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ARTICLE

Quality-related descriptors to increase fresh blueberries purchase—Evidence from a basket-based choice experiment

Xueying Ma[1] | **R. Karina Gallardo**[2] | **Elizabeth Canales**[3] | **Massimo Iorizzo**[4]

[1]School of Economic Sciences, Washington State University, Pullman, Washington, USA

[2]School of Economic Sciences, Puyallup Research and Extension Center, Washington State University, Puyallup, Washington, USA

[3]Department of Agricultural Economics, Mississippi State University, Mississippi, USA

[4]Department of Horticultural Science, Plant for Human Health Institute, Plant Genetics and Nutritional Genomics, Kannapolis, North Carolina, USA

Correspondence
Xueying Ma, School of Economic Sciences, Washington State University, Pullman, WA 99164-6210, USA.
Email: xueying.ma@wsu.edu

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Abstract
This study addresses the need to boost fruit and vegetable consumption amidst rising diet-related health concerns. Blueberries, rich in phenolic phytochemicals, offer significant health benefits. Using a basket-based choice experiment (BBCE), the study identifies sensory descriptors that enhance blueberry purchasing likelihood. Packaging with a "Stay Fresh" label reduces price sensitivity compared to others. Additionally, blueberries are commonly purchased alongside other berries rather than as substitutes. Demographic factors such as gender, age, education, employment, fitness, ethnicity, region, nutritional value perception, and budget influence blueberry selection. These insights can aid growers, retailers, and marketers in increasing fresh blueberry demand.

KEYWORDS
basket-based choice experiment, blueberries, price elasticity, quality descriptor

JEL CLASSIFICATION
D12, M31, Q13

1 | INTRODUCTION

To reduce the prevalence of overweight and obesity,[1] the World Health Organization (WHO) recommends increasing the consumption of fruits and vegetables, legumes, whole grains, and nuts (World Health Organization, 2021). Fruits containing high phenolic phytochemicals, such as blueberries, blackberries, pomegranate, cranberries, plums, and apples, contribute to the antiobesity

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effects of fruit consumption (Sharma et al., 2016; Wolfe et al., 2008). Recent studies demonstrate the benefits of blueberries and its anthocyanins components in reducing the risk of cardiovascular disease, type 2 diabetes mellitus, hypertension, and cognitive decline in older adults (Basu et al., 2010; Cassidy et al., 2011; Cassidy et al., 2013; Devore et al., 2012; Istek & Gurbuz, 2017; Jennings et al., 2012; Kalt et al., 2020; Wedick et al., 2012). Given the host of health benefits associated with consuming fruits and vegetables, the food industry and policymakers must identify marketing strategies promoting healthy foods, such as blueberries.

The U.S. per capita consumption of fresh blueberries has doubled over the past decade, from a yearly average of 1.2 in 2012 to 2.3 pounds in 2021 (USDA, 2023a). Reasons for the increase in blueberry consumption include the recognition of health benefits, as well as their improved quality, year-round availability, and convenient packaging (Cook, 2011). Other reasons include the decrease in the real price of blueberries and prices of blueberry substitutes, the increased individual income in the United States, and the promotion efforts of the U.S. Highbush Blueberry Council (USHBC) (Kaiser, 2015). USHBC (2018) confirmed the need to increase per capita consumption, highlighting the importance of identifying population segments representing growth opportunities. In the early 2010s, reports by The Packer (2013) and Brazelton (2013) suggest that a small percentage of individuals (about 15%) who purchased blueberries were frequent buyers. As a result, Gilbert et al. (2014) emphasizes the importance of converting seldom buys into regular purchases through product satisfaction. The authors claim that limitations in the industry's ability to supply berries with a consistent appearance, texture, and sensory profiles curtail the number of consistent buyers, hindering the growth of the U.S. blueberry industry.

Despite the need for the berry industry to center on "consumer satisfaction," there is limited research connecting the sensory quality characteristics of blueberries with the possibility of raising per-capita consumption. Specifically, it remains unknown whether and how word descriptors indicating sensory or hedonic quality attributes affect the likelihood of purchasing blueberries when presented with other commonly consumed fruits in the United States. This knowledge can guide stakeholders in providing consistent, high-quality blueberries that meet consumer expectations and potentially boost per capita consumption. It can also inform policies promoting healthy food consumption.

This study applies the basket choice models, that has been used in a limited capacity in the agricultural economics literature (Caputo & Lusk, 2022; Kwak et al., 2015; Richards et al., 2018). In particular, this study implements the basket-based choice experiment (BBCE) method introduced by Caputo and Lusk (2022). Unlike traditional DCEs, which offer participants a single food item with different attribute levels, a BBCE presents participants with various food items, allowing them to select a food item or a combination of food items to construct a bundle, resembling an actual grocery shopping experience more closely. The use of BBCE also allows us to identify substitution and complementary patterns and inform key stakeholders in the food industry about how including word descriptors on labels, signaling hedonic or sensory quality attributes, can impact demand.

The study aims to estimate the price elasticity of blueberries using different word descriptors that signal specific sensory and hedonic quality attributes such as "Sweety," "Crunchy," and "Stay Fresh." In doing so, the study has four primary objectives: (1) to identify which sensory and hedonic quality attributes increase the likelihood of consumers purchasing fresh blueberries by triggering the expectancy of higher quality blueberries and increasing their desirability; (2) to determine how these specific sensory quality factors influence consumers' responsiveness to changes in the price of blueberries (i.e., own price elasticity); (3) to analyze the cross and own price elasticities of commonly

[1]Obesity and overweight represent worldwide problems. The World Health Organization (WHO) reports that as of 2016, 39% of adults worldwide were overweight and 13% obese (World Health Organization, 2021). The United States has one of the highest prevalence of overweight and obesity among adults and children worldwide. From 1999 to 2000 to 2017-2018, the age-adjusted prevalence of obesity increased from 30.5% to 42.4%. Obesity costs the U.S. healthcare system $147 billion a year (Hales et al., 2020).

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consumed fresh fruits in the United States, identifying patterns of complementarity and substitution; and (4) to characterize the profile of individuals who are regular blueberry purchasers.

