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Consumer acceptance of cisgenic food and the impact of information and status quo☆

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ABSTRACT

Genetically Modified (GM) foods have been a debated topic for decades, and consumer concerns are widespread. Scientific proposals to increase consumer acceptance include the use of cisgenics, where GM technology is used but the inserted gene(s) originates from closely related organisms. Results from a choice experiment display greater willingness to pay (WTP) for cisgenics than transgenics, although traditional methods are preferred, and more accessible information about the technologies increases acceptance. The disutility from cisgenics and transgenics is offset by the utility from product quality improvement related to eating experience, indicating potential demand for cisgenic food, provided it improves the product in aspects of importance to the consumers.

1. Introduction

Genetically Modified (GM) foods have been a debated topic for decades, and consumer concerns are widespread. Moreover, new scientific approaches are evolving that aim to meet public concerns, where the types of gene transfers are being restricted (Holme, Wendt, & Bach Holm, 2013; Schouten, Krens, & Jacobsen, 2006). One example is *cisgenics*, where the inserted genes must originate from sexually compatible organisms (e.g., gene transfers from one type of grape to another). In *transgenics*, the more general form of genetic modification, no such restrictions occur and therefore genes from, for example, bacteria can be inserted into a grape.

Public debate regarding mandatory labeling of GM food, and evidence from a vast body of research, demonstrate concern for GM food among consumers (see reviews in Costa-Font, Gil, & Traill, 2008; Lusk, Jamal, Kurlander, Roucan, & Taulman, 2005). Today, the legal status of cisgenics in the US receives little attention, as all GM products face voluntary labeling. However, the introduction of mandatory labeling would imply greater importance of the legal status of cisgenics. In the European Union (EU), there is currently mandatory labeling of GM food, although in practice this means that little GM food is available to consumers in supermarkets (Qaim, 2016). While cisgenics is currently classified as GM in the EU, the legal status has been debated, concerning whether it will be exempt from labeling requirements or remain equal to transgenics in terms of labeling (Holme et al., 2013). The attitudes and preferences regarding cisgenics relative to transgenics and traditional breeding is hence a relevant question for potential future policy decisions on its labeling status. Previous research, although limited, does suggest a more favorable attitude toward cisgenics than transgenics, while maintaining the preference for traditional breeding technologies (Edenbrandt, Gamborg, & Thorsen, 2017; Delwaide et al., 2015; Lusk & Rozan, 2006[1]). However, the sparse research on willingness to pay (WTP) for cisgenic food motivates this paper.

The rather technical distinctions between the different breeding methods raise questions regarding consumers' understanding of the concept and how descriptions affect the acceptance of cisgenics and transgenics compared to traditional breeding methods. By testing different levels of information we aim to elicit consumers WTP for the different breeding methods.

Moreover, we compare consumers of two similar products (two types of grapes) which differ in their natural state of a central quality aspect (type of seeds), and analyze if this difference in status quo

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[1] Ingenic is defined in the paper by the restriction of gene transfers between sexually compatible organisms, wherefore it coincides with cisgenics.

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regarding seeds affects the preferences regarding cisgenics. By exploring consumer WTP for cisgenics, and relating this to the impact of status quo in an attribute and the understanding of the breeding concepts, this paper contributes to the discussion on the potential of cisgenics. The subsequent section provides background from previous research. The survey design and theoretical framework are then presented, followed by the results, and the final sections discuss the findings.

1.1. Background

Consumers are willing to pay less for GM food than for corresponding products with no GM ingredients, and there is plentiful literature that attempts to identify factors that affect the level of acceptance (e.g., Lusk et al., 2005; Dannenberg, 2009). Among the identified explanations are concerns related to personal health, environmental impact, fear of unknown future impacts, and ethical considerations (Zilberman, Kaplan, Kim, Hochman, & Graff, 2013). Improved qualitative characteristics through genetic modification are often proposed as a means to increase consumer acceptance, and this is supported in empirical studies. Increased consumer benefits, such as improved nutrition or taste, increase consumer acceptance of GM foods, although non-GM remains the preferred technology (Dannenberg, 2009; Lusk et al., 2005; Onyango & Nayga, 2004).

The acceptance of GM food is also affected by type of product and application. The acceptance is lower toward genetic modification in products that are perceived as natural (e.g., tomatoes) compared to unnatural products (e.g., crisps) (Tenbült, De Vries, Dreezens, & Martijn, 2005) and for fresh compared to processed food (Lusk, McFadden, & Rickard, 2015). Some studies suggest a higher WTP when genetic modification is only used in production (e.g., yeast or animal feed) than when the product itself contains modified genes, although there are consumer segments that do not differentiate (Burton & Pearse, 2002; Chern, Rickertsen, Tsuboi, & Fu, 2002). Moreover, acceptance is lower for genetic modification in animals than in crops (Dannenberg, 2009; Lusk et al., 2005; Onyango & Nayga, 2004). These results suggest that perceived naturalness is a key factor for WTP for GM food.

