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European Consumers' Attitudes Towards Cisgenic Rice

Anne-Cécile Delwaide
University of Arkansas, Fayetteville

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Anne-Cecile Delwaide
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University of Arkansas

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Dr L. Lanier Nalley Thesis Director	Dr. Wim Verbeke Committee Member
Dr. Rodolfo Nayga, Jr. Committee Member	Dr. Bruce L. Dixon Committee Member

Abstract

The enhancement of existing plant breeding techniques, such as cisgenesis, allows plant breeders to enhance an existing cultivar quicker and with little to no genetic drag. Cisgenesis is the genetic modification of a recipient plant with natural gene(s) from a sexually compatible plant. Unlike transgenesis, which is the genetic modification of a recipient plant with gene(s) from any non- plant organism, or from a donor plant that is sexually incompatible with the recipient plant, the results of cisgenesis could occur naturally over time. Currently, both cisgenic and transgenic products are classified as genetically modified organisms (GMOs) and are labeled as such in countries which require mandatory GMO labeling. Critics claim that cisgenic products should be exempt from the GMO legislation and therefore no mandatory labeling should apply for cisgenic products. This study analyzes European consumers' attitudes towards a cisgenic product, rice, and estimates consumers' willingness-to-pay (WTP) for rice labeled as GM, as cisgenic, as with environmental benefits or as any combination of these attributes. The data were collected from 3,002 respondents through an online survey administrated in Belgium, France, the Netherlands, Spain and the United Kingdom in 2013. Censored regression models were used to estimate consumers' WTP in each country. The results highlight significant differences across countries in terms of attitudes towards and between cisgenic and transgenic rice, WTP and demographics affecting the WTP. In all the five studied countries, consumers are willing-to-pay a premium to avoid consuming rice labeled as GM. In all the studied countries except Spain, consumers have a significantly different and lower WTP to avoid to consume rice labeled as cisgenic compared to rice labeled as GM. In addition, consumers in Spain and in France are willing-to-pay a premium for rice labeled as having environmental benefits compared to conventional rice. Finally, the results suggest that consumers differentiate cisgenic and transgenic products and that they tend to

have a more positive attitude towards cisgenic rice than transgenic rice. This seems to indicate that not all GMOs are the same in consumers’ eyes and thus, can have important policy implications in terms of labeling and importation of cisgenic products.

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List of abbreviations

Abbreviation	Meaning
Bt	Bacillus thuringiensis
BE	Belgium
ENV	Environmental
EC	European Commission
EFSA	European Food Safety Agency
EU	European Union
FAO	Food and Agriculture Organization
FR	France
FWER	Familywise error rate
GM	Genetically modified
GMO	Genetically modified organisms
IFIC	International Food Information Council
IRRI	International Rice Research Institute
ISAAA	International Service for the Acquisition of Agri-biotech Applications
#	Number
OECD	Organisation for Economic Co-operation and Development
UK	United Kingdom
US	United States
WTP	Willingness-to-pay

Introduction

A. Problem Statement

The estimated food supply must drastically increase by 2050 to support the large estimated population growth. Rice (*Oryza sativa L.*) is the staple food for nearly half of the world's seven billion people and the staple food of nearly 560 million impoverished consumers in Asia alone[1]. Among the different pathways to increase food production, genetically modified (GM) crops are often presented as a potential viable but controversial option. The International Service for the Acquisition of Agri-biotech Applications (ISAAA) predicts that, by 2015, GM crop will cover approximately 200 million hectares worldwide, spread over more than 40 countries. In total, more than 20 million farmers will be using biotechnology (Clive 2009). Unlike corn, soybeans, and cotton, there is currently no GM rice commercially produced in the world. This is attributed to the fact that several countries have shown high reluctance towards GM crops, specifically rice and wheat. Rice and wheat are unique in the fact they are eaten in their unprocessed forms, unlike soybeans and corn, which primarily go into animal food and biofuels and cotton which is not ingested. The European Union's stringent rules on GM crops and the high European consumers' aversion to GM food product discourage seed companies to develop and invest in GM crops such as rice and wheat. In 2012, BASF, a German company active in the biotech industry, declared that it was ending its research and development operations on GM crops for the European market. This decision was based on the widespread hostility of farmers, consumers and politicians (Laursen 2012).

[1] http://irri.org/rice-today/trends-in-global-rice-consumption

In that context, attempts are underway to foster increased food production with the development of new breeding techniques. Cisgenesis is a breeding technique defined as “a genetic modification of a recipient organism with a gene from a crossable – sexually compatible – organism (same species or closely related species)” (EFSA Panel on Genetically Modified Organisms (GMO) 2012, p. 33). Unlike transgenesis which is the genetic modification of a recipient plant with one or more genes from any non- plant organism, or from a donor plant that is sexually incompatible with the recipient plant, the results of cisgenesis could occur naturally over time. However, because cisgenic products currently fall under the GMO legislation in the European Union (EU) and in many countries across the world, the future of cisgenic crops will depend on its legal status, which is currently being debated, and on consumer acceptance.

This study aims to analyze European consumers' attitudes towards cisgenic rice and to assess their willingness-to-pay (WTP) for rice labeled as GM, as cisgenic, as having environmental benefits or as a combination of these three attributes.

B. Future challenges of rice production

The rice is a staple food for more than 50% of the world population and rice represents more than 20% of the daily calories intake for approximately 3.5 billion people (Seck, Diagne, Mohanty and Wopereis 2012). Furthermore, the livelihood of more than one billion people depends on rice cultivation (Demont and Stein 2013). However, to date and as a consequence of the high aversion to GMOs of some consumers’ in many part of the world, there is no GM rice commercially cultivated in the world. As a result, advances in breeding for yield enhancements along with biotic and abiotic stress for rice have lagged behind corn, cotton and soybeans for which GM crops have been cultivated for at least 17 years. As an example, the rate of annual change of rice yield between 1991 and 2010 has been estimated to 1% per acre while the rate of annual change for maize yield is equal to 1.5% per acre (Fischer, Byerlee and Edmeades 2014).

With the population growth in low-income countries, the demand for rice is expected to increase drastically by 2050. According to the International Rice Research Institute (IRRI), global rice production should be increased by 8 to 10 million tons every year in order stabilize price[2] (IRRI). In 2011, the United States (US) was the fifth largest exporter of rice in the world[3]. Approximately half of US rice production is exported, mainly to Mexico and Japan[4]. By contrast, the EU imports about 40% of its rice consumption needs, mainly from India, the US, and from Thailand (Directorate-General for Agriculture and Rural Development 2012).

In order to keep up with the increasing demand for rice globally due to population growth in rice consuming regions, the supply has to be increased by improving rice yield and reducing losses. Ideally this increase would come from technology that increases production while using less water and chemicals products (pesticides, fertilizer, etc.) in order to respond to decreasing water supplies, increasing input prices and the expectations of consumers and policy makers to reduce the impact on the environment.

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[2] http://irri.org/news/hot-topics/international-land-acquisition-for-rice-production
[3] http://faostat.fao.org
[4] http://www.usarice.com/doclib/157/3366.pdf

Rice blast: a threat to rice production

Another challenge associated with rice production results from the various diseases that can reduce output. One of the most destructive rice diseases is rice blast: rice blast is a fungal disease caused by *Magnaportha grisea*. In the US, this fungal disease was identified for the first time in California in 1996 and has spread to the midsouth rice-growing region (Greer and Webster 2001). Its effect can be dramatic if not addressed: throughout the world, annual losses caused by rice blast are estimated to be sufficient to feed more than 60 million people (Flores 2008). Rice blast has been identified in over 85 countries and can affect rice at several stages of development (from seed through maturity) (Flores 2008). Like most fungi, warm and humid conditions are favorable for the development of the disease[5].

The disease can be managed through a combination of different cultural techniques and appropriate fertilizer's and fungicide's uses. Chemicals such as Quadris® and Quilt® are available on the US market to fight rice blast (Nalley, Anders, Kovacs and Lindquist 2014) but the frequent use of these is not recommended because this results in the emergence of resistant populations of the pathogen (Norton, Heong, Johnson and Savary 2010). Thus, none of these techniques is entirely satisfactory. They are expensive (in the US, they can cost up to $20.87 per acre) and cannot be implemented in a sustainable way (Nalley and Lee 2009). In addition, the fungus responsible for rice blast can quickly mutate making it difficult to breed resistant varieties: in fact, on average it takes between 8 and 12 years from the initial cross for a new cultivar to reach the market (Natti 2002). Because resistant genes have been identified in wild

[5] http://www.arkansas-crops.com/2013/06/26/rice-blast-sheath-blight-active-now/

rice varieties (see for example (Imam, Alam, Mandal, Variar, et al. 2014; Ramkumar, Madhav, Rama Devi, Manimaran, et al. 2014), cisgenesis could therefore transfer this resistant gene in a high yield cultivar in just one generation with no genetic drag while conventional breeding takes several generations. In other words, rice, and rice blast specifically, is a very attractive candidate for cisgenic breeding.

Currently, in the US, a large rice cisgenesis program is underway to breed for rice blast resistance. However, before this cisgenic rice can be produced in the US it must ensure that its export markets, such as the EU, will accept rice bred in this manner. The resulting question that remains is both simple and fundamental: will consumers who do not accept transgenic crops be willing to buy and consume cisgenic rice?