2 | LITERATURE REVIEW

Previous research has shown that food labels and descriptions on the outside package of food products impact consumers' a priori expectations regarding taste and quality (Blackmore et al., 2021; Liem et al., 2012; Papies et al., 2020a; Piqueras-Fiszman & Spence, 2015). For instance, including sensory and hedonic descriptors on food labels enhances eating simulations and food attractiveness, positively impacting consumers' preferences (Papies et al., 2020b; Turnwald & Crum, 2019). Woods et al. (2011) demonstrated that labels suggesting extra sweetness increased the perception of the intensity of sweetness. The way flavors are described can also influence consumers' desires and purchase behavior (Klein Hazebroek & Croijmans, 2023).

A substantial body of literature explores consumers' evaluation of blueberries and their attributes. These studies conclude that consumers prefer locally produced fresh blueberries (Girgenti et al., 2016; Hu et al., 2009; Qu et al., 2017; Shi et al., 2011, 2013, 2015). The size of the blueberry and eating quality attributes, including the intensity of blueberry flavor, sweetness, freshness, juiciness, tartness, and texture, are strongly associated with consumers' acceptance of blueberries (Blaker et al., 2014; Donahue & Work, 1998; Gilbert et al., 2014; Mennella et al., 2017; Qu et al., 2017; Saftner et al., 2008; Sater et al., 2021; Yue & Wang, 2016). In particular, firmness has been identified as one of the most critical factors positively impacting consumers' preferences (Ehlenfeldt & Martin, 2002; Sater et al., 2021; USDA, 2020). Regarding consumers' preferences for processed blueberry products, consumers favor organic and sugar-free features (Hu et al., 2009). In tandem with consumers' preferences, blueberry producers consider improved fruit quality, firmness, flavor, and shelf-life as the most important characteristics to improve in new blueberry cultivars (Gallardo et al., 2018).

Previous studies estimated consumers' willingness to pay (WTP) for quality characteristics associated with blueberries and blueberry products (Hu et al., 2009; Shi et al., 2011, 2013, 2015; Stevens et al., 2015). These studies found that consumers are willing to pay more for organic blueberries, locally produced, pollinated by native bees, and sugar-free. To elicit WTP, researchers commonly used discrete choice experiments (DCE) (Hu et al., 2009; Shi et al., 2011; Stevens et al., 2015) and experimental auctions (Shi et al., 2013, 2015). Similar approaches have been used in consumer WTP studies for other berries (Darby et al., 2006; Hoke et al., 2017).

Unlike previous research, this study evaluates how the effects of labels denoting sensory quality attributes impact consumers' likelihood of purchasing blueberries among a variety of fresh fruits. To fulfill this aim, the study employs the BBCE following the framework proposed by Caputo and Lusk (2022). The BBCE approach includes the selection of shopping bundles multiple times, enabling the analysis of the substitution and complementarity relationships between products included. Similar studies but using different methods have been used in the literature. Song and Chintagunta (2006) used a bundle-specific utility that included a category-specific and a brand-specific component. Their analysis used store-level scanner data, showing that softeners and detergents are complementary and brands influence cross-price elasticities. Kwak et al. (2015) utilized an assortment choice model to investigate consumers' yogurt choices during a single shopping trip. They found that brand impacts consumers' yogurt choices, and when the perceived product quality is higher, consumers prefer less variety. Richards et al. (2018) used a shopping basket model to explore the effect of complementary goods on retail competition based on household-scanner data collected on purchase occasions. They discovered that the presence of complementary goods decreases retail competition.

Caputo and Lusk (2022) conducted a BBCE study on 21 foods, which enabled them to examine the substitution and complementarity patterns among foods and their own and cross-price

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elasticities. The researchers applied their results to assess how changes in the price of food items can affect the nutritional intake of individuals, as well as the welfare consequences of food policies. Their analysis revealed that changes in food prices have the potential to influence dietary habits by impacting nutrient intake. Neill and Lahne (2022) conducted an experiment involving six vegetable choices using a Basket and expenditure-based choice experiment (BEBCE) design combined with a sensory experiment. They found that most vegetables are considered complements or independent of each other rather than substitutes. These studies' outcomes provide insights into consumer behavior and inform policy decisions.

3 | EXPERIMENTAL DESIGN

The study gathered data via an online survey on the Qualtrics platform, utilizing the Qualtrics Consumer Research Panel. Pretesting occurred in February 2023, followed by full implementation in the second and third weeks of the same month. Researchers requested a sample close to the U.S. population based on age, income, and region demographics. The survey had four version with different labeling treatments for blueberries. Qualtrics provided 801, 802, 805, and 800 participants for each version, totaling 3,208 respondent across the U.S. Respondents had to be 18 or older, primary grocery shoppers, and had consumed blueberries in the past year. Each version included the BBCE. The survey also gathered data on blueberry preferences, consumption habits, label attention, and sociodemographic characteristics. The Institutional Review Board (IRB) approved the survey at Washington State University, IRB number 19812-001.

3.1 | The food basket choice experiment

For our study, we selected the top fresh fruits most popular in the United States in 2021 (International Fresh Produce Association, 2022). We added blackberries to the list as they are often seen as a substitute for blueberries (Arnade & Kuchler, 2015; Cook, 2011; Sobekova et al., 2013). We removed lemons and cherries from our study because lemons are typically eaten in combination with other foods rather than being consumed alone, and cherries are seasonal and not commonly available throughout the year. Despite the controversy surrounding whether avocados are considered fruits (USDA, 2019), they are typically displayed with other fruits at grocery stores; therefore, we decided to incorporate them into our study to imitate an actual shopping scenario. Thus, our chosen 14 fresh fruits to be included in the choice basket were apples, avocados, bananas, blackberries, blueberries, cantaloupe, grapes, oranges, peaches, pears, pineapple, raspberries, strawberries, and watermelon.

Every survey participant was presented with six choice scenarios (choice baskets) in which they were presented with 14 different fresh fruits at a posted price. The same fruit options were presented in each scenario, as scenarios only differ in the prices shown to participants. In each scenario, participants were asked to choose the fruit or combination of fruits they would most likely buy in a shopping experience. They could opt out if none of the fruits at the listed prices appealed to them. Figure 1a illustrates a screenshot of a fruit basket choice scenario presented to the survey participants. Participants could add any fruit to their virtual shopping cart on the right by clicking the "+" icon. To assist respondents in setting realistic expenditure levels, we requested that they state their weekly spending on fresh fruits before conducting the choice experiment. Neill and Lahne (2022) suggested that one displays the budget respondents indicated for fresh fruit in each choice question, reminding them of their cognitive budget constraint. Showing their regular fruit budget encouraged respondents to view the experiment as real rather than hypothetical.

