the utility associated with the opt-out option, β_k $(k = 1, \dots, 7)$ represents the model coefficients associated with price and non-price attributes, and ε is error term. The utility model (1) uses an advanced mixed logit approach where *OptOut* and price coefficients are fixed effects, and the other parameters are assumed to be random effects ~ N(μ, σ^2) relating to the assumption of heterogeneity in consumer preferences (Bansai, Daziano, & Achtnicht, 2017).

Also, a second model is specified by adding interaction terms between production methods and local/Missouri Grown labels to model 1 to examine WTP for combinations of 50% Reduced pesticide and local or Missouri Grown and how they differ from organic.

Results

The Maximum Likelihood Estimation method is used to estimate the two empirical models. All attributes in both models are significant and there is significant heterogeneity in consumer preferences. Model (2) fits better and provides more policy-relevant implications than model (1). Estimates and statistics are reported in Table 3.

The overall results show positive effects for "organic" and "50% Reduced pesticide use" vs. conventional, indicating higher preferences for these production methods. The findings are consistent with previous studies even though most studies had only two production method attributes versus the three in our study.

However, the mean WTP results indicate consumers would pay a much higher premium for "organic" than "50% less pesticide" compared to conventional, e.g. 56 cents/lb. for organic tomatoes vs. 11 cents/lb. for "50% less pesticide" ones. Using a reference price of $1.99/lb. for conventional tomatoes, this is equivalent to a premium of 28% for "organic" vs. 6% for "50% less pesticide". This is expected since "organic" has a wider range of environmental and perceived health benefits than 50% reduction in pesticide use alone.

Results (continued)

Table 3. Mixed Logit Regression Results

Attribute-specific vaiables	Model 1		Model 2	
	Preferences	WTP	Preferences	WTP
Opt-out	-4.398***		-4.738***	
Price	-0.797***		-0.915***	
Organic	0.459***	0.576***	0.509***	0.556***
Reduced 50% pesticide use	0.126**	0.158**	0.097**	0.106**
Local	0.109***	0.137***	0.154***	0.168***
Missouri Grown	0.440***	0.551***	0.513***	0.561***
Small, medium family farm	0.278***	0.277***	0.258***	0.282***
Large family farm	0.295***	0.315***	0.294***	0.322***
Interaction terms				
Organic * Local			-0.227***	-0.249***
Reduced 50% pesticide use * Local			0.143**	0.157**
Organic * Missouri Grown			0.021	0.023
Reduced 50% pesticide use * Missouri Grown			0.110*	0.120*
Heterogeneity (Standard Deviation)				
Organic	0.634***	0.710***	0.629***	0.658***
Reduced 50% pesticide use	0.355***	0.397***	0.368***	0.385***
Local	0.245**	0.275**	0.232**	0.242**
Missouri Grown	0.415***	0.465***	0.429***	0.449***
Small, medium family farm	0.541***	0.606***	0.529***	0.553***
Large family farm	0.055	0.062	0.061	0.064
Model Statistics				
Log-likelihood	-3161		-3153	
Wald χ^2 (df)	211(6)		206(6)	
Pr(>χ^2)	0.000***		0.000***	
AIC	6349		6341	
Pseudo-R^2	23.8%		24.0%	
Number of observations	3087		3087	

*Notes: Superscripts *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively*

The interaction effects suggest consumers prefer "50% reduced pesticide use" tomatoes from local or Missouri Grown farmers rather than those from non-local producers. This may reflect a desire by Missouri's consumers to support the local economy. The mean WTP for a combination of "less pesticide and local" is 16 cents/lb., and 12 cents/lb., for "less pesticide and Missouri Grown." Surprisingly, consumer WTP for "organic and local" is negative, indicating lower WTP for this combination than the sum of WTP associated with "organic" and "local" tomatoes. This might be explained by overlapping valuations of "organic" and "local" among the sample consumers (Printezis & Grebitus, 2018).

Figure 1. Individual WTP for organic & less pesticide claims

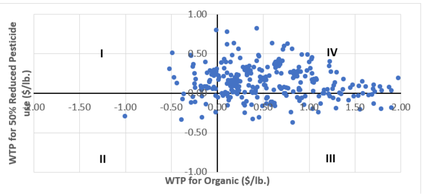

Figure 1 shows differences in individual WTP for organic and for 50% reduced pesticide use: 65% of the sample would pay a premium for both production methods (area IV), 18% would only pay extra for organic (area III), 13% would only pay extra for less pesticide (area I), and 4% would pay less for both or prefer conventional (area II).

Conclusions

Consumers on average would pay 11 cents/lb. more for 50% less pesticide tomatoes, much less than the premium of 56 cents/lb. for organic tomatoes. Local or Missouri farmers who reduce pesticide use by 50% can obtain 12-16 cents/lb. more.

Further research could examine the cost of pesticide reduction in tomato production, given the low WTP by consumers. More research to identify those who would be interested in lower pesticide production methods is also needed.

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