C. Worldwide adoption of transgenic crops and controversy: overview of the current situation

In agriculture, GM crops have been commercialized in the US since 1994 with the introduction on the market of the transgenic tomato (*Lycopersicon esculentum)* FlavrSavr and followed quickly with the cultivation of GM soybean[6] (1996) and GM corn[7] (1997). To date, the most common traits in GM crops are herbicide tolerance (such as Round Up Ready®) and insect tolerance (such as *Bacillus thuringiensis* (Bt)) but other GM traits include disease resistance, nutritional value improvement (micro nutrients), yield improvement, and nitrogen utilization

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[6] http://www.gmo-compass.org/eng/grocery_shopping/crops/19.genetically_modified_soybean.html
[7] http://www.gmo-compass.org/eng/grocery_shopping/crops/18.genetically_modified_maize_eu.html

improvement[8]. Total hectares devoted to GM corps have grown over the last 18 years, rising from 1.7 million hectares (4.3 million acres) in 1996 to 170.3 million hectares (420 million acres) in 2012(Clive 2009). Today, 29 countries around the world grow GM crops. The top 5 countries in term of GM crop planted area are US, Brazil, Argentina, Canada, and India, respectively. The top GM crops in order of acreage are soybean, maize, cotton, and canola (rapeseed), respectively (Clive 2009).

Widespread sentiment amongst the scientific community has not been unanimous about the safety of GMOs. Since the early 1990's some scientists have expressed concerns about GMOs, and in particular about the lack of information on the environmental and health long-term effects. Of primary concern to these skeptics are the perceived risks inherent in the technology used to develop and to produce GMOs (potential risk of horizontal gene transfer between GMOs and soil or intestinal bacteria, potential risk of allergic reaction, etc.). Second, certain scientists warn about the potential drawbacks of GMOs such as with herbicide tolerant cultivars and new resistant weeds which can develop and lead to a resistant weed population (Gilbert 2013). Furthermore, on a social point of view, an ethical debate has sprung with the development of genetic engineering. Consumers view the GM product has unnatural and interrogate the ethic of life's manipulation in laboratory (Bennett, Chi-Ham, Barrows, Sexton, et al. 2013; Haperen, Gremmen and Jacobs 2012).

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[8] http://www.gmo-compass.org/eng/agri_biotechnology/gmo_planting/145.gmo_cultivation_trait_statistics.html

D. General context of GM crops perception and regulation

US acceptance and EU rejection

The differing opinions within the scientific community about the safety of GMOs has led to diverging approaches on regulations (approving, growing and labeling) on GMOs around the world. On the one hand, the EU has implemented a stringent legislation based on the precautionary principle. On the other hand, the US has a considerably more flexible approach towards GMOs, and as such the US has become the largest producer of GM crops globally. In 2011, the US accounted for a total of 69.5 million hectares of GM crops out of a total worldwide of approximately 160 million hectares (Clive 2009); and in 2012, 88%, 94% and 93% of corn, cotton, and soybean respectively, planted in the US were GM crops[9].

The divergences between the EU and the US' views on GM crops and their impact on trade

In 2013, the US exported over 11 billion dollars of agricultural products to the EU[10] and therefore any difference or change in GMOs legislation between the EU and the US can cause trade disputes and can have trickle down effects on research on some GM crops, mainly rice and wheat in the US. Interestingly both sides claim to have facts based off scientific knowledge but come to different safety conclusions in regards to GMOs. In May 2003, the US, supported by

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[9] http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx#.U9JjWxYnJg0
[10] http://www.ustr.gov/countries-regions/europe-middle-east/europe/european-union

Canada and Argentina and a series of other countries[11], filed a complaint under the auspices of the WTO against the EU concerning the EU authorization regime for GMOs. The US claimed that the European position towards GMO affected food imports from the US[12]. The issue culminated in August 2006, when some traces of the GM rice LLRICE601 were found in several samples of rice exported from the US. Liberty Link® or LL is an herbicide resistant trait commonly found in maize, soya, cotton and canola but is not approved for commercial rice production.[13] Despite the United States Department of Agriculture (USDA) and the Food and Drug Administration (FDA) claims that LLRICE601 did not affect environmental and health safety of the American rice supply, the worldwide reaction was immediate and prices of US rice fell as Japan and South Korea quickly halted all imports of US long-grain rice, while the EU, a major market, imposed a screening procedure to verify that US rice imports were exempted of LLRICE601. Bayer® (the manufacturer of Liberty Link) agreed to pay U.S. rice producers $750 million in economic damages to settle actions over the contamination of the nation's rice by Bayer's experimental and at that time, unapproved GM Liberty Link rice (Bomgardner 2011). This example illustrates the radical effects of the "zero tolerance" policy towards GMOs of the EU, which was, in 2011, the largest importer of food and drink products in the world (FoodDrinkEurope 2012).

One of the loudest arguments in favor of GMOs is that it allows for quicker scientific progress

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[11] Australia; Brazil; Chile; China; Taiwan; Colombia; El Salvador; Honduras; Mexico; New Zealand; Norway; Paraguay; Peru; Thailand; Uruguay

[12] http://europa.eu/rapid/press-release_IP-10-325_en.htm

[13] It is important to note that this trait was not spread from corn/cotton/soya/canola to rice via pollination but rather was on a test plot where LL rice was being analyzed for potential release.

that could help feeding the rising global population. The reluctance to accept GMOs can slow down the research and development of new biotechnologies by the public sector as well as create a disincentive for private companies.

E. Scope and purpose of the study

This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2013-68004-20378 from the USDA National Institute of Food and Agriculture and aims to analyze European consumers' attitudes towards cisgenic rice and to assess consumers' WTP for cisgenically bred products. To date, the literature is deep on consumers' acceptance of transgenic foods but is sparse on consumers' preferences and WTP for cisgenic commodities. Several important questions surround the future of agricultural products which are cisgenically bred in the US. First, do consumers view cisgenic and transgenic products differently or do they classify them as both GMOs? Second, given additional information about cisgenesis such as the fact that can provide positive environmental benefits, would consumers alter their acceptance of cisgenic products? Lastly, if European consumers do view cisgenesis differently than transgenesis but also differently than traditional breeding, what would the premium/discount be for cisgenic vs. conventional food products?

Thus, the objectives of this study are the following:

1) To estimate the consumers' WTP for cisgenic rice in Europe in order to elicit consumer acceptance for cisgenic technology;

2) To assess if there is a statistically significant difference in European consumers' attitudes between cisgenic and transgenic rice; and

3) To determine if consumers are willing to pay a premium for a rice cultivar labeled as cisgenic if it possesses an environmental benefit which conventional rice does not.

F. Organization of the study

The following chapter is a review of the existing literature on cisgenic products and cisgenic breeding, on consumers' acceptance for cisgenic products and discusses the current European legislation for cisgenic agricultural goods. Chapter three displays the material and methods used to obtain the data and the econometric models used to analyze the data. Chapter four explores, interprets and discusses the results of the study. Finally, chapter five highlights the main findings of the study, discusses their utility for policy makers, for the industry, and for producers in and outside the EU and develops recommendations for further research.

Literature Review

A. Cisgenesis: An alternative to transgenesis, but still a GMO

"GMOs are organisms, such as flora and fauna, whose genetic characteristics are artificially modified in order to give them a new property"[14]. More precisely, a GMO is an organism in which one or several genes of interest have been added/replaced to its genome[15]. With the development of the new breeding techniques and enhancement of existing techniques, a further distinction between different types of GMOs can be made on the basis of the origin of the inserted gene. Currently there are three main classifications of GMOs:

1) **Transgenic organisms**: A transgenic organism is an organism in which one or more genes have been inserted. The inserted genes come from a non-plant (in the case of rice) organism, such as bacteria, or from non-sexually compatible organism with the recipient organism.
2) **Intragenesis**: An intragenic plant is a plant that has been modified only with genetic material derived from the species itself or sexually compatible species. In addition, this genetic material can be transformed to create new gene combination by "in vitro rearrangements" (Holme, Wendt and Holm 2013, p. 395).
3) **Cisgenic organisms**: The term "cisgenic plant" was introduced internationally in 2006 by Shouten, Henk and Jacobsen and defined as "a crop plant that has been genetically

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[14] http://ec.europa.eu/food/food/biotechnology/index_en.htm

[15] The genome refers to the genetic material of a species, i.e its DNA and includes the coding sequences and the non-coding DNA sequences.

modified with one or more genes (containing introns and flanking regions such as native promoter and terminator regions in a sense orientation) isolated from a crossable donor plant"[16] (Schouten, Krens and Jacobsen 2006, p. 750). Thus, as for intragenesis, cisgenesis refers to the genetic modification of an existing cultivar using only genes from a sexually compatible organism (cisgenes). In the case of cisgenic breeding, the cisgenes are natural gene that have not been modified and that could also be transferred by traditional breeding techniques. The cisgenes are therefore genes that have already been present in the species or in crossable relatives for centuries and therefore, cisgenic breeding does not add an extra trait to the species genome. Another characteristic of cisgenic product is that the final product should be exempt of alien DNA such as marker genes or any other vector-backbone genes (Telem, Wani, Singh, Nandini, et al. 2013).

Compared to conventional plant breeding, the main advantage of cisgenesis resides in its ability to modify a plant faster and more precisely an existing cultivar without any potential problem of linkage drag (Telem, Wani, Singh, Nandini, et al. 2013). The linkage drag refers to the fact that in a species' genome, the gene of breeding/transfer interest might be tied to other unwanted and sometimes deleterious genes and the transfer of the gene of interest is often non achievable without being accompanied with the transfer of these unwanted genes. A way to avoid linkage drag is to have recourse to successive generations of recurrent backcrossing with the cultivated plant which can require a long period of time to isolate the desired gene/trait. Cisgenic breeding

[16] It is important to note that, over the last 10 years, several authors have defined 'cisgenesis' differently (see (Holme, Wendt and Holm 2013, p. 395)). In this study, we used the definition provided by Schouten, Henk and Jacobsen (2006b).

also proves to be useful in order to increase or to reduce the expression level of a trait that has limited allelic variation within the sexually compatible gene pool (Schouten, Krens and Jacobsen 2006b).