To further enhance the real experience of the decision-making process, the total cost of the respondent's choices was presented as "Total Bill" in their shopping cart, following Caputo and Lusk

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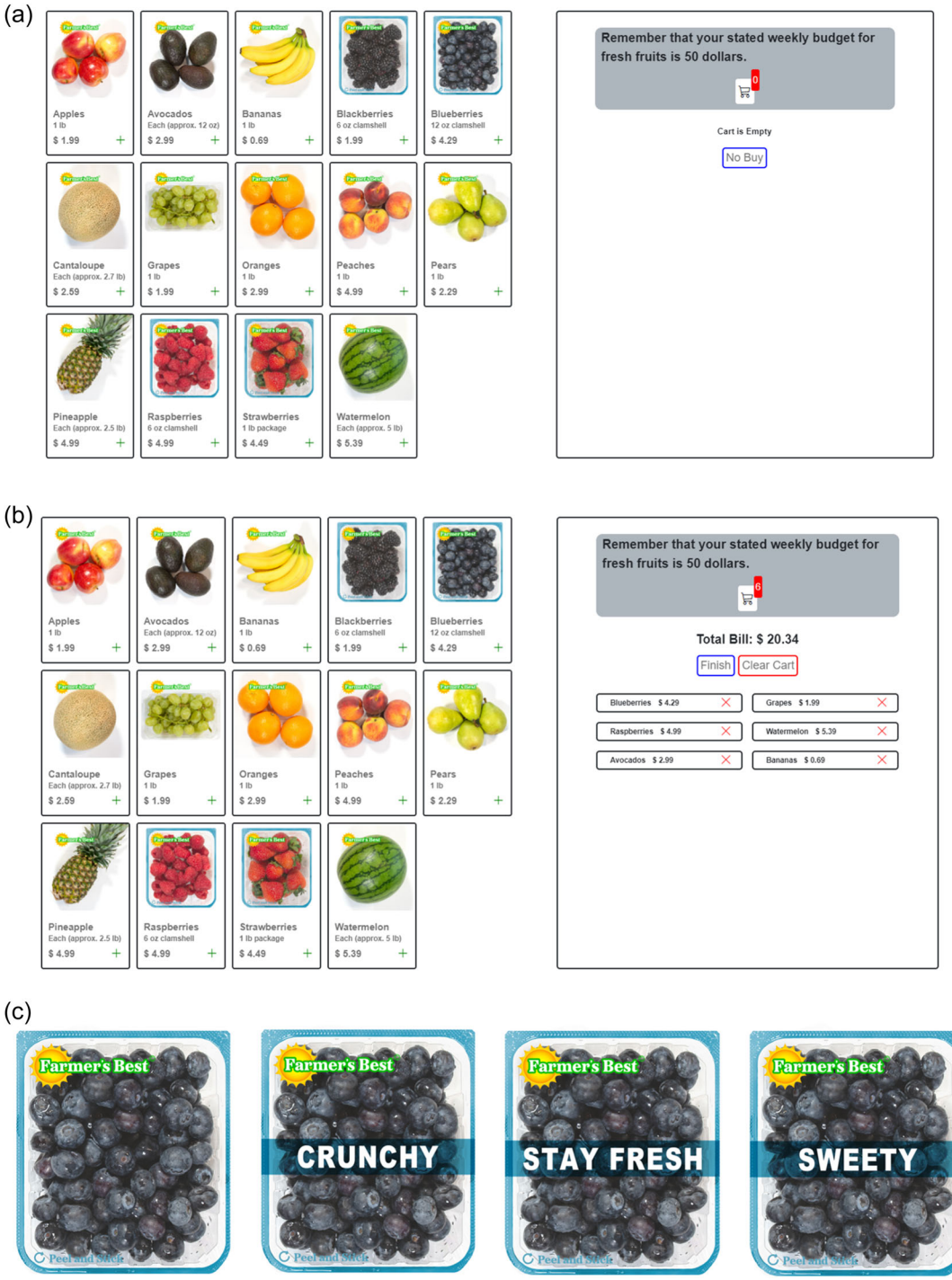

FIGURE 1 Example of experimental design. (a) Example of a fruit-basket choice scenario. (b) Example of a fruit-basket scenario with the selected fruits placed in the shopping cart. (c) Blueberry clamshell labels used in each treatment.

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(2022). If they changed their mind or accidentally selected the wrong fruit, they could remove it by clicking on the "X" icon. Participants could use the "Clear Cart" button to remove all fruits selected. The shopping cart displayed the selected fruits' total cost on the screen's right side. After selecting their desired fruits, respondents could click the "Finish" button to complete their purchases. If they chose not to purchase fruits in a scenario, they could click the "No Buy" option to proceed to the following scenario with an empty cart. A screenshot of a scenario where fruits have been added to the shopping cart is presented in Figure 1b.

Each choice question had the same format, with the only variation across questions being the prices of the fruits. Each fruit option's price varied at three levels: low, medium, and high. The prices used in each choice were selected through research of online grocery store prices across the United States during the last week of January 2023 (Supporting Information S1: Appendix A). These prices were also compared and validated using prices reported by the Agricultural Marketing Service, weekly advertised fruit retail prices (USDA, 2023b). Out of the 3^{14} possible price combinations, an orthogonal fractional factorial design selected a subset of 54 fruit choice scenarios. The 54 questions were organized into nine blocks consisting of six scenarios each. Each participant was randomly assigned to one of the nine blocks.

To minimize the impact of hypothetical bias, we employed a cheap talk script (Champ et al., 2009) in all treatments. Furthermore, we implemented a random ordering of choice sets to decrease the likelihood of learning effects and ordering bias (Caputo et al., 2017).

3.2 | Treatments

The goal of the study is to measure the impact of blueberry word descriptors indicating sensory or hedonic quality attributes on the likelihood of purchasing blueberries. The exercise used "Crunchy," "Stay Fresh," and "Sweety" on the front of the blueberry packages in a between-subjects design yielding four treatments. Hereafter, when we refer to "labeling treatment," each is associated with a different survey version.