One aspect of naturalness concerns the origin of the inserted genes (Kronberger, Wagner, & Nagata, 2014; Mielby, Sandøe, & Lassen, 2013). The concept of cisgenics, introduced by Schouten et al. (2006) implies that genes can only be transferred between sexually compatible organisms, wherefore it is feasible in nature. There exist different definitions of cisgenics, and other similarly restricted GM methods such as intragenics; see Baeksted Holme et al. (2013) and Palmgren et al. (2015) for overviews and recent developments in this area.

A number of studies address citizen perceptions of cisgenics, and the main findings suggest that naturalness is a central concept and many do differentiate between cisgenics and transgenics, although both are seen as less natural than traditional breeding (Kronberger et al., 2014; Mielby et al., 2013). A survey conducted in the US and France found a greater willingness to eat ingenic than transgenic vegetables, although traditional breeding was the preferred technology (Lusk & Rozan, 2006), while only 40 percent in a Swiss survey differentiate between transgenic and cisgenic apples (Haller, 2009). Similarly, in a Eurobarometer survey, with 26,671 respondents from the EU member states, 78 percent found transgenic apples unnatural, while 57 percent found the cisgenic counterparts unnatural (Gaskell et al., 2010). The WTP for cisgenics is, however, sparsely explored. Data from a choice experiment with bread in a Danish study were enriched with data from the same respondents' actual purchases, providing greater external validity to the results. While the negative preferences towards transgenics were large in magnitude and relatively homogenous, the preferences towards cisgenics were less negative and revealed significant variation among respondents, suggesting that a share of consumers do not differentiate between traditional and cisgenic breeding methods (Edenbrandt et al., 2017). A survey with respondents in five European countries found that consumers require a discount for GM rice compared to conventional, although it was smaller for cisgenics (Delwaide et al., 2015). Cisgenics was rated more favorable than transgenics among respondents in a study in the Netherlands, while the difference was considerably larger between cisgenics and traditional breeding (Schenk et al., 2011). Colson, Huffman, and Rousu (2011) conducted experimental auctions where 190 participants in the US bid on vegetables, and found a greater WTP for intragenic[2] than transgenic vegetables. Vitamin and antioxidant enhanced intragenic vegetables were preferred over the non-enhanced, GM-free counterparts. We seek to add to this literature by not only examining WTP for cisgenic versus transgenic and conventionally bred products, but to consider if further explanation on the technology impacts acceptance, and relate these WTP back to consumers with different expectations related to the benefit gained from the technology.

2. Material and methods

2.1. Choice experiment design

Because products based on cisgenic breeding are not currently labeled as such in grocery stores, purchasing data do not reveal consumers' preferences for different breeding technologies. Consequently, this study elicits consumers' stated preferences through a choice experiment, as this enables analysis of new attributes and combinations of attribute levels that are unavailable on the market. A potential disadvantage is the hypothetical nature of this type of experiment, where respondents may overstate their actual WTP without monetary consequences. Lusk and Schroeder (2004) find that this is of limited concern for marginal WTP for different attribute levels, although the potential hypothetical bias should be kept in mind.

The choice experiment in our survey presented respondents with grapes, each described by quality attributes and price. Grapes were used in the choice tasks as it fulfills aspects of importance to the study. They are generally marketed as a homogenous product, seldom promoted by type of grape, and often with few attributes (typically just the color of the grape and the seed type). An exception is found with Muscadine grapes (*Vitis rotundifolia Michx.*), typically produced and marketed in the southern region of the U.S. and only during a limited season (Barchenger, Clark, Threlfall, & Sleezer, 2014; Conner, 2013). Muscadines, with their distinct aroma and flavor and thick skin, also have noticeable seeds. However, biotechnological advances have made it possible to produce seedless and disease resistant Muscadine grapes via cisgenics (Gray, Li, & Dhekney, 2014); although consumer willingness to purchase these are unknown.

As the characteristics of the Muscadine grapes are distinctly different from that of typical table grapes (Thompson variety, which typically have a mild flavor, thin skin, and soft seeds, that are often marketed as seedless), we suspect that consumers of Muscadines have different preferences regarding grape attributes. To test for this, respondents were asked if they had bought and/or consumed Muscadine and Thompson grapes (hereafter referred to as Table Grapes), respectively. Both types were illustrated with photographs before the choice experiment, as the names may not be commonly recognized by consumers. Both grapes are available as green and red/purple, and the pictures showed both colors for each grape type.

Based on interviews with grape market experts and a focus group of consumers, seed type was identified as a key attribute, and one that is distinctly different between the two types of grapes. As a result, the grapes in the choice experiment were described by seed type, price, and production method. Seed type varied between large seeds, small seeds,

[2] This study uses the term intragenic, which is similar to cisgenics, in the restriction of gene transfers between sexually compatible organisms, although intragenic also includes in vitro rearrangements (Holme et al., 2013).