However, some scientists have pointed out several drawbacks and risks associated with cisgenesis. First, a "position effect" might occur because the gene is introduced as an extra copy and at a random position in the genome resulting in variability in expression of the inserted gene (Schaart and Visser 2009). In addition, this random insertion of one or more genes in the genome is also susceptible to affect the expression of the genes located close to the insertion site (de Cock Buning, Lammerts van Bueren, Haring, de Vriend, et al. 2006). Russell and Sparrow (2008) also highlighted that, contrary to what Schouten, Krens and Jacobsen (2006b) argued, cisgenic breeding may still result in adding novel traits to the cisgenic product and therefore give rise to novel hazards.

There are multiple potential applications of cisgenesis, but one of the most attractive features of cisgenesis is the ability to quickly introduce a resistance gene (to biotic or abiotic stresses) isolated from a wild cultivar into a commercial cultivar. More precisely, cisgenic breeding is a particularly efficient method to improve plants with a long reproduction cycle for which the conventional breeding can be extremely long (Schaart and Visser 2009). Since 2008, the literature has identified only a few cisgenic products such as cisgenic apples, cisgenic potatoes, cisgenic barley, with more currently under development.[17]

The development of cisgenesis is perceived by some as an alternative to transgenesis and could therefore alleviate some of the issues regarding the use of biotechnology in the European Union. However, the potential adoption of cisgenic by agricultural producers in the field is highly dependent on the consumers' acceptance for this new breeding technique and on the legal status and labeling requirements of cisgenic plants and products.

B. Consumer Acceptance for Cisgenic Food Products in Europe

Previous studies have shown that European consumers are highly averse to GM foods consumption. Among these studies, the Eurobarometer reports of the European Commission show the evolution of consumers' attitudes towards biotechnology (including GM food) in the EU. The results of these different surveys (1991, 1993, 1996, 1999, 2002, 2005 and 2010) suggest that European consumers' opinion on GM food has evolved in such a way that they became more averse to GM products over time. In fact, in 1991, 74% of the respondents agreed (tend to agree or totally agree) that genetic engineering' research on plants is worthwhile and should be encouraged (International Research Associates (INRA) 1991). Five years later, in

[17] In their article "Intragenesis and cisgenesis as alternatives to transgenic crop development", Holme, Wendt and Holm (2013) have listed the following cisgenic varieties: a cisgenic apple developed by Vanblaere et al. (2011), a potato with late blight resistance developed by Haverkort et al. (2009), a grapevine with Fungal disease resistance developed by Dhekney et al., (2011), a poplar cultivar with different growth types developed by Han et al., (2011), a barley with improved grain phytase activity developed by Holme et al., (2012), and a Durum wheat with improved baking quality developed by Gadaleta et al., (2008).

1996, 69% of the respondents declared that "taking genes from plant species and transferring them into crop plants to make them more resistant to insect pests" is beneficial to society and only 48% of them agreed that it involves risks for society. In addition, 62% agreed that it is morally acceptable and 58% agree that it should be encouraged (European Commission 1996).

By contrast, in 2005 a minority of 27% of the respondents was supporting GM food. In addition, respondents of the survey viewed GM food as risky, not useful and not morally acceptable and a majority of them disagree with the idea that the development of GM food should be encouraged (Gaskell, Stares, Allansdottir, Allum, et al. 2006). Results in the latest report published in 2010 confirm this negative attitude. While 70% of the respondents agree that GM food is fundamentally unnatural, only 23% agree that the development of GM food should be encouraged (European Commission 2010).

On the other hand, Knight, Mather, Holdsworth and Ermen (2007) reported that European consumers were actually wiling to consume GM food if the product was both cheaper and provided an environmental benefit (spray-free fruits).

Consistent through all studies is that European consumers' attitude towards GM food differs across member countries. As an example, in the Eurobarometer survey conducted in 2010, the percentage of respondents who agree that the development of GM food should be encouraged ranges from 10% in Greece, Bulgaria and Lithuania to 36% in Czech Republic (European Commission 2010).

Myskja (2006) emphasizes that one of the main concerns related to transgenic food products is linked to the concept of naturalness and the fact that transgenic food product are seen as "unnatural" by European consumers. Thus, it has been widely assumed in the literature that European consumers will accept cisgenic food products at a higher rate than transgenic food products (Nielsen 2003; Myskja 2006). Although few studies have been conducted so far to test this assumption and assess consumers' WTP for cisgenic food products, Mielby, Sandoe and Lassen (2013) revealed that consumers consider cisgenic products as more natural and therefore more acceptable than transgenic similar products. However, this holds true only when consumers assess the naturalness of a product on a "substance-based" argument, i.e. a product is perceived as natural if the latter does not cross species borders. On the contrary, some consumers consider cisgenic and transgenic products as equally unnatural because they both require human intervention to be developed (history-based argument). In a study conducted in Japan and Austria, Kronberger, Wagner and Nagata (2014) concluded that consumers view cross-species gene transfers more negatively. In addition, they observed that consumers in Austria and in Japan have a more negative attitude when they are familiar with the method of genetic modification. In addition, based on a statistical analysis of the data provided by the last Eurobarometer (European Commission 2010), they conclude that European consumers view a cisgenic product as more natural because the breeding process involves genes from the same species compared to a transgenic product in which borders species are crossed. However, both cisgenic and transgenic products remain perceived as unnatural by a majority of respondents (Kronberger, Wagner and Nagata 2014).

The 2010 Eurobarometer survey analyzed the perceptions of the respondents on the naturalness of cisgenic and transgenic crops. The results show that a smaller proportion (but still a majority) of respondents either agree or tend to agree that cisgenic crops are fundamentally unnatural (52%) compared to 72% for transgenic crops (Gaskell, Stares, Allansdottir, Allum, et al. 2010).

As highlighted above, the literature about consumers' attitudes towards cisgenesis is still sparse and at present little is known about consumers WTP for cisgenic food products and if consumers differentiate cisgenesis from transgenesis.

C. Current European Regulation of Cisgenic Food Products

Current EU policy on Cisgenesis

Currently, cisgenic products are not subject to any specific labeling regulations in the European Union. However, they fall under the scope of the GMO legislation, as this legislation applies to "*any organism*[18]*, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination*"[19]. However, the EU regulations relating to GMOs do not apply to organisms obtained through certain techniques of genetic modification which have conventionally been used in a number of applications and have a long safety record, such as mutagenesis. [20]

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[18] An organism is defined as "*any biological entity capable of replication or of transferring genetic material*".

[19] Article 2 (2) of Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC

[20] A list of the techniques that do not fall under the scope of the GMO regulation can be found

The European legislation relating to GMOs is based on the precautionary principle and includes one directive, three regulations and several guidelines from the European Commission[21]. The authorization process for the commercialization and the cultivation of GMOs is complex and involves all Member States. The process is costly, time-consuming and difficult. The European Food Safety Authority (EFSA) is responsible for the risk assessment of each application.

Once a GMO has been approved by the EU and admitted for commercialization, the authorization remains valid for a period of 10 years and Member States may in principle not prohibit, restrict or impede the commercialization of the relevant GMO, as or in products, in their territory. However, the Directive 2001/18/EC includes a 'safeguard clause' according to which a Member State may provisionally restrict or prohibit the use and/or sale of a GMO as or in a product on its territory if such Member State "*has detailed grounds for considering that a GMO as or in a product which has been properly notified and has received written consent under this Directive constitutes a risk to human health or the environment*" and if "*new or*

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in the Annex 1A of Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC.

[21] Directives, regulations and guidelines are three instruments of European law. The main difference between a directive and a regulation is that the former must be transposed into each of the Member States' national legislation, and may therefore give some flexibility to the Member States whereas the latter is immediately applicable without any further action from the Member States being required. Guidelines are non-binding recommendations usually issued by the European Commission which aim, as their name indicates, at providing guidance on the interpretation of certain rules contained in directives and regulations. They give additional clarification on certain matters covered by these instruments.

additional information made available since the date of the consent affects the environmental risk assessment or reassessment of existing information on the basis of new or additional scientific knowledge". The safeguard clause has been invoked on nine separate occasions to ban GMOs which had been authorized pursuant to Directive 2001/18/EC and six Member States are currently applying safeguard clauses to ban the cultivation of GM maize (MON810) on their territory: Austria, France, Greece, Hungary, Germany and Luxembourg[22].

The approval process is long and costly and as such only 49 GMOs are currently authorized for food and feed uses in the EU and only one GMO is presently commercially grown in Europe, Spain: maize (MON810)[23]. In 2012, five European countries (Spain, Portugal, Czech Republic, Romania, and Slovakia) were producing GM maize for a total of 318,941.39 acres (129,071 hectares) of biotech maize. Spain has the most acres in production with 287,400.86 acres (116,307 hectares) of MON810 maize[24](Clive 2009) . On February 12, 2014 and after more than 12 years of waiting, the European Commission has approved a new GM maize cultivar: maize TC1507 (a DuPont Pioneer product). The authorization has been granted due to the lack of a qualified opposing majority at the Council and despite the fact that 19 Members States (out of 28) were against the approval.