The choice of the words "Crunchy" and "Sweety" was based on previous literature that found that the intensity of these sensory quality attributes is strongly associated with consumers' acceptance of blueberries (Blaker et al., 2014; Donahue & Work, 1998; Gilbert et al., 2014; Mennella et al., 2017; Qu et al., 2017; Saftner et al., 2008; Sater et al., 2021; Yue & Wang, 2016). The label "Stay Fresh" was chosen to convey the idea of preferences for an extended shelf-life. Prior studies investigating preferences for shelf-life, utilized a combination of dates to assess consumer preferences for the same fruit or vegetable (Baselice et al., 2017; D'Amato et al., 2023; Zheng et al., 2016). However, our study had a different purpose, it aimed to examine whether a label with descriptors signaling quality attributes (e.g., extended shelf-life, crunchiness, or sweetness) influenced the decision to purchase blueberries when presented alongside a larger selection of the fruits most commonly consumed in the United States.

To avoid any effect from only having the blueberries exhibit a labeling treatment, all the fruits (including blueberries) in the control and the other three treatments displayed the logo "Farmers' Best." All the fruit options, including the blueberries, remained the same within each treatment, and only prices varied randomly. In sum, the four treatments are as follows. Treatment 1 was the control, in which all fruits, including the blueberries, exhibited the logo "Farmers' Best" on the clamshell. Treatment 2 presented the blueberry clamshell with the word "Crunchy," suggesting the blueberries exhibit a crisp texture. Treatment 3 showed the blueberry clamshell with the phrase "Stay Fresh," meaning the blueberries exhibit long-lasting durability in the refrigerator. And Treatment 4 presented the blueberry clamshell with the word "Sweety" to indicate that the blueberries taste sweet. Figure 1c shows the labeling treatments. We expect the treatment groups to exhibit lower own-price elasticities, implying that consumers will display less sensitivity towards

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price changes for fresh blueberries labeled "Crunchy," "Stay fresh," or "Sweety" relative to those without labeling (the control group).

4 | EMPIRICAL APPROACH

We used the Multivariate Logit (MVL) choice models to model basket-based choices (Caputo & Lusk, 2022; Kwak et al., 2015; Richards et al., 2018; Song & Chintagunta, 2006). This approach treats every possible bundle as a distinct choice alternative, resulting in $2^{14} = 16{,}384$ possible bundles. The empirical approach is based on the random utility model introduced by McFadden (1972). Following Richards et al. (2018) and Caputo and Lusk (2022), the utility respondent i derives from choosing bundle b is

$$U_{ib} = V_{ib} + \varepsilon_{ib}, \tag{1}$$

where ε_{ib} is distributed generalized extreme value following Train (2009), and V_{ib} can be written as

$$V_{ib} = \sum_{j=1}^{J} \alpha_{ij} x_j + 0.5 \sum_{j=1}^{J} \sum_{k \neq j}^{J} \gamma_{jk} x_j x_k, \tag{2}$$

x_j equals 1 if fruit j is being placed in basket b and 0 otherwise. α_{ij} is the baseline utility for fruit j derived by individual i, and it can be defined as $\alpha_{ij} = \alpha_{0,j} + \beta_j p_j + X_i \delta_i$, where $\alpha_{0,j}$ is the constant of fruit j or the opt-out option, p_j is the price of fruit j, X_i is the vector of characteristics of individual i, and β_j and δ_i are parameters. Parameter γ_{jk} represents the relationships between the item j and k in terms of their effect on utility. When $\gamma_{jk} > 0$, items j and k are complements in utility. When $\gamma_{jk} < 0$, items j and k are substitutes in utility. The utility of consuming item j is invariant in the presence of item k when $\gamma_{jk} = 0$. We followed previous studies (Besag, 1974; Cressie, 2015; Caputo & Lusk, 2022; Kwak et al., 2015; Russell & Petersen, 2000) and implemented the following restrictions$\gamma_{jk} = \gamma_{kj}$ and $\gamma_{jj} = 0$.

When ε_{ib} is represented by the generalized extreme value distribution following Train (2009), the probability of individual i choosing the observed basket b among the 16,384 possible bundles is

$$\text{Prob}(\text{individual } i \text{ chooses basket } b) = \frac{e^{V_{ib}}}{1 + e^{V_{ib}}}. \tag{3}$$

The composite conditional likelihood[2] function can be expressed by the multivariate logit (MVL) form in the following form (Besag, 1974; Caputo & Lusk, 2022):

$$\text{Prob}(\text{individual } i \text{ places fruit } j \text{ in basket}) = \frac{e^{z_{ij}}}{1 + e^{z_{ij}}}, \tag{4}$$

$$z_{ij} = \alpha_{ij} + \sum_{k \neq j}^{J} \gamma_{jk} y_{ik}, \tag{5}$$

[2]Bel et al. (2018) compares three alternative methods to the maximum likelihood (ML): composite conditional likelihood function (CCL), stratified importance sampling (SIS), and generalized method of moments (GMM). They conducted a series of Monte Carlo simulations and conclude that CCL stands out as the most promising alternative to the ML estimation method. The advantages of CCL include its relatively short computation time, its ability to sidestep numerical problems, its minimization of small-sample biases. Moreover, CCL exhibits negligible losses in efficiency.

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where z_{ij} is the utility of individual i who places fruit j in the basket, y_{ij} equals to 1 when the individual i places fruit k in the basket, and 0 otherwise.

4.1 | Own and cross-price elasticities

Previous research suggests that the cross-utility effects γ_{ij} do not necessarily indicate whether two products are substitutes or complements based on price (Caputo & Lusk, 2022; Richards et al., 2018). Therefore, to determine if products are substitutes or complements in response to price changes, we utilize the estimates from the MVL model to estimate the own and cross-price elasticities of fruit items. Specifically, the arc elasticity is determined by examining how the likelihood of selecting fruit j changes with the prices of fruit j and k. To estimate the elasticity of fruit j resulting from a 1% increase in the midpoint price of fruit k, p_k, we follow:

$$e_{jk} = \frac{\text{Prob}(\text{fruit } j \text{ is placed in basket at } 1.01 \times p_k) - \text{Prob}(\text{fruit } j \text{ is placed in basket at } p_k)}{\text{Prob}(\text{fruit } j \text{ is placed in basket at } p_k)}. \tag{6}$$

The probability of fruit j being in a basket can be calculated by adding up the probability of choosing all the baskets that contain fruit j, contingent on individual characteristics and the price of each fruit.

