Food Policy 69 (2017) 82–96

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

Consumer valuation of information about food safety achieved using biotechnology: Evidence from new potato products ☆

Jonathan R. McFadden [a,1], Wallace E. Huffman [b,*]

[a] Economic Research Service, U.S. Department of Agriculture, 1400 Independence Ave., SW Mail Stop 1800, Washington, DC 20250, United States
[b] Iowa State University, Department of Economics, 460E Heady Hall, Ames, IA 50011, United States

ARTICLE INFO

Article history:
Received 18 April 2016
Received in revised form 3 March 2017
Accepted 4 March 2017

Keywords:
Experimental auctions
Potato products
Information and labeling effects
Biotechnology
Food safety

ABSTRACT

This study focuses on the role of food labels and information for affecting consumers' valuation of food safety achieved through application of biotechnological (biotech) methods. In 2002, potato products cooked to a high temperature were first reported to contain the human carcinogen acrylamide. Research discoveries using genetic engineering can substantially reduce carcinogenic-forming potential, and thereby increase food safety of potato products. Adult consumers from three distant regions of the U. S. were the subjects in lab auctions of potato products. They engaged in distinct rounds of bidding, first without packaged information and again after receiving information about the food safety risks and benefits of new biotech potato products. The study finds that willingness-to-pay (WTP) for these new potato products are not significantly different from conventional potato products under no information. However, exposure to a scientific perspective and scientific plus industry perspectives increases participants' willingness-to-pay for the new potato products and reduces willingness-to-pay for conventional products. Exposure to the negative perspective on the new technology significantly reduces willingness-to-pay. Consumer valuation of the new potato products is affected by food labels, information, and consumer attributes. A consumer information program could be needed to gain consumer acceptance of these potato products or other foods that have been genetically modified to increase certain food safety dimensions.

1. Introduction

Potatoes are native to South America but spread to North America, Northern and Eastern Europe, and beyond in the seventeenth- and eighteenth centuries as explorers and travelers returned from Peru. The potato had several advantages over other food staples: convenience in storability, ample sources of energy and fiber, and ease of growing on small plots. Initial introductions into cropping and food systems were not without problems arising from low genetic diversity under unsatisfactory growing conditions, such as potato blight (Hirsch et al., 2013). Today, the potato is the most important vegetable in the United States (Jansky et al., 2014) and is widely consumed in the American and European diets.[2,3]

The popularity of the potato for human consumption is being challenged by the recent discovery that potato products cooked at high temperatures (>250°F) contain acrylamide (Tareke et al., 2002), which the International Agency for Research on Cancer (IARC) classifies as "probably carcinogenic to humans (Group 2A)" (Lineback et al., 2012). Acrylamide is also a neuro-toxin (OEHHA, 2014). Affected potato products include French fries, hash browns, and potato chips. Roughly, the darker is the browning, the higher is the acrylamide concentration.[4]

In 2005, the California Office of the Attorney General sued the U. S. potato industry under Proposition 65 (California Safe Drinking Water and Toxic Enforcement Act of 1986), necessitating substantial reductions in acrylamide levels in potato products. The settlement of the suit required many California restaurant chains to post warnings about acrylamide exposure from eating cooked potato

☆ The views expressed are those of the authors and should not be attributed to the Economic Research Service or the U.S. Department of Agriculture (USDA).

* Corresponding author.
E-mail addresses: jonathan.mcfadden@ers.usda.gov (J.R. McFadden), whuffman@iastate.edu (W.E. Huffman).

[1] The experiment was completed while at Iowa State University.

[2] The potato is a good source of potassium (Institute of Medicine, 2015).

[3] In 2013, FAO estimates world production of potatoes at 368 million tons. Roughly two thirds are eaten directly by humans (FAO, 2015).

[4] Acrylamide is a by-product of the Maillard chemical reaction and is a stable compound after formation. After controlling for water content, a positive relationship exists between chip and fry color and acrylamide content. Processing conditions, environmental factors during plant growth, storage, and field management practices influence acrylamide-forming potential in potatoes. Acrylamide concentrations in potatoes vary widely as a function of reducing sugar content and cooking temperatures (Bethke and Bussan, 2013).

http://dx.doi.org/10.1016/j.foodpol.2017.03.002
0306-9192/

products (OAG, 2008). The goal of these warnings is to promote public health. They also signal to the U.S. potato industry a need to reduce the acrylamide content of potato products cooked to high temperatures.

Biological researchers have been searching for a method to substantially reduce acrylamide levels in cooked potato products. However, conventional plant breeding and new field- and potato-storage management strategies have been unsuccessful. In contrast, new genetic engineering methods provide viable opportunities. Bethke and Bussan (2013) report that biotech gene-silencing methods significantly reduce asparagine and sugar content of cooked potato products. These are the two naturally-occurring compounds in potatoes that react to form acrylamide in potato products cooked at high temperatures. As such, in 2016, the FDA indicated that biotech varieties may ultimately be the most effective solution for acrylamide reduction (US-FDA, 2016). Hence, genetic modification (GM) can be employed to significantly improve the food safety of an important food crop – the white potato.