Regarding the labeling requirements in the EU, Regulation (EC) No 1830/2003 relates to the "Traceability and labeling of genetically modified organisms and the traceability of food and

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[22] http://ec.europa.eu/food/food/biotechnology/gmo_ban_cultivation_en.htm
[23] http://ec.europa.eu/food/dyna/gm_register/index_en.cfm
[24] MON810 maize is a GM maize that produces Bt toxin and have insect resistance.

feed products produced from genetically modified organisms". It applies to all products, including food and feed, containing or consisting of GMOs, which have been authorized for the placing on the market in the EU. In substance, the regulation obliges the persons/companies who place a product on the market or receive a product placed on the market within the EU to be able to identify their supplier and the companies to which the products have been supplied. In addition, it provides that any product consisting of or containing more than 0.9% of GMOs must be labeled with the words: "*This product contains genetically modified organisms*".

Regulation EC 619/2011 addresses 'The zero-tolerance policy on non-authorized genetically modified (GM) material in feed' and sets up the maximum level of non-authorized GM traces to the lowest detectable amount; i.e. to the level of 0.1 %.

It is important to note that GMO regulations have been under review at the European level since 2010[25] and that a political agreement has been reached on June 12, 2014 towards giving more possibilities to Member States to ban or restrict GMO cultivation within their borders. Under the proposed new regulations, Member States would be allowed to ban or restrict cultivation of a GMO in their country, even if it has been authorized at the European level, on grounds as various as environmental or agricultural policy objectives, town and country planning, land use, socio-economic impacts, avoidance of GMO presence in other products, or public policy[26]. Most

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[25] Proposal for a regulation of the European Parliament and of the Council amending Directive 2001/18/EC as regards the possibility for the Member States to restrict or prohibit the cultivation of GMOs in their territory, COM(2010) 380.

[26] Whereas under current regulations, Member States may only restrict or ban the cultivation

commentators expect that this new regulation will facilitate the authorization process at European level. The Member States that are opposed to the cultivation of a GMO will indeed have no incentive to block the process at European level, as they will be allowed to ban a GMO from their territory much more easily than under the current regulations[27] [28]. On the other hand, some people argue that the new regulations will weaken single market principles and will increase the lobby and pressure of large biotech companies on national authorities (Schimpf 2014). Provided that the council's proposal receives a majority of favorable votes in the European Parliament, the new regulation should be adopted in 2015.

Regulating Cisgenic Products: Are all GMOs the Same?

The future of global cisgenic acreage relies somewhat on its legal status in the EU and the EU Commission has been called out on several occasions by scientists, industries and by the European Parliament to adapt the EU legislation to the new breeding techniques. In 2006, Schouten, Krens and Jacobsen in their articles "Do cisgenic plants warrant less stringent oversight?" published in Nature Biotechnology and "Cisgenic plants are similar to traditionally bred plants", argued that cisgenic plants should be exempt from the GM legislation and urged the European Commission to adapt the current legislation to fit the specificity of cisgenesis. According to them, cisgenic products should be treated as conventional products. Their main

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of a GMO on their territory where new serious risks to human health, animal health and the environment are identified after the GMO has been authorized at European level.

[27] http://www.leobrincat.com/viewer.aspx?id=831

[28] http://www.wort.lu/en/politics/eu-environment-council-luxembourg-warns-against-new-gmo-agreement-539b0e6ab9b3988708035ef5

arguments are that, compared to transgenesis, cisgenesis does not extend the gene pool of the recipient organism and therefore does not add any extra trait. They argue that one of the main concern of transgenesis is related to this “added extra trait” that could possibly lead to a change in the fitness of the plant and be transferred from the GM plant to wild varieties resulting in a change in the natural vegetation. They also argue that compared to traditional breeding, cisgenesis does not carry any extra risk and

> “does not invoke a fitness change that could not also occur through traditional breeding or in nature”

and should therefore be differentiated from transgenesis (Schouten, Krens and Jacobsen 2006b, p. 750). They also suggest that

> “cisgenic plant should be tested to confirm that they contain only the intended modifications and no foreign genes, such as a backbone gene from a plasmid. If such a foreign gene is unintentionally introduced, the plant is, by definition, transgenic” (Schouten, Krens and Jacobsen 2006b, p. 753).

On the other side and as a reaction to the proposition of Schouten, Krens and Jacobsen (2006a, 2006b), several scientists, in a correspondence published in Nature Biotechnology, have raised their voice and pointed out several drawbacks of Schouten, Krens and Jacobsen argumentation. The main critic concerns the environmental risk carried by cisgenesis. According to de Cock Buning, Lammerts van Bueren, Haring, de Vriend, et al. (2006) and Giddings (2006), environmental risks depend on phenotypical changes, not the origins of the inserted genes. Schubert and Williams (2006) also rebutted the argument that normal plant breeding also entails mutagenic processes, stating that the genetic alterations occurring naturally are

> “very rare, and subject to long-term natural selection, human selection and safe food” (Schubert and Williams 2006, p. 1327).

It was also suggested that a lack of regulation for cisgenic products could cause a hostile reaction from the public, which would have long-term costly consequences (Russell and Sparrow 2008).

The discussion was reignited when the US Environmental Protection Agency proposed in 2011 a draft rule exempting cisgenics from the requirement to be registered before being field-tested or marketed (Reardon 2011). Schubert, an advocate for a more stringent regulation of GMOs, criticized the proposal and called cisgenic products

> “semantics and illusions to scam the public into thinking that they are eating a natural product” (Reardon 2011).

Others claimed that a different regulatory treatment for cisgenic could unfairly challenge the safety of transgenics (Kronberger, Wagner and Nagata 2014).

Between 2009 and early 2011, the Directorate-General for Health and Consumers (European Commission) evaluated the GMO legislation. Among its main findings, the report highlighted the need for an assessment of new plant breeding techniques including cisgenesis (European Commission Directorate General for Health and Consumers 2010). The Commission then called on the EFSA Panel on GMOs to deliver a scientific opinion related to cisgenic and intragenic plants in terms of the risks they might pose and the applicability of the existing guidance documents for their risk assessment. Among other questions, the panel was asked to determine if the new breeding techniques (including cisgenesis) constitute techniques of genetic modification and, if so, whether the resulting organisms fall within the scope of the EU GMO legislation. The final report of the EFSA Panel on Genetically Modified Organisms supports Schouten, Krens and Jacobsen (2006) conclusion that cisgenic products should be treated as conventional products as it concludes that

> "Similar hazards can be associated with cisgenic and conventionally bred plants, while novel hazards can be associated with intragenic and transgenic plants" (EFSA Panel on Genetically Modified Organisms (GMO) 2012, p. 33).

The Panel however added

> "all of these breeding methods can produce variable frequencies and severities of unintended effects. The frequency of unintended changes may differ between breeding techniques and their occurrence cannot be predicted and needs to be assessed case by case" (EFSA Panel on Genetically Modified Organisms (GMO) 2012, p.1).

More recently, in its report on the "Future of Europe's horticulture sector – strategies for growth" adopted in March 2014, the European Parliament

> "calls on the Commission to differentiate between cisgenic and transgenic plants and to create a different approvals process for cisgenic plants; awaits the EFSA opinion demanded by DG Sanco evaluating the findings of the working group of new biotech breeding techniques[29] » (McIntyre 2013).

[29] The draft report was even more favorable to cisgenic products as it was drafted as follows: "*calls on the Commission to differentiate between cisgenic and transgenic plants and to create a different approvals process for cisgenic plants so as to recognise that cisgenesis is an extension of plant breeding and not a form of genetic modification"* but this wording has been

The EU is currently studying existing GMOs regulations and examining how cisgenic products should be treated. These issues are critical for the future of cisgenic products and regulators around the world should carefully consider the consequences of the standards they shall adopt. What appears to be evident is that the EU is now aware that cisgenesis may need to be treated differently than transgenesis in terms of regulation and labeling. What is not as clear is if European consumers will make the same distinction in their purchasing habits if cisgenesis becomes available to purchase.

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amended during the discussions in the European Parliament. This amendment shows that the treatment of cisgenic products remains a very sensitive issue in the European Union.

Material And Methods

A. Experimental Design

Given the uncertain nature of labeling requirements for cisgenic products in the EU, this study explores possible labeling options the EU could implement and the resulting WTP under each scenario. In addition, this study analyses consumers' attitudes towards GM, cisgenic and transgenic rice. If consumers view cisgenesis and transgenesis equally then separate labeling requirements for cisgenic products could be a fruitless effort. However, if consumers view cisgenic products as a different type of GMO then segmenting markets could beneficial to both producers and consumers.

Survey design

A survey was designed to elicit information on i) EU consumers' WTP for cisgenic rice, ii) consumers' attitudes towards cisgenic, transgenic and GM rice, iii) consumption habits, and iv) demographics. The questionnaire was divided into five parts. The complete survey can be found in Appendix 1.

Part I: Introduction

Part I included information about the survey itself (description, risks and benefits, confidentiality, voluntary participation, right to withdraw at any time, etc.). In an attempt to mitigate the risk of the so-called hypothetical bias, which can be common in hypothetical surveys or polls, a cheap talk script was included in the introduction of the survey. The "hypothetical bias" refers to potential erroneous WTP amounts (often times inflated) that result from the fact that respondents are not confronted with an actual purchase situation but merely with a hypothetical decision. Studies have shown that participants in a hypothetical survey tend to state higher WTP than when faced with actual decisions (Harrison and Rutstrom 2008). In order to reduce that hypothetical bias, “cheap talk” can be incorporated at the beginning of a survey (Lusk 2003) which informs respondents about this potential bias, and invites them expressly to avoid it.

