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Consumers' food safety risk perceptions and willingness to pay for fresh-cut produce with lower risk of foodborne illness

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ABSTRACT

There has been an increasing number of foodborne illness outbreaks associated with fresh and fresh-cut produce recently; however, few studies have examined consumers' risk perceptions and their willingness to pay (WTP) for fresh-cut produce with lower foodborne illness risk (FBIR). Hence, the objectives of this study were to examine how consumers perceived different food safety risk factors associated with fresh-cut produce and explore the factors associated with consumers' WTP for the fresh-cut produce with lower FBIR. The results showed that consumers' risk perception of foodborne pathogens was significantly lower than that of pesticides, which was mainly because consumers with optimistic bias perceived a very low probability of the occurrence of foodborne illness related to fresh-cut produce. The analysis of variance (ANOVA) indicated that millennial and female consumers had higher risk perceptions compared to other demographic groups. In addition, the WTP data demonstrated that the majority of consumers were willing to pay a premium for fresh-cut produce with lower FBIR. Millennial consumers with high-risk perceptions of pathogens and high fresh-cut produce purchasing frequency were more willing to pay a premium. The results provide useful information for fresh-cut produce processors to make decisions on enhancing the compliance of food safety practices. In addition, the results suggest that food safety regulatory agencies that develop public education materials should include information to reduce consumers' optimistic bias and enhance consumers' awareness of the risks associated with foodborne pathogens related to fresh-cut produce.

1. Introduction

The fresh-cut produce industry continues to grow rapidly into a multi-billion-dollar segment of the produce industry (Rico, Martin-Diana, Barat, & Barry-Ryan, 2007). Fresh-cut produce has been defined by the International Fresh-Cut Produce Association (FDA, 2013) as "any fresh fruit or vegetable that has been physically altered from its original form but remains in a fresh state." This may include but is not limited to peeling, chopping, or slicing, all of which can facilitate rapid microbial growth (Beuchat, 1996; Francis et al., 2012). Since consumers are preparing less food at home and have the perception of fresh-cut produce being healthy, the food service and retail industry is responding to consumers' health concerns by providing more fresh-cut fruit and salad options (Choi, Norwood, Seo, Sirsat, & Neal, 2016).

Foodborne illness outbreaks associated with fresh and fresh-cut produce have become more frequent, although fresh produce was once considered to be a safe food (Neal, Marquez-Gonzales, Cabrera-Diaz, Lucia, O'Bryan, Crandall, Ricke, & Castillo, 2011). Painter et al. (2013) reported that fresh produce accounted for more than 46% of the foodborne disease outbreaks in the U.S. from 1998 to 2008. Approximately 100 outbreaks were linked to fresh-cut produce in United States (U.S.) between 2000 and 2007 (Anderson, Jaykus, Beaulieu, & Dennis, 2011). Processing (cutting, peeling, shredding) can destroy cell surfaces and the exposure of cytoplasm may provide a better source of nutrients for microorganisms that intact produce (Francis et al., 2012). Additionally, much of the fresh and fresh-cut produce is consumed raw without pathogen inactivation processes such as cooking. Several studies showed that fresh-cut produce may carry higher foodborne illness risks compared to fresh produce. For example, Herman, Hall, and Gould (2015) analyzed the data on foodborne illness outbreaks associated with produce between 1973 and 2012 and found that 73.6% of the outbreaks with fresh-cut leafy salad as the vehicle. In addition,

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Sirsat and Neal (2013) indicated that bagged fresh-cut romaine lettuce has equal if not higher levels of bacteria and spoilage microorganisms than whole lettuce.

Previous studies have demonstrated that three critical factors affect the safety of fresh-cut produce: (1) the post-harvest treatments in the processing facility, (2) employees' handling practices in the retail environment, and (3) consumers' handling practices in the domestic kitchen (Lynch, Tauxe, & Hedberg, 2009; Ramos, Miller, Brandão, Teixeira, & Silva, 2013). Multiple physical and chemical methods for pathogen reduction and shelf life extension have been designed in recent years. Examples of chemical methods include the use of chlorine-based chemicals such as hypochlorite and chlorine dioxide (Baur, Klaiber, Wei, Hammes, & Carle, 2005; Baert, Mattison, Loisy-Hammon, Harlow, Martyres, Lebeau, et al., 2011), organic acid-based chemicals (Francis & O'Beirne, 2002), and electrolyzed water (EW) (Habibi & Haddad, 2009). Examples of physical methods include modified atmosphere package (MAP) (Ramos et al., 2013), irradiation (Neal, Cabrera-Diaz, Marquez-Gonzalez, Maxim, & Castillo, 2008), and ultraviolet light (UV) (Neves, Vieira, & Silva, 2012). According to FDA estimates, "*the costs arise from FSMA would cost the domestic producer sector $386.23 million per year and the foreign producer sector $529.62 million per year*" (FDA, 2015). The owners of processing plants are not convinced whether such investments are financially beneficial (Toivonen et al., 2014). One way to alleviate this concern is to charge premiums for reducing foodborne illness risk (FBIR) of fresh-cut produce. However, to our knowledge, no research has been conducted to examine consumers' risk perceptions and their willingness to pay (WTP) for reducing FBIR related to fresh-cut produce. To fill this gap, the objectives of the current study were to examine (1) consumers' risk perceptions toward fresh-cut produce, and (2) factors influencing their WTP for fresh-cut produce with lower FBIR.