This article reports the results of applying an innovative approach to valuing and comparing various information treatments on risk reduction. The risk, food-borne acrylamide exposure, is an emerging food safety issue that has attracted worldwide attention. This study focuses on the effect of food labels and packaged information on consumers' valuation of low-acrylamide biotech potato products. Adult consumers from three distant regions of the U.S. were chosen as subjects. They were from California, Iowa and Massachusetts. Iowa and California are large producers of food and agricultural products, while farmers in Massachusetts tend to be engaged in small-scale farming and agro-tourism. In addition, three New England states voted over 2013–14 to require some type of mandatory labeling of GM foods, but state-level votes in other U.S. regions have failed. Hence, our sample contains significant regional diversity. The subjects participated in laboratory auctions, which created a unique data set.

The experimental design included three white potato products (fresh whole potatoes, frozen French fries, and potato chips), two types of products (low-acrylamide biotech and conventional), and six information treatments. The six information treatments were constructed from three different perspectives—a scientific perspective on health risks from acrylamide exposure, an industry perspective on low-acrylamide potatoes obtained by using biotechnology, and environmental groups' perspective on biotechnology. Subjects participate in private-information-revealing experimental auction markets, where they place bids under both the "treatment" and "control," i.e., a with-in person statistical experimental design (List, 2009). Each participant bids on both types of the three products, both before receiving one of the randomly-assigned information treatments and after receiving information.

Prior to receiving packaged information, subjects' average willingness-to-pay for new biotech potato products is not significantly different from that of conventional potato products. However, when subjects receive packaged information, willingness-to-pay differences emerge. Under the scientific information treatment, all average treatment effects (ATEs) are statistically significant at the 10 percent level, being positive for biotech commodities but negative for conventional commodities. When subjects receive environmental groups' information, average WTP is reduced for biotech and conventional products, but the reduction is larger and statistically stronger for the biotech products. When subjects receive industry and scientific perspectives, the mean bids for the biotech products increase significantly, and bids for conventional products decline significantly.

2. Related research

The current study stems from past applied work on incentive-compatible elicitation mechanisms, food experiments, and experiments involving information and labeling treatments. For the past half-century, economists have used the Vickrey (1961) second-price auction to learn about consumer WTP. Participants submit private bids, and the highest bidder wins but pays the second-highest price. Since the weakly dominant strategy is sincere bidding, the auction is said to be incentive compatible (Hurwicz, 1972). Second-price auctions remain widely used because of their incentive-compatible properties and ease of implementation, including identification of a single winner.

Another common method of eliciting consumer valuations is the Becker et al. (1964) mechanism (hereafter denoted as BDM). In this value elicitation procedure, participants are asked to report their WTP for a good (or group of goods) and then a random price is drawn, typically from a uniform distribution. Those whose valuations are higher than the random price receive the good and pay the random price, whereas participants with a WTP less than the random price do not receive the good and pay nothing. The BDM device is therefore incentive compatible.

Shogren et al. (2001) build on the BDM mechanism and Vickrey auction to create a mechanism known as a random nth-price auction. In this method, participants bid on the experimental product, bids are ranked from highest to lowest, and a random number, n, is drawn uniformly on [2, k], where k is the number of session participants. Those who bid higher than the nth bid are winners but pay the nth bid, not their submitted bid. As in the BDM, the bidders' dominant strategy is to truthfully reveal their valuations. Shogren et al. (2001) argue that random nth-price auctions are desirable because of engaging "low-margin" bidders, i.e., low-value participants still have a positive probability of winning. Using an experiment with induced values, the authors find more sincere bidding from low-value individuals in the random nth-price auction than the Vickrey auction.[5] This auction is especially useful for assessing valuations for all subjects in an auction.

The literature on the use of experimental auctions to examine the effects of information treatments on WTP for food products has evolved since the 1990s (Menkhaus et al., 1992; Hoffman et al., 1992; Schmitz et al., 1993; Hayes et al., 1995; Fox et al., 2002). In the first three studies, fifth-price auctions with repeated trials were conducted in the Denver and Los Angeles areas to assess WTP for beef steaks with two types of packaging. They found that information treatments, income, household size, employment, beef shape, cholesterol concerns, and "all natural" labels significantly influence the WTP difference between vacuum-sealed and plastic overwrapped steaks. The latter two studies employ Vickrey auctions to assess valuations for meat sandwiches with varying levels of food safety risks.

Since the wider adoption of laboratory experimental methods in agricultural economics, there has been an increase in studies examining information and labeling effects (Rousu et al., 2007; McFadden and Lusk, 2015). Although these studies use different experimental methods, one commonality is that prior beliefs, information treatments, labels and seals, and framing have substantial effects on consumer values. For example, Hayes et al. (2002) find that information treatments have asymmetric effects on WTP for irradiated pork sandwiches, with negative information having more impact than positive information. Similarly, Marette

[5] There is a growing literature examining potential divergence between incentive compatibility in theory and in practice (Lusk and Shogren, 2007). In recent work, Malmendier and Lee (2011) document irrational bidding behavior in eBay auctions. We use random nth-price auctions because of their frequent use in food auction research and their desirable properties in practice.