Part II: Estimation of the WTP with a Multiple Price List format

The second part of the questionnaire was designed to collect consumer responses that would reveal their actual WTP for a 2.25 kg (approximately 5 pounds) bag of rice under different information sets. This was based upon the multiple price list (MPL) format described by Anderson, Harrison, Lau and Rutstrom (2006). The MPL format can be used to estimate the WTP for commodities or products, as well as to elicit risk attitudes and individual discount rate. In WTP elicitation studies, the MPL format can be designed in two ways. In the first method, respondents are asked to make a series of consecutive choices between two alternatives, and the values of at least one choice vary from one alternative to the other. For example, the values of Option 1 stay constant, while the values of Option 2 decrease from one choice set to the other. In the second design, respondents are presented with an array of ordered prices in a table, one per row, and are asked if they would buy certain product (“yes” or “no”) (Anderson, Harrison, Lau and Rutstrom 2007). In this study, the first methodology was chosen and respondents were presented a series of dichotomous choices and asked to choose one of the two options.

One of the main benefits of the MPL is that it is easy to implement and easy for participants to understand. Anderson, Harrison, Lau and Rutstrom (2006) have however pointed out three distinct drawbacks of the MPL. First, the MPL only estimates intervals instead of 'point' valuations. In other words, it is a way to test respondents' reaction to a certain price range but it does not show what price respondents are precisely and actually willing to pay. Secondly, the MPL is subject to framing effects - if the different rows of the table are presented to the respondents all at once, respondents are likely to pick the middle value of the ordered table irrespective of the consumer's true intentions. Thirdly, the MPL format is prone to a 'switching behavior' if all the MPL questions are presented to the respondents at once (Bruner 2011), as respondents can "switch back and forth from row to row, implying potentially inconsistent preferences" (Anderson, Harrison, Lau and Rutstrom 2007, p. 675). In our survey, framing effects and switching behavior were avoided by presenting the MPL questions to the respondent one by one, not all at once, and with no possibility to go back and change the response to a previously answered question in the survey.

Respondents were asked to choose between a 2.25 kg bag of a conventionally bred rice variety and an alternative rice variety (described under different information sets), presented as Variety A. The price of alternative/baseline rice variety was constant and equal to €2.25 for a 2.25 kg bag of rice, while the price of the conventional variety decreased from €50 to €0.5 with intermediate values at €20, €15, €10, €8, €5, €3, €2.25 and €2.

All respondents were required to answer three rounds of questions. In each round, respondents were presented additional information about the alternative rice variety. In the first round the alternative rice variety (Variety A) was presented as either i) cisgenic, or ii) GM or iii) as a variety with environmental benefits (defined as using less fungicide to produce). Thus respondents received one type of information (either on cisgenic, GM or environmental benefits) in the first round. In the second round, two out of the three attributes of the alternative rice were presented to the respondents and thus, they received additional information on top of the first round. In the third round everyone received the full information on all three characteristics: GM, cisgenic, and the associated environmental benefits. These three attributes describing the Variety A were provided to the respondents in different order, resulting in six possible treatments depending on the sequence in which the three types of information are given. Respondents were randomly assigned to one of the six treatments. For each country, an equal number of respondents were assigned to each treatment. Table 1 illustrates these six different possible information orders, depending on the sequence in which the three types of information are given.

Table 1: Random ordering of Information Treatments for Variety A

Random Treatment	**Choice Set 1**	**Choice Set 2**	**Choice Set 3**
1	Cisgenic	GM Cisgenic	GM Cisgenic Environmental
2	Cisgenic	Cisgenic Environmental	GM Cisgenic Environmental
3	GM	GM Cisgenic	GM Cisgenic Environmental
4	GM	GM Environmental	GM Cisgenic Environmental
5	Environmental	GM Environmental	GM Cisgenic Environmental
6	Environmental	Cisgenic Environmental	GM Cisgenic Environmental

The cisgenic information presented to the participant about Variety A was described as followed:

> "Cisgenic rice is bred using a process in which genes are transferred between crossable organisms (same species or closely related species). The same result could be obtained by cross-breeding that occurs in nature or by traditional breeding methods but it would

require a longer time frame."

When consumers were presented Variety A as having environmental benefits, Variety A was described as followed:

> "New breeding techniques can result in a rice variety that is resistant to rice blast disease and that would not require fungicide sprays. Rice blast is a disease that decreases yields and increases Greenhouse Gas emissions because of the fungicide sprays that are required to treat the disease. The variety A would not require fungicide applications."

Finally, no additional information was given with respect to the GM attribute except it was a GM product. Table 2 shows, by way of example, how questions were presented to the participants in round 1. In Table 2, Variety A is defined to the participant as cisgenic with the description showed above. The same choices were repeated with decreasing prices for the conventional variety (€ 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5) until the conventional variety was chosen.

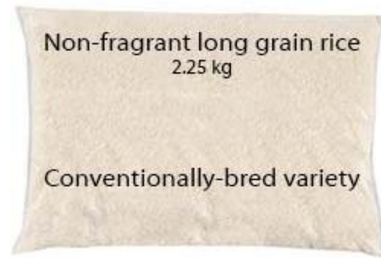
Table 2: Survey Round 1: Example where the cisgenic rice variety is presented as the alternative rice

Cisgenic Rice is bred using a process in which genes are transferred between crossable organisms (same species or closely related species). The same result could be obtained by cross-breeding that occurs in nature or by traditional breeding methods but it would require a longer time frame. In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices: (1) a Cisgenic rice variety (2) a Conventionally-bred rice variety

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag.
Indicate your preferences between two rice varieties at the indicated prices:

(1) a Cisgenic rice variety
(2) a Conventionally-bred rice variety

Cisgenic variety
€2.25



Conventional variety
€50.00

Part III: Rice consumption and purchasing habits

This part included questions about rice consumption and food purchasing habits, willingness to consume GM or cisgenic food products, and questions relating to the rationale for consuming or not consuming GM products.

Part IV: Opinions towards GM, transgenic and cisgenic rice

The fourth part focused on respondents' opinions about GM, cisgenic and transgenic rice. Eight statements were presented to respondents who were asked to state how much they agreed or disagreed with each statement. A 5-point Likert scale was developed and used to measure the level of agreement with the proposed statements (Totally disagree, Tend to disagree, Don't know, Tend to agree, Totally agree). The eight statements were presented successively for GM, cisgenic and transgenic rice resulting in 24 propositions. Seven out of the eight proposed statements were previously used by the Eurobarometer report of the European Commission (EC, 2010). Table 3 shows the eight statements used in the survey, the statements highlighted in bold are the statements used previously in the Eurobarometer report.

Table 3: Statements used to assess consumers' attitudes towards GM cisgenic and transgenic rice

1. ***GM / Cisgenic / Transgenic rice is good for the national economy***
2. ***GM / Cisgenic / Transgenic rice helps people in developing countries***
3. ***GM / Cisgenic / Transgenic rice is safe for future generations***
4. ***GM / Cisgenic / Transgenic rice is fundamentally unnatural***
5. ***GM / Cisgenic / Transgenic rice is safe for my health and my family's health***
6. ***GM / Cisgenic / Transgenic rice does no harm to the environment***
7. ***The development of GM / Cisgenic / Transgenic rice should be encouraged***
8. *I am in favor of allowing GM / Cisgenic / Transgenic rice to be sold in my country*

Part V: Demographics

The fifth part of the survey included questions about the demographic characteristics of the participants (age, gender, living environment, annual net income, household composition and education level).

Data collection

The original survey was designed in English and translated into French, Dutch/Flemish and Spanish and the survey was pre-tested in each language by native speakers. The marketing company Survey Sampling International (SSI) conducted the survey in five European countries: Belgium, The Netherlands, Spain, the United Kingdom and France. The sample was balanced on age and gender and is therefore not meant to be representative of the education level of the population, its income level and other demographics. The same multilingual questionnaire was sent to all respondents so that respondents could choose their preferred language for the survey.

The survey was administered in November 2013, and the complete dataset was obtained within a week. Participants took approximately 20 minutes to complete the survey.

Sample

In total, 3002 participants completed the survey. The target number of respondents per country was determined on the basis of the available budget and SSI's ability to obtain respondents. Table 4 shows the target number for each country and the total number of surveys completed for each country.

Table 4: Target number and number of surveys completed per country and in total

	Belgium	France	Netherlands	Spain	United Kingdom	Total
Target #	500	750	600	400	750	3,000
#	500	750	602	399	751	3,002

Table 5 shows the socioeconomic characteristics of the sub-sample by country and for the total sample. Women were slightly overrepresented with 54.3% of the total number of respondents. Female participations rates ranged from 49.8% in Belgium to 58.9% of in France. The sample was relatively highly educated (31.5% of respondents held a master degree or a Ph.D.). The overrepresentation of highly educated people in the sample is particularly evident in Spain, where 63.9% of the respondents held an undergraduate degree, whereas only 30.7% of the Spanish population holds such a degree according to the Organisation for Economic Co-operation and Development (OECD 2014).

Respondents were distributed almost evenly among the five age categories (less than 30 years old, between 30 and 39 years old, between 40 and 49 years old, between 50 and 59 years old and

60 years old and more). The household composition revealed that 20.1% of all respondents lived alone and that the household composition varied substantially across countries with only 6.5% of the respondents living alone in Spain whereas 26.6% of the respondents claimed to live alone in the UK. This important variation in household composition was also observed with regard to the presence of a child (or more) less than 7 years old in the household: on average 14.2% of the respondents had one (or more) child less than 7 in their household and with country level values ranging from 8.6% in Belgium to 18.3% in Spain.