5 | RESULTS

Table 1 presents the sociodemographic variables included in the model. Compared to the 2021 U.S. population (U.S. Census Bureau, 2021), our sample exhibited a higher percentage of individuals with a 4-year college degree, a greater proportion of females, and a higher rate of white respondents. This pattern aligns with the demographics of individuals more responsive to surveys (Curtin et al., 2000). Furthermore, our sample had a larger proportion of individuals with at least one child while having a lower percentage of respondents with a higher income (≥ $75,000 per year) compared to the overall U.S. population. The summary statistics of the entire set of sociodemographic variables across all treatment samples can be found in Supporting Information S1: Appendix B.

5.1 | Survey findings

First, we present the control treatment (no label) group responses to avoid labeling treatment effects. The average number of selected fruits was 5.25 (out of 14 fruits presented in each scenario). Around 5.86% of baskets were empty as respondents chose not to buy any fruits, while 1.43% of baskets were full as respondents chose to buy all 14 fruits (Supporting Information S1: Appendix C).

The frequency distribution of responses to fresh fruit purchase questions can be found in Supporting Information S1: Appendix D. The most prevalent form of blueberry consumed was fresh, followed by frozen and dried blueberries. The preferred method of consuming fresh blueberries was eating them raw and alone, adding them as toppings to granola or yogurt, and using them in smoothies and beverages. The most popular package size was a 6 oz package, followed by 4.4 and 12 oz packages, the weighted average quantity of fresh blueberries purchased during one shopping occasion was 0.80 pounds. Furthermore, our survey revealed the top five reasons why fresh blueberries were not consumed frequently (less than once a month). These included price, short shelf-life at home, lack of freshness, lack of fresh blueberries available, and unwanted package size. Among these reasons, price was the primary

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TABLE 1 Summary statistics of the pooled sample and across treatment.

	Description	U.S. Census 2021	Pooled sample All treatments, $N = 3208$	Pairwise comparison between pooled sample and U.S. Census 2021 (t value)	Treatment sample			
					Treatments			
					Control $N = 801$	Crunchy $N = 802$	Fresh $N = 805$	Sweety $N = 800$
Socio-demographic characteristics								
Female	1 if female; 0 otherwise	0.51	0.64	15.21***	0.63	0.67	0.62	0.63
Millennial	1 if born in or after 1982; 0 otherwise		0.56		0.57	0.56	0.55	0.56
High income	1 if $75,000/year or more; 0 otherwise	0.47	0.45	2.12**	0.45	0.48	0.42	0.46
Children	1 if ≥1 child under 18; 0 otherwise	0.33	0.37	4.48***	0.37	0.38	0.37	0.35
Employed	1 if employed; 0 otherwise		0.62		0.62	0.62	0.62	0.62
College	1 if minimum of 4-year college degree; 0 otherwise	0.32	0.54	24.69***	0.54	0.54	0.53	0.54
White	1 if white; 0 otherwise	0.61	0.74	17.26***	0.73	0.74	0.73	0.77
Variables used in the multivariate logit model								
Liberal[a]	1 if liberal; 0 otherwise		0.33		0.36	0.34	0.31	0.33
Conservative[a]	1 if conservative; 0 otherwise		0.26		0.26	0.25	0.27	0.26
Northeast	1 if northeast; 0 otherwise		0.17		0.17	0.17	0.17	0.17
West	1 if west; 0 otherwise		0.24		0.24	0.24	0.24	0.24
South	1 if south; 0 otherwise		0.38		0.38	0.38	0.38	0.39
Physically fit[b]	1 if physically fit; 0 otherwise		0.23		0.25	0.21	0.22	0.23
Diabetes	1 if diabetes; 0 otherwise		0.09		0.09	0.07	0.10	0.09

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TABLE 1 (Continued)

	Description	U.S. Census 2021	Pooled sample All treatments, $N = 3208$	Pairwise comparison between pooled sample and U.S. Census 2021 (t value)	Treatment sample			
					Treatments			
					Control $N = 801$	Crunchy $N = 802$	Fresh $N = 805$	Sweety $N = 800$
Cholesterol	1 if high cholesterol; 0 otherwise		0.20		0.17	0.21	0.22	0.18
Main_nutrition[c]	1 if nutrition was ranked 1, 2, or 3; 0 otherwise		0.78		0.77	0.79	0.78	0.76
Fresh fruit weekly budget	Continuous		36.75		39.42	32.10	40.85	37.08
Label_domestic	1 if label "domestic product" was marked important or crucial; 0 otherwise		0.44		0.43	0.42	0.44	0.46
Label_organic	1 if label "organic" was marked important or crucial; 0 otherwise		0.35		0.35	0.35	0.38	0.31
Label_nonGMO	1 if label "not genetically engineered" was marked important or crucial; 0 otherwise		0.44		0.45	0.43	0.47	0.40
Label_healthy	1 if label "healthy benefits" was marked important or crucial; 0 otherwise		0.41		0.42	0.40	0.43	0.39
N			3208		801	802	805	800

[a]The reference level for the categories Liberal and Conservative was Mixed, which referred to respondents who identified themselves as "Moderate or middle of the road" or "Mixed: liberal on some issues and conservative on other issues" when asked about their political views.

[b]Physically fit was 1 if the respondent identified themselves as physically fit.

[c]Main_nutrition was 1 if the respondent ranked health and nutrition as one of the top three factors influencing their overall food choices and eating patterns.

Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.

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concern, identified by 54.56% of the respondents. This corresponds with Yue and Wang's (2016) discovery that price played a significant role for U.S. consumers when selecting fresh blueberries. In contrast to our survey results, Girgenti et al. (2016) found that the price of a product was not a crucial factor for Italian consumers when choosing blueberries and raspberries, as these products were typically bought in small quantities. Supporting Information S1: Appendix E summarizes the responses to questions about other aspects of blueberry consumption. When asked to rate the importance of blueberry quality attributes on a 1–5 scale (1 = most important, 5 = least important), the freshness was rated the highest, followed by free from defects, ripeness, phytonutrient content, and sweetness. When asked what quality characteristics should be improved to increase consumption, improved eating quality traits were rated the highest, followed by improved visual quality traits, staying fresh longer, an improved response to climate change, and nutritional traits. When asked about the importance of labels, the top three rated were pesticide-free, domestic product, and not genetically engineered.