2. Material and methods

2.1. Participants

A survey instrument was designed to investigate consumers' risk perception, consumers' fresh-cut produce handling practices, and WTP for FBIR reduction of fresh-cut produce. Questions were screened and approved by the University of Houston's Human Subjects Review Board. Fifty participants pilot tested the questionnaire to assess question clarity and identify whether response options were clear. The questionnaire was revised based on the results of pilot tests. The survey instrument was distributed nationwide using an online panel (www.Qualtrics.com) and completed responses were obtained from 1043 participants. The survey was equally distributed to ten regions of the U.S. based on regions assigned by the U.S. Environmental Protection Agency (EPA) with 105 respondents (10.1%) per region (Table 1; EPA, 2016) so that the results reflected a national representation of risk perceptions and WTP for FBIR reduction of fresh-cut produce. The survey contained an initial question to ensure that the respondents who chose to participate in the study had purchased fresh-cut produce at least once a month during a regular season. In addition, three filter questions were included in the survey to examine the quality of responses. The surveys completed by 106 participants that failed to respond to the filter questions were eliminated from the study and 937 valid responses remained for further data analysis.

Table 1
U.S. Environmental protection agency (EPA) region distribution.

Region	States
Region 1	CT, MA, ME, NH, RI, VT
Region 2	NY, NJ, PR, VI
Region 3	DC, DE, MD, PA, WV, VA
Region 4	AL, FL, GA, KY, MS, NC, SC, TN
Region 5	IL, IN, MN, OH, MI, WI
Region 6	AR, OK, NM, LA, TX
Region 7	IA, KS, MO, NE
Region 8	CO, MT, ND, SD, MT, UT
Region 9	AZ, CA, HI, NV
Region 10	AK, ID, OR, WA

2.2. Survey development and measures

The survey instrument consisted of three major parts. The first section consisted of questions regarding respondents' risk perceptions of fresh-cut produce. Respondents' risk perception was measured by evaluating how risky a certain situation (Yeung & Morris, 2001) is and the perceived likelihood of this situation based on the theory of planned behavior (TPB) "E-V" method (Ajzen, 1991). Four risks of fresh-cut produce including foodborne pathogens (*E. coli* O157:H7, *Salmonella* spp., and *Listeria* monocytogenes), GMO's, antibiotics, and pesticide were adopted from Lobb, Mazzocchi, and Traill's study (2007). The evaluation of risk (r) was rated on a five-point Likert scale (1 = very safe, 5 = very risky). An example item was "If there is *Salmonella* spp. in my fresh-cut produce, I think the implication for my health is ___".

The likelihood of this risk (p) was also rated on a five-point Likert scale (1 = very unlikely, 5 = very likely). An example item was: "*Salmonella* in fruits and vegetables you purchase was____". The risk perception (R) was computed by the square root of multiplication of the evolution of certain risk and likelihood of this risk (equation (1)).

$$R_i = \sqrt{r_i^* p_i} \tag{1}$$

Hence, the range of certain risk perception R_i was between 1 and 5 and the probability density function (PDF) R_i of was followed the normal distribution well. Consumers' risk perception towards foodborne pathogens associated with fresh-cut produce was measured by the average of risk perceptions of three major pathogens related to fresh-cut produce (i.e., *E. coli* O157:H7, *Salmonella* spp., and *Listeria monocytogenes*) (equation (2)).

$$R_b = \frac{\sum_{i=1}^{3} r_i^* p_i}{3} \tag{2}$$

The second section consisted of questions regarding consumers' WTP for FBIR reduction of fresh-cut produce using contingent valuation method (CVM), which is a nonmarket-valuation method that is used to value specific changes from the status quo (Fu, Liu, & Hammitt, 1999). Using this method, individuals are asked about the status quo versus alternative states, and information is elicited about their WTP. In this survey, information was provided on the statistics of foodborne illness outbreaks related to fresh-cut produce and the probability of fresh-cut produce causing foodborne illness. An example is as follows: "The Centers for Disease Control and Prevention (CDC) identified 713 fresh-cut produce-associated outbreaks that were associated with 34,081 illnesses and 16 deaths for the period 1990–2005". In addition, an example of packaged salad-related multistate foodborne illness outbreak cited by the CDC (2016) was provided. Based on the price of bagged salad provided by five major grocery store websites, the average price of 12 Oz bagged salad is approximately $3. Respondents were asked to decide whether they would like to pay $1 more per 12 Oz bagged salad to reduce the probability of foodborne illness by from 10