Table 5: Socioeconomic Characteristics by country (%)[30]

	Country					
	Belgium (N=500)	France (N=750)	Netherlands (N=602)	Spain (N=399)	United Kingdom (N=751)	Total sample (N=3002)
Gender						
Male	50.2	41.1	44.7	46.4	47.9	45.7
Female	49.8	58.9	55.3	53.6	52.1	54.3
Education						
High school or less	49.0	47.2	33.9	36.1	35.8	40.5
Undergraduate [a]	23.8	21.3	45.3	18.3	28.9	28.1
Master degree or PhD	27.2	31.5	20.8	45.6	35.3	31.5
Living environment						
Very rural	10.8	12.4	9.1	3.0	7.1	8.9
Somewhat rural	36.2	29.1	23.4	16.3	24.4	26.3
Suburban	23.0	14.5	21.5	8.8	35.1	21.8
Somewhat urban	17.2	25.3	24.9	23.1	18.0	21.8
Very urban	12.8	18.7	20.9	48.9	15.4	21.4
Net household income [b c]						
Less than €18 000	23.2	25.6	28.4	30.6	25.8	26.5
€18 000 to €34 999	44.2	42.7	37.0	42.4	35.3	39.9
€35 000 to €49 999	20.8	19.1	20.1	16.0	19.0	19.2
€50 000 and more	11.8	12.7	14.5	11.0	19.8	14.5

[30] All results are presented in percent save for the mean age that is presented in years.

[a] This education category encompasses respondents who have obtained degree equivalent to 3 or 4 years of additional studies after the completion of high school.

[b] In the United Kingdom, all monetary units were presented in equivalent €.

[c] Net income represents the income after taxes.

Table 5 (Cont.): Socioeconomic Characteristics by country (%)[31]

	Country					Total sample (N=3002)
	Belgium (N=500)	France (N=750)	Netherlands (N=602)	Spain (N=399)	United Kingdom (N=751)	
Age						
Less than 30 years old	22.4	19.9	30.6	31.8	21.3	24.4
Between 30 and 39 years old	10.6	19.7	11.0	28.3	19.0	17.4
Between 40 and 49 years old	18.6	26.4	16.9	25.6	22.0	22.0
Between 50 and 59 years old	21.6	20.3	20.1	11.0	20.2	19.2
60 years old or more	26.8	13.7	21.4	3.3	17.4	17.0
Household composition						
Respondent lives alone	20.8	21.6	24.9	6.5	26.6	20.1
One or more children aged	8.6	16.0	11.6	18.3	16.0	14.2

[31] All results are presented in percent save for the mean age that is presented in years.

B. Empirical Models

Descriptive statistics

The first part of the empirical findings analyzes European consumers' attitudes towards GM, cisgenic and transgenic rice, opinions on labeling requirement, willingness-to-consume GM and cisgenic food products and percentage of respondents right and left censored. This part primarily includes frequency tables.

In addition to the frequency tables, the data have been analyzed to determine whether respondents have different opinions towards cisgenic and transgenic rice. The methodology used was as follows: for each respondent and each statement, a score (used in the Likert Scale) was assigned to each respondent on a scale from one to five with regards to their degree of agreement: *1: Totally disagree - 2: Tend to disagree - 3: Don't know - 4: Tend to agree - 5: Totally agree*. Seven out of the eight statements presented to the respondents are "positive" statements about cisgenic or transgenic rice. Thus, the 5-point Likert scale is ordered from the most negative attitude (1=Totally disagree) to the most positive attitude (5=totally agree) with a neutral attitude in the middle (3=Don't know). However, for statement 4 only (Cisgenic/Transgenic rice is fundamentally unnatural) the scale is ordered from the most "positive" attitude to the most "negative" attitude. This particularity of statement 4 has to be taken into account in the analysis and interpretation of the results. A new variable called "Difference in opinions between cisgenic and transgenic rice" was created in the dataset and is equal to the difference in score (on a scale from 1 to 5) between the attitudes towards transgenic rice and cisgenic rice[32]. As such, a two-tailed t-test was performed for each statement in order to determine if the mean of the variable "Difference in opinions between cisgenic and transgenic rice" is statistically different from zero and therefore if respondents have different attitudes towards cisgenic and transgenic rice.

Interval regression model

An interval regression was used to estimate the premium that European consumers are willing to pay for conventional rice to avoid the alternative (GM/Cisgenic/Environmentally friendly) rice. However, these values were not directly observed. For each respondent, the WTP to consume the conventional rice instead of the alternative rice was observed as an interval $[Y_{i1}, Y_{i2}]$ for respondent *i* where $Y_{i1} < Y_{i2}$. Assuming respondents are rational, the actual WTP, Y_i^*, lies in this interval (including the lowest boundary). To determine the impact of hypothesized conditioning variables (regressors) we specify a linear WTP model as:

$$Y_i^* = \beta_0 + \boldsymbol{\beta}_1\, Treatment + \boldsymbol{\beta}_2\, Agecategory + \boldsymbol{\beta}_3\, Childlt\_7 + \boldsymbol{\beta}_4\, Education + \boldsymbol{\beta}_5\, Income + \varepsilon_i \quad (1)$$

where ε_i is normally distributed with a mean zero and variance σ^2. The parameter β_0 is the intercept and, in this model, an estimate of the WTP of a respondent less than 30 years old, with no children less than 7 in its household, with an education equivalent to high school or less and

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[32] *Difference in opinions between cisgenic and transgenic rice = $score_{transgenic}$ - $score_{cisgenic}$*

with an annual net household income less than €18,000 is considered to the be the baseline of comparisons. The five listed variables (Treatment, Agecategory, Childlt_7, Education and Income) are all categorical variables. The **β**j are vectors that represent the deviations from the base level of each of the five categorical variables.

While previous WTP studies have shown that gender significantly affects the WTP and acceptance for genetic technology (Agmon, Fleisher, Zilberman and Heiman 2011), in all the models estimated in this study gender was not significant in any of the five countries, nor were the variables "living environment" and "size of the household". Thus, these variables were not included in the estimated model.

Two regression models have been used to estimate consumers' WTP. In the first model, the variable "*treatment"* indicates the information respondents received (regarding rice Variety A) as well as the order in which information was provided to them. By taking into account the type of information received and the order in which information was provided, respondents were assigned three of 15 different 'treatments' (one treatment for each round). Table 6 shows the 15 different treatment categories.

Table 6: Treatment categories

Treatment	Round	Information
1	1	GM
2	1	Cisgenic
3	1	Environmental Benefits
4	2	Environmental Benefits – Cisgenic
5	2	Environmental Benefits – GM
6	2	Cisgenic – GM

7	2	Cisgenic – Environmental Benefits
8	2	GM - Environmental Benefits
9	2	GM – Cisgenic
10	3	GM – Cisgenic - Environmental Benefits
11	3	GM - Environmental Benefits - Cisgenic
12	3	Cisgenic – GM - Environmental Benefits
13	3	Cisgenic - Environmental Benefits - GM
14	3	Environmental Benefits – Cisgenic - GM
15	3	Environmental Benefits – GM - Cisgenic

The WTP questions were asked in three information rounds for each respondent. Each respondent was asked its WTP for conventional rice (Variety B) versus the alternative rice (Variety A).

In the second model, the variable "*treatment*" indicates the information received in the first round of questions and comprised three categories: cisgenic, GM or environmental benefits. All respondents were included in the sample[33] to estimate the WTP model. As a result, the sample is a panel with three WTP values to avoid/pay for the alternative rice per respondent corresponding to the three information rounds.

The likelihood function from equation 1 is the product of the probabilities of the observations lying in the observed interval (so for individual *i,* Pr ($Y_{i1} \leq Y_i^* \leq Y_{i2}$)). If the observation is right

[33] There was consideration of whether to restrict the analysis of WTP to those respondents who did not reject consumption of a GM or Cisgenic rice in the later "would you consume GM rice" question at the end of the survey. Because of the survey design, it was felt that the information sets had likely influenced attitudes toward consumption, and that aversion to GM would be captured in the WTP amounts. Therefore all respondents were included in the sample to estimate the WTP model.

censored, i.e if respondent is willing to pay a premium of €47.75[34] or more to avoid the alternative rice, then the probability is Pr (€47.75 ≤ Y_i^*). If the observation is left censored, i.e if respondent *i* is willing to pay €1.75[35] or more to consume the alternative rice instead of the conventional rice, then the probability is Pr (Y_i^* ≤ €-1.75). The maximum likelihood estimates were obtained from using the interval regression command INTREG' in STATA 13. Finally, because the sample was by nature panel data, clustered robust standard errors were estimated to account for the correlation existing in the error term (ε_i) among the three observations for a given respondent.

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[34] €47.75 = €50-€2.25, €2.25 is the price at which the alternative rice is presented to the respondents
[35] €0.5-€2.25= €-1.75, €2.25 is the price at which the alternative rice is presented to the respondents and thus left censored respondents are willing to pay a premium for the alternative rice equal to 1.75€.

Results and Discussion

The first part of this chapter includes a descriptive analysis of the surveyed European consumers' consumption and purchasing habits, attitudes towards GM, transgenic and cisgenic rice and willingness to consume cisgenic and GM rice. The second part presents and describes the results for the interval regression models. In both parts, the results have been obtained based on the sample data collected online and representing 3002 European consumers from Belgium, France, the Netherlands, Spain and the UK.

A. Descriptive statistics

European consumers' consumption and purchasing habits

Table 7 shows the percentage of respondents who eat rice and who purchase groceries for their household. In all five countries, at least 93.4% of the respondents eat rice. Thus, as most of the respondents in our sample consume rice, the sample is suitable to elicit WTP for cisgenic rice.

Larger disparities among countries are observed regarding the purchase of groceries with 84.8% of the respondents in Belgium declaring that they purchase groceries for their household and 97.24% of the respondent in Spain of the respondents stating the same. On average, 92.7% of the respondents purchase groceries for their household.