5.2 | Baseline utility estimates

We estimated two different MVL models, Model 1 using a single price effect β for all fruit varieties resulting in 422 parameters, and Model 2 assigning a specific price effect for each fruit variety β_j, resulting in 435 parameters. Supporting Information S1: Appendix F presents the model fit statistics for both specifications. Our findings show that Model 2 generally outperformed Model 1 based on AIC and loglikelihood values. We also performed a likelihood-ratio test, where the likelihood-ratio test statistic was computed as $-2(LLR_{Model1}\text{-}LLR_{Model2})$, with 13 degrees of freedom. The likelihood-ratio test statistics were 36, 29, 25, 49, and 101 for the control, "Crunchy," "Stay fresh," "Sweety," and pooled sample. We rejected the null hypothesis in all cases, indicating that Model 2 was preferred. Therefore, we chose to use the estimation from Model 2 in this study.[3]

Individual characteristics were selected based on their significance in a logistic regression model, where the choice of selecting blueberries was the dependent variable and the set of individual characteristics were the independent variables. Table 1 presents the summary statistics for the individual characteristics used in our model. All individual characteristics were represented as dummy variables except for the stated weekly budget for fresh fruits, where the mean value was $36.75.

The results from the MVL model 2 for the pooled and all treatment samples are shown in Table 2. The price coefficient was negative for the pooled and the treatment samples implying that blueberries were less likely to be placed in baskets as prices increased. Also consistent for the pooled and treatment samples is that non-millennials and white respondents were more likely to choose blueberries. Other sociodemographics, such as gender, presence of children, employment, college education, conservative views, living in the Northeast, being physically fit, and considering health and nutrition important, are statistically significant factors but not consistently across treatment samples. In general, male respondents, employed, with a college degree, were physically fit, lived in the Northeast region, placed a high value on nutrition, and had a higher weekly budget on fresh fruits were more likely to choose blueberries. These findings align with the results of Gilbert et al. (2014), who reported that blueberry buyers tend to have an income exceeding $100,000 and reside in the northeastern region of the United States. It also aligns with the findings by Laaksonen et al. (2016), who found that elderly and health-conscious consumers were more inclined to be interested in berries. Reports by The Packer

[3]Model 1 and Model 2 yielded parameter estimates similar in magnitudes.

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TABLE 2 Baseline utility estimates from the multivariate logit model.

	Probability of choosing blueberries under the sample treatments				
	Control (N = 801)	Crunchy (N = 802)	Fresh (N = 805)	Sweety (N = 800)	Pool (N = 3208)
Constant	−0.103	−1.150***	−0.620***	−0.168	−0.453***
	(0.188)	(0.197)	(0.187)	(0.190)	(0.093)
Price	−0.371***	−0.317***	−0.274***	−0.333***	−0.318***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.012)
Female	−0.188***	−0.029	−0.201***	0.039	−0.111***
	(0.070)	(0.072)	(0.071)	(0.070)	(0.035)
Millennial	−0.138*	−0.183**	−0.237***	−0.288***	−0.210***
	(0.073)	(0.074)	(0.074)	(0.073)	(0.036)
Income ≥$75,000/yr	−0.017	0.069	−0.027	0.129*	0.025
	(0.073)	(0.074)	(0.075)	(0.073)	(0.036)
With at least one child	0.118	−0.190***	−0.180**	−0.083	−0.088**
	(0.072)	(0.071)	(0.072)	(0.072)	(0.035)
Employed	0.273***	0.049	0.126*	0.065	0.114***
	(0.071)	(0.070)	(0.070)	(0.071)	(0.034)
4-yr college degree	−0.046	0.203***	0.079	0.126*	0.092***
	(0.072)	(0.071)	(0.071)	(0.070)	(0.035)
White	0.136*	0.327***	0.229***	0.150*	0.208***
	(0.079)	(0.079)	(0.077)	(0.081)	(0.039)
Liberal	−0.037	−0.074	0.164**	−0.181**	−0.021
	(0.077)	(0.078)	(0.079)	(0.078)	(0.038)
Conservative	−0.176**	−0.096	0.029	−0.129	−0.090**
	(0.085)	(0.084)	(0.082)	(0.083)	(0.041)
Northeast	0.271**	0.063	0.324***	0.028	0.171***
	(0.107)	(0.106)	(0.107)	(0.106)	(0.052)
West	0.080	0.135	0.095	−0.242**	0.019
	(0.100)	(0.099)	(0.098)	(0.101)	(0.049)
South	−0.124	0.035	0.176*	0.031	0.049
	(0.090)	(0.090)	(0.090)	(0.089)	(0.044)
Physically fit	0.069	0.058	0.132	0.238***	0.124***
	(0.081)	(0.084)	(0.086)	(0.083)	(0.041)
Diagnosed with diabetes	−0.278**	0.023	−0.004	−0.304**	−0.149**
	(0.122)	(0.131)	(0.118)	(0.122)	(0.060)

(Continues)

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TABLE 2 (Continued)

	Probability of choosing blueberries under the sample treatments				
	Control ($N = 801$)	Crunchy ($N = 802$)	Fresh ($N = 805$)	Sweety ($N = 800$)	Pool ($N = 3208$)
Diagnosed with high cholesterol	0.000	−0.203**	−0.065	−0.196**	−0.113***
	(0.093)	(0.085)	(0.086)	(0.093)	(0.043)
Health and nutrition is important	0.230***	0.544***	0.058	−0.044	0.158***
	(0.080)	(0.086)	(0.081)	(0.077)	(0.039)
Fresh fruit weekly budget	0.000	0.003***	0.003***	0.003***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Label domestic is important	0.065	−0.016	−0.051	0.082	0.019
	(0.072)	(0.073)	(0.071)	(0.072)	(0.035)
Label organic is important	0.075	0.367***	0.046	0.125	0.145***
	(0.083)	(0.083)	(0.083)	(0.085)	(0.041)
Label non-GMO is important	0.237***	0.125	0.109	−0.172**	0.089**
	(0.081)	(0.081)	(0.081)	(0.084)	(0.040)
Label healthy is important	0.233***	0.106	0.075	0.353***	0.190***
	(0.075)	(0.076)	(0.074)	(0.076)	(0.037)

Note: Standard errors are in parentheses.
Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.