Table 7: Rice consumption and purchasing practices (%)

	Belgium	France	Netherlands	Spain	United Kingdom	Total
Do you eat rice?						
Yes	93.40	97.87	93.85	95.74	97.20	95.9
No	6.60	2.13	6.15	4.26	2.80	4.10
Do you purchase any of the groceries for your household?						
Yes	84.80	96.93	86.38	97.24	96.54	92.70
No	15.20	3.07	13.62	2.76	3.46	7.30

Table 8 shows the importance of seven product attributes when purchasing groceries: price, brand name, origin of production, organic status, nutritional content, taste and product quality. The online questionnaire was designed in a way that respondents were asked to state their degrees of importance for the seven attributes only if they had previously declared that they purchase groceries for their household. Therefore, because 92.7% of the total respondents declared that they purchase groceries (

Table 7),

Table 8 gives the results for a sample of remaining 2,784 respondents.

Table 8: Importance of product attributes when purchasing groceries (%)

	Not at all important	Slightly important	Moderately important	Very Important	Extremely Important
Price	1.5	5.9	27.0	43.4	22.2
Brand Name	17.6	28.8	33.7	16.1	3.8
Origin of Production	11.2	24.2	37.0	21.4	6.3
Organic Status	14.3	25.5	35.7	18.2	6.3
Nutritional Content	6.5	16.6	32.6	34.8	9.5
Taste	0.9	1.4	15.9	56.1	25.6

Product Quality	1.0	1.8	18.1	53.1	26.0

Based on the analysis of
Table 8, it appears that the most important attributes when purchasing groceries are "taste", "product quality" and "price" with respectively 81.7%, 79.1% and 65.6% of the respondents stating that these attributes are very or extremely important. These results are consistent with other studies: Van Loo, Caputo, Nayga Jr., Meullenet, et al. (2010) have identified the most important meat quality criteria for poultry meat and taste appeared to be the most important criteria for poultry meat. In addition, in 2011, the International Food Information Council (IFIC) conducted a survey to 1,000 American adults and results showed that taste is the most important attribute when purchasing groceries followed closely by price. Brand name, origin of production and organic status are the three attributes that are of less importance for respondents when purchasing groceries with respectively 46.4%, 35.4% and 39.8% of the respondents declaring that these are slightly important or not at all important.

European consumers' perceptions of GM, Cisgenic and Transgenic Products

Attitudes towards GM rice

Table 9 shows the opinions of respondents towards GM rice.

Table 9: Attitudes towards GM rice (%)

#	Statement	Totally disagree	Tend to disagree	Do not know	Tend to agree	Totally agree
1	GM rice is good for the national economy	6.3	12.2	33.1	36.4	11.9
2	GM rice helps people in developing countries	6.6	11.5	25.8	34.7	21.7
3	GM rice is safe for future	9.9	12.7	36.1	29.1	12.2

	generations					
4	GM rice is fundamentally unnatural	6.8	21.5	26.2	29.0	16.4
5	GM rice is safe for my health and my family's health	9.3	13.3	36.9	29.7	10.9
6	GM rice does no harm to the environment	8.8	14.4	34.9	29.2	12.6
7	The development of GM rice should be encouraged	11.2	14.2	31.9	28.7	13.9
8	I am in favor of allowing GM rice to be sold in my country	12.6	12.0	30.7	30.7	14.0

Statement 2 "GM rice helps people in developing countries" is the statement that receives the highest support with 56.4% of the respondents who tend to agree or totally agree. Statement 5 "GM rice is safe for my health and my family's health" is the statement for which respondents are the most uncertain with 36.9% of respondents who do not know how they feel. This finding is consistent with the results of other studies. For example, it has been shown that Dutch consumers are more fearful and feel uncertain towards GM food compared to conventional or other type of food such as organic food (Laros and Steenkamp 2004).

Evolution of attitudes towards cisgenic and transgenic rice and towards GM food

The data collected in this survey can loosely[36] be compared with the results of the Eurobarometer report of the European Commission (EC, 2010). In the Eurobarometer report, statements 1 to 7 (on Table 3) were presented to the respondents for "GM food" instead of GM rice.

Generally, the results from this study show a more positive attitude towards GM rice when

[36] It is important to note that the sample of this study is not representative for some demographics such as education and thus, can only be loosely compared with the Eurobarometer results.

compared to the statistics provided by the European Commission in the Eurobarometer report (2010): As an example, for the statement "GM rice is good for the national economy", almost half (48.3%) of the respondents in our survey tend to agree or totally agree while only 36.7% of the respondents[37] agreed with the same statement regarding GM food in 2010. For statements 3 (GM food is safe for future generations), 5 (GM food is safe for your health and family health), and 6 (GM food does no harm to the environment), more than 40% of the respondents tend to agree or totally agree in our survey but less than 30% of the respondents agreed with these statements in 2010. Another fundamental difference with the data reported in the Eurobarometer report concerns the percentage of respondents who do not know how they feel about the statements. This percentage ranges from 9.2% to 25.6% in the Eurobarometer report compared to 25.8% to 36.9% in our sample.

These differences between the results obtained through our survey in 2013 with the results of the Eurobarometer report suggest that European consumers attitude towards GM food may have evolved over time. Across all countries, there appears to be a shift from a negative attitude to either a positive attitude or to more incertitude with a rise in the proportion of respondents who do not know how they feel of up to 19% (statement 4: GM food is fundamentally unnatural).

Attitudes towards cisgenic and transgenic rice

Table 10 and Table 11 report the degree of agreement of the 3002 respondents for the eight statements that were included in the survey to analyze respondent's attitudes towards cisgenic

[37] The percentages presented for the Eurobarometer report are the weighted averages for the five countries of our survey (Belgium, France, the Netherlands, Spain, the United Kingdom)

and transgenic rice. The detailed of the percentages per country can be found in Appendix 2 (Tables A2-A6).

Table 10: European consumers' attitudes towards cisgenic rice (%)

#	Statement	Totally disagree	Tend to disagree	Do not know	Tend to agree	Totally agree
1	Cisgenic rice is good for the national economy	6.1	8.8	28.7	41.5	14.9
2	Cisgenic rice helps people in developing countries	6	8.8	22.4	39.4	23.4
3	Cisgenic rice is safe for future generations	8	10.1	35.6	32.2	14
4	Cisgenic rice is fundamentally unnatural	7.3	23.2	26.8	28.9	13.9
5	Cisgenic rice is safe for my health and my family's health	8.1	9.1	36.9	33.2	12.7
6	Cisgenic rice does no harm to the environment	7.8	10.4	33.1	33.9	14.9
7	The development of cisgenic rice should be encouraged	9	10.6	30.6	34.4	15.4
8	I am in favor of allowing cisgenic rice to be sold in my country	9.9	10.4	29.5	34.8	15.4

As for GM rice, statement 2 "Cisgenic rice helps people in developing countries" is the statement towards which respondents have the most positive attitude with a total of 62.8% of the respondents who tend to agree (39.4%) or totally agree (23.4%). On the contrary, the statement "Cisgenic rice is fundamentally unnatural" is the statement for which respondents have the most "negative attitude" with a total of 42.8% of the respondents who state that they tend to agree (28.9%) or totally agree (13.9%). Approximately half of the respondents believe that the development of cisgenic rice should be encouraged (49.8%) and are in favor of allowing cisgenic rice to be sold in their country (50.2%). For the eight statements, the percentage of respondents who are uncertain about how they feel is really high with values ranging from 22.4% for statement 2 up to 36.9% for statement 5.

Table 11: European consumers' attitudes towards transgenic rice (%)

#	Statement	Totally disagree	Tend to disagree	Do not know	Tend to agree	Totally agree
1	Transgenic rice is good for the national economy	7.2	9.6	30.4	38	14.8
2	Transgenic rice helps people in developing countries	6.5	9.4	25.1	38.8	20.3
3	Transgenic rice is safe for future generations	9.5	10.8	36.9	30.3	12.6
4	Transgenic rice is fundamentally unnatural	7.5	20.9	28.2	28.9	14.6
5	Transgenic rice is safe for my health and my family's health	9.4	10.9	37.7	30.8	11.2
6	Transgenic rice does no harm to the environment	8.9	11.7	34.8	31.1	13.6
7	The development of transgenic rice should be encouraged	10.3	11.8	31.8	32.1	13.9
8	I am in favor of allowing transgenic rice to be sold in my country	11.6	10.8	31	32.1	14.6

An identical set of statements was given replacing transgenic with cisgenic. "Transgenic rice helps people in developing countries" is again the statement towards which respondents have the most positive attitude with a total of 59.1% of the respondents who tend to agree (38.8%) or totally agree (20.3%). Similarly, statement 4 is the statement for which respondents have the most "negative attitude" with a total of 43.5% of the respondents who state that they tend to agree (28.9%) or totally agree (14.6%) that transgenic rice is fundamentally unnatural. Finally, the percentage of respondents who are uncertain about how they feel is also really high with values ranging from 25.1% for statement 2 up to 37.7 % for the statement "transgenic rice is safe for my health and my family's health".

Based on the comparison of Table 10 and Table 11, several conclusions can be drawn. First, the percentage of respondents who do not know how they feel about a statement is always higher for the statements concerning transgenic rice than for the statements that concern cisgenic rice. This highlights the fact that, despite being aware of the existence of transgenic food product for almost 20 years, European consumers still appear to need more information on transgenesis to make a sound decision as to its safety towards the environment and those who consume them.

Secondly, the percentage of respondents who totally disagree (which is a negative response for 7 out of the 8 statements) with a statement is always higher for the statements regarding transgenic rice compared to cisgenic rice. This is also the case for the percentage of respondents who tend to disagree apart for the statement about the naturalness of cisgenic and transgenic rice (statement 4) for which 23.2% of the respondent tend to disagree when it comes to cisgenic rice while 20.9% of the respondents tend to disagree for transgenic rice. In addition, the percentage of respondents who tend to agree or totally agree with a statement is always higher for the statements concerning cisgenic rice except, once more, for the statement about the naturalness of the cisgenic and transgenic rice.