(2019) support these findings, as there is a higher probability of fresh blueberry purchases among white, older, and high-income individuals.

Other sociodemographic results that were statistically significant and negative, albeit not consistently across samples, indicate that conservative views, households with at least one child, and respondents diagnosed with diabetes or high cholesterol were less likely to include blueberries in their shopping carts. A possible explanation might be that those diagnosed with diet-related diseases might not necessarily respond to healthful eating styles or health information even after diagnosis (Mancino & Kinsey, 2004). On the presence of children, Mennella and Bobowski (2015) found that kids dislike the bitterness of berries, possibly explaining why households with children are less likely to choose blueberries.

Other respondents' characteristics with significance and sign inconsistent across pool and treatment samples were liberal views and the importance of the label "non-GMO." Respondents who identified with liberal views chose blueberries in the "Stay fresh" group, while they were less likely to select blueberries in the "Sweety" group. Respondents for whom the label non-GMO was important were more likely to choose blueberries in the pooled and control sample but less likely to select blueberries in the "Sweety" group. In addition, baseline utility estimates from the MVL model for the 14 fruits across control and treatment groups were reasonably consistent (Supporting Information S1: Appendix G).

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5.2.1 | Cross-utility effect estimates

As shown in Table 3, most of the cross-effects show a positive correlation, which suggests that the fruits have complementary effects on respondents' utility. Across all treatments (except for the "Stay fresh"), negative coefficients were observed in the cross-utility effects between blueberries and pineapples, as well as blueberries and oranges, indicating that pineapples and oranges are not likely

TABLE 3 Cross-utility effect estimates from multivariate logit model change in utility of purchasing.

	Blueberries				
	Control ($N = 801$)	Crunchy ($N = 802$)	Fresh ($N = 805$)	Sweety ($N = 800$)	Pooled ($N = 3208$)
Apples	0.071	0.083*	0.235***	0.108**	0.107***
	(0.049)	(0.049)	(0.049)	(0.048)	(0.024)
Avocados	0.312***	0.423***	0.372***	0.367***	0.356***
	(0.049)	(0.048)	(0.049)	(0.049)	(0.024)
Bananas	0.293***	0.320***	0.254***	0.314***	0.286***
	(0.054)	(0.058)	(0.054)	(0.054)	(0.027)
Blackberries	0.570***	0.388***	0.566***	0.422***	0.483***
	(0.054)	(0.055)	(0.054)	(0.057)	(0.027)
Blueberries	0	0	0	0	0
Cantaloupe	0.203***	0.031	0.068	0.020	0.078***
	(0.062)	(0.059)	(0.061)	(0.060)	(0.030)
Grapes	0.459***	0.368***	0.391***	0.309***	0.363***
	(0.048)	(0.049)	(0.048)	(0.048)	(0.024)
Oranges	−0.079	−0.025	0.012	−0.106**	−0.039*
	(0.049)	(0.049)	(0.048)	(0.048)	(0.024)
Peaches	0.121**	0.104*	0.158***	0.212***	0.149***
	(0.054)	(0.054)	(0.054)	(0.054)	(0.027)
Pears	−0.059	0.168***	−0.101*	0.079	0.019
	(0.055)	(0.056)	(0.056)	(0.055)	(0.027)
Pineapple	−0.173***	−0.215***	0.254***	−0.105*	−0.056**
	(0.057)	(0.056)	(0.055)	(0.056)	(0.027)
Raspberries	0.298***	0.358***	0.448***	0.608***	0.426***
	(0.053)	(0.052)	(0.053)	(0.054)	(0.026)
Strawberries	0.935***	0.799***	0.937***	0.963***	0.904***
	(0.048)	(0.048)	(0.048)	(0.047)	(0.024)
Watermelon	0.166***	0.127**	0.142**	−0.020	0.095***
	(0.058)	(0.058)	(0.057)	(0.057)	(0.028)

Note: Standard errors are in parentheses.

Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels.

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to be purchased with blueberries. Interestingly, berries (i.e., strawberries, blackberries, raspberries, and blueberries) are more likely to be bought together, inconsistent with previous studies on elasticity patterns between berries. For example, Sobekova et al. (2013) found that strawberries, blueberries, blackberries, and raspberries are substitutes for one another. Kaiser (2015) also found that strawberries are a substitute for blueberries. We also found that almost all cross-utility effect coefficients for the 14 fruits were positive (Supporting Information S1: Appendix H), indicating that fruits are more likely to be purchased together. This is consistent with Caputo and Lusk's (2022) findings that apples and bananas are frequently purchased together and proposed that this tendency for similar items to be bought together may be due to "variety seeking or differential preferences among members of a household."

5.3 | Own and cross-price elasticities

Table 4 shows the own and cross-price elasticities of blueberries. The elasticities were computed based on the parameter estimates from Model 2, using the mean individual characteristics and medium price. The cross-price effects indicate a negative correlation, indicating that all products have complementary demands. This means that an increase in the price of other fresh fruits decreases the likelihood of purchasing blueberries. In contrast to the findings of Sobekova et al. (2013), our study suggests that all types of berries have complementary relationships.

The cross-price effect with the highest magnitude in all treatment groups is from strawberries, indicating that a 1% increase in the price of strawberries leads to a 0.20% decrease in the likelihood of buying blueberries. Blueberries with the words "Stay fresh" on the package showed an own-price elasticity of −0.544, implying that the demand for "Stay fresh" blueberries declined by 0.54% on

TABLE 4 Own and cross price elasticities of blueberries at mean demographics and prices implied by multivariate logit model.