It is important to note that out of the eight statements, statement 4 "Transgenic/cisgenic rice is fundamentally unatural" is the only statement with a negative connotation. In this sense, it makes sense that the way respondents feel about this statement is the opposite of the trend observed for the seven other statements. In conclusion, the results tend to show a more positive attitude of the respondents towards cisgenic rice than transgenic rice except for the statement 4

"Cisgenic/Transgenic rice is fundamentally unnatural". This suggests that respondents view transgenic rice as more natural than cisgenic rice. However, the difference in percentage is marginal (0.2%).

Difference in attitudes towards cisgenic and transgenic rice

Table 12 shows the results of the t-test for the eight statements.

Table 12: T-test results for the difference in opinions towards cisgenic and transgenic rice

Statement		Mean	Std Dev
1	Cisgenic/Transgenic rice is good for the national economy	-0.0663*	0.7535
2	Cisgenic/Transgenic rice helps people in developing countries	-0.0856*	0.7917
3	Cisgenic/Transgenic rice is safe for future generations	-0.0829**	0.7958
4	Cisgenic/Transgenic rice is fundamentally unnatural	0.0323**	0.9888
5	Cisgenic/Transgenic rice is safe for my health and my family's health	-0.0999*	0.7885
6	Cisgenic/Transgenic rice does no harm to the environment	-0.0883*	0.8224
7	The development of Cisgenic/Transgenic rice should be encouraged	-0.0916*	0.7714
8	I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	-0.0823*	0.7673

*Denotes statistical significance at the 1% level
**Denotes statistical significance at the 10% level

For six of the eight statements (statements 1, 2, 5, 6, 7, 8), the mean of the difference in opinions towards transgenic and cisgenic rice is statistically different from 0 at the 1% level. The remaining two statements 3 and 4, the mean differences were statistically significant at the 10% level. For all statements, the results of the t-test indicate that the mean difference is always smaller than 0 and therefore that respondents have more positive attitudes towards cisgenic rice than transgenic rice. However, the mean difference is comprised between -0.0999 and -0.0663 and thus represents a marginal difference on a scale from 1 to 5. For statement 3 ("Cisgenic/Transgenic rice is safe for future generations) and for statement 4 ("Cisgenic/Transgenic rice is fundamentally unnatural"), the t-test (Table 12) indicates that the mean is not statistically different from zero at the 1% confidence level but is at the 10% confidence level.

Table 13: Frequency table for the change in opinions between cisgenic and transgenic rice (%)

#	Statement	Difference in scores < 0	Difference in scores = 0	Difference in scores > 0
1	Cisgenic/Transgenic rice is good for the national economy	13.9	76.6	9.6
2	Cisgenic/Transgenic rice helps people in developing countries	15.0	76.4	8.7
3	Cisgenic/Transgenic rice is safe for future generations	14.9	75.6	9.6
4	Cisgenic/Transgenic rice is fundamentally unnatural	13.2	71.8	15.0
5	Cisgenic/Transgenic rice is safe for my health and my family's health	14.5	77.4	8.2
6	Cisgenic/Transgenic rice does no harm to the environment	15.9	75.1	9.0
7	The development of Cisgenic/Transgenic rice should be encouraged	14.8	76.9	8.3
8	I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	13.7	78.1	8.2

Table 13 reports the frequency of the variable "Difference in opinions between cisgenic and transgenic rice”. The first column gives the percentage of respondents for which the difference in score is negative, i.e. respondents who have a more positive attitude towards cisgenic rice than transgenic rice (except for statement 4 “Cisgenic / Transgenic rive is fundamentally unnatural” for which a negative difference in scores reflects a more positive attitude towards transgenic rice). At least 13.7% (statement 8 “I am in favor of allowing cisgnice/transgenic rice to be sold in my country) of the respondents have a more positive attitude towards cisgenic rice than transgenic rice. The second column shows, for each statement, the percentage of respondents who have the same attitude towards cisgenic and transgenic rice. For each statement, at least 71.8% have the same attitude towards cisgenic and transgenic rice. Finally, between 8.2% (statement 5 and 8) and 13.2% (statement 4) of the respondents report a more positive attitude towards transgenic rather than cisgenic rice.

To consume or not to consume

Table 14 presents the country breakdown by percentage of participants by country who indicated they were willing to consume a GM food product and/or a cisgenic food product as well as their opinions about labeling of cisgenic and transgenic rice. As mentioned in Chapter 3, these questions were asked in the fourth part of the survey when all respondents had received all sets of information (definition of cisgenic and description of the environmental benefits).

Table 14: Willingness to consume GM and cisgenic food and opinions on labeling by country (%)

	BE N=500	**FR N=750**	**NL N=602**	**SP N=399**	**UK N=751**	**Total N=3002**
Willingness to consume GM food						

No	10	31	15	11	15	17
Yes	38	23	32	46	47	36
Not enough info	52	46	53	43	39	46
Willingness to consume cisgenic food						
No	9	26	10	8	10	14
Yes	38	27	30	52	46	38
Not enough info	53	47	60	40	44	49
Labeling for rice created by Cisgenic breeding						
Not need special labeling	21	12	24	7	16	16
Should be clearly identified	79	88	76	93	84	84
Labeling for rice created by transgenic breeding						
Not need special labeling	19	12	24	7	14	15
Should be clearly identified	81	88	76	93	86	85

On average, 36% of the total respondents are willing to consume a GM food product with values ranging from 23% in France to 47% in the UK, respectively. Respondents from France are the less willing to consume a GM and a cisgenic food product with respectively 31% and 26% of the respondents not willing to consume a GM or cisgenic food product. Across all countries, the willingness to consume a cisgenic product is 38% with values ranging from 27% in France to 52% in Spain.

The percentage of respondents who consider that they do not have enough information to decide whether they would be willing to consume a cisgenic or a GM food product is very high. This seem to indicate that there is a potential market for GM and cisgenic products but promotional or at least educational campaigns are greatly needed to inform consumers about each. In addition, in all countries but Spain, the percentage of “Don’t know” for the question regarding the willingness to consume a cisgenic or a GM food product is always higher for the cisgenic product. Furthermore, the percentage of “No” is always smaller for the cisgenic product than for the GM product. This shows that respondents are less familiar with cisgenic food products than GM food products. However, this finding is consistent with the results of the study conducted by Kronberger, Wagner and Nagata (2014) that shows that consumers have a more negative attitude when they are familiar with the method of genetic modification.

With regards to labeling it was found that on average respondents have similar opinions for potential labeling requirements for cisgenic and transgenic products in France, the Netherlands and Spain where 88%, 76% and 93% of the respondents consider that cisgenic and transgenic rice should be clearly identified with a label, respectively. In Belgium, 81% of the respondents indicated that transgenic rice should be clearly identified with a label while 2% less (79%) consider that cisgenic rice should be clearly identified with a label.

Bounded Responses

In each country, respondents were randomly assigned to one of the six treatments presented above (Table 6). Table 15 shows the repartition of the respondents between the three different set of information in round 1.

Table 15: Repartition of respondents per information set in round 1

	Country					**Total**
	BE	**FR**	**NL**	**SP**	**UK**	
Cisgenic information	166	263	216	132	254	*1031*

GM information	186	250	211	137	249	*1033*
Env. Benefits information	148	237	175	130	248	*938*
Total	*500*	*750*	*602*	*399*	*751*	*3002*

The percentages of left and right-censored respondents (those who choose to pay 50 euros for the conventional rice are right censored and those who choose to pay 2.25 euros for the alternative rice when the conventional rice was available for 0.5 euro are left censored) in round 1 for each set of information in illustrated in Table 16. Thus, right censored respondents are respondents who are willing to pay €47.75 [38] extra to consume the conventional rice instead of the alternative rice and left censored respondents are respondents who are willing to pay 1.75€[39] extra to consume the alternative rice compared to the conventional rice. The percentages presented in Table 16 are calculated per country and per information received and should be interpreted as follows: out of the 166 Belgian respondents who received the information about GM rice in round 1, 19.4% were right censored and 2.7% of left censored.

Table 16: Right and left censored respondents per country and per treatment in round 1 (%)

	BE	FR	NL	SP	UK	Total
% of right censored respondents in round 1						
Cisgenic information	7.2	28.5	6.9	16.7	12.6	15.1
GM information	19.4	48.8	19.4	21.2	25.3	28.2

[38] 47.75€ = 50€-2.25€, 2.25€ is the price at which the alternative rice is presented to the respondents
[39] 0.5€-2.25€= -1.75€, 2.25€ is the price at which the alternative rice is presented to the respondents and thus left censored respondents are willing to pay a premium for the alternative rice equal to 1.75€.

Env. Benefits information	8.1	4.2	9.1	5.4	7.3	6.7
% of left censored respondents in round 1						
Cisgenic information	7.2	2.7	3.2	3.8	2.4	3.6
GM information	2.7	0.8	1.9	0.7	0.4	1.3
Env. Benefits information	23	36.7	13.7	28.5	18.1	24.2

Not surprisingly for all the five countries, the highest percentage of right censored (highest aversion to the alternative rice) respondents is observed when the alternative rice is labeled as GM rice and the highest percentage of left censored (highest demand) respondents corresponds to the treatment in which the alternative rice is presented as a rice with environmental benefits.

Interestingly, France is the country with the highest proportion of right *and* left censored respondents: 48.8% of the French respondents who were presented the GM rice as the alternative rice were right censored