	Quantity of blueberries				
Change in price of	**Control ($N = 801$)**	**Crunchy ($N = 802$)**	**Fresh ($N = 805$)**	**Sweety ($N = 800$)**	**Pooled ($N = 3208$)**
Apples	−0.037	−0.043	−0.050	−0.029	−0.040
Avocados	−0.046	−0.052	−0.039	−0.039	−0.042
Bananas	−0.023	−0.019	−0.026	−0.023	−0.022
Blackberries	−0.102	−0.100	−0.077	−0.097	−0.092
Blueberries	**−0.759**	**−0.768**	**−0.544**	**−0.736**	**−0.685**
Cantaloupe	−0.051	−0.056	−0.049	−0.039	−0.047
Grapes	−0.118	−0.117	−0.090	−0.085	−0.100
Oranges	−0.033	−0.040	−0.054	−0.018	−0.036
Peaches	−0.029	−0.029	−0.034	−0.026	−0.029
Pears	−0.017	−0.035	−0.023	−0.023	−0.023
Pineapple	−0.035	−0.031	−0.064	−0.033	−0.041
Raspberries	−0.077	−0.094	−0.087	−0.099	−0.089
Strawberries	−0.201	−0.227	−0.216	−0.224	−0.214
Watermelon	−0.056	−0.053	−0.067	−0.042	−0.052

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average with a one percent increase in price. This value is the lowest compared to other sample treatments. The blueberries' own price elasticity for blueberries with the word "Control" is −0.759, "Crunchy" is −0.768, "Sweety" is −0.736, and the pooled sample is −0.685. This finding is consistent with prior research, which has shown that sensory and quality labels, along with product descriptions, have an impact on consumers' perception of the product (Blackmore et al., 2021; Papies et al., 2020a; Piqueras-Fiszman & Spence, 2015). Our result suggests that blueberries with a longer shelf life could potentially reduce consumers' sensitivity to price changes.

Across all treatments, the treatment that showed the highest frequency of blueberry selection was the "Stay fresh" label, with 52.19% of baskets including blueberries, which was higher than the other treatments. For instance, the control treatment had a selection rate of 50.75%, the "Crunchy" treatment had a selection rate of 43.37%, and the "Sweety" treatment had a selection rate of 47.67%. See Supporting Information S1: Appendix C. This is consistent with previous studies that found blueberries' freshness was the most significant factor in consumers' decision to purchase them (Girgenti et al., 2016; Qu et al., 2017; Yue & Wang, 2016). Even though previous studies have shown that consumers prefer sweet and crispy fresh blueberries (Gilbert et al., 2014; Yue & Wang, 2016), our results do not indicate that a "Sweety" or "Crunchy" logo would increase the probability of purchase.

We used individual characteristics to calculate the individual own-price elasticity of fresh blueberries. We conducted t-tests to determine if there was a significant difference in the own price elasticity of fresh blueberries across different treatment groups. Supporting Information S1: Appendix I shows the histograms of each group's price elasticity of fresh blueberries. Most individuals in the "Control" and "Crunchy" groups had a price elasticity for blueberries between −1.1 and −0.5. In the "Stay fresh" group, most individuals had a price elasticity between −0.7 and −0.4, while in the "Sweety" group, the majority had a price elasticity between −1.0 and −0.5. Our t-test results indicated that respondents had a smaller price elasticity for fresh blueberries labeled as "Stay fresh" ($t = -32.434$, $p < 0.001$) and "Sweety" ($t = -3.773$, $p < 0.001$) compared to fresh blueberries without any labeling. There was no significant difference in the price elasticity of "Crunchy" compared to the "Control" groups ($t = 0.330$, $p = 0.629$). However, the price elasticity for "Stay fresh" blueberries was smaller than that of "Sweety" blueberries ($t = -31.236$, $p < 0.001$). These findings support the conclusion that consumers are less responsive to price changes for fresh blueberries labeled as "Stay fresh" or "Sweety."

In terms of own and cross elasticities of all 14 fruits, we found that in the Control treatment (Supporting Information S1: Appendix J), bananas were the most own price inelastic fruit (−0.150) while cantaloupe (−1.059), watermelon (−0.921), and blackberries (−0.960) were the most own price elastic fruits. This is consistent across the control, "Crunchy," and "Sweety" blueberry label treatments (Supporting Information S1: Appendix J). While cantaloupe, watermelon, and blackberries were among the most elastic fruits in the "Stay Fresh" group, strawberries, raspberries, and pineapples were more elastic than blackberries. The scope of the price elasticity of fruits is consistent with what was found in the previous study (Andreyeva et al., 2010). In the case of berries, our findings showed that strawberries and blueberries were less responsive to changes in other berries' prices. Overall, results suggest that the demand for each type of berry is sensitive to price changes, with blackberries being the most price elastic, followed by strawberries, raspberries and blueberries, with blueberries being the least elastic. The result is consistent with the findings of Sobekova et al. (2013), which similarly reported that blueberries have lower price elasticities than other berries. An exception was observed in the "Stay Fresh" group, where strawberries displayed higher price elasticity compared to other berries. Moreover, it is noteworthy that the price elasticities for each type of berry within the "Stay Fresh" group were lower in comparison to those observed in the other treatment groups. Considering the evident higher probability of "Stay Fresh" blueberries being purchased and the evident pattern of purchasing berries together, there is a potential for "Stay Fresh" blueberries to influence the acquisition of other berry varieties.

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6 | CONCLUSION AND IMPLICATIONS

This study investigated quality-related attributes of blueberries that may contribute to increasing the likelihood of consumers purchasing fresh blueberries. We collected survey data and found that the top five reasons for infrequent consumption of fresh blueberries were price-related, the short shelf-life of the fruit at home, concerns about its freshness, unavailability of fresh blueberries in the market, and packaging size. Among these reasons, price emerged as the respondents' primary concern. Our analysis using MVL models and elasticity analysis confirmed that quality-related descriptors on the label of packaged blueberries impact consumers' behavior, in terms of their sensitivity to price changes and likelihood of purchase. Specifically, we found that blueberries labeled with descriptors indicating a longer shelf life (e.g., "Stay fresh") were associated with reduced sensitivity to price changes among respondents. Instead of being substitutes for each other, our results suggested that berries (blueberries, blackberries, raspberries, and strawberries) complement each other. These berries are likely to be purchased together at the grocery store.

The findings of this study provide useful insights for blueberry growers, retailers, and marketers that could help inform the development of strategies to increase the per capita consumption of fresh blueberries. For example, this information could help stakeholders understand how highlighting distinct and desirable sensory qualities of their blueberries, differentiate them in the market and draw in consumers seeking specific sensory attributes, potentially leading to higher sales. Moreover, these findings can serve as a quality control mechanism for stakeholders to monitor and maintain the desired sensory characteristics (indicated on the label) ensuring consumers receive a consistent high-quality experience with each purchase occasion. Ultimately, this information offers valuable insights for shaping policies aimed at promoting the consumption of healthy fruits.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ORCID

Xueying Ma http://orcid.org/0000-0001-9346-9980

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Additional supporting information can be found online in the Supporting Information section at the end of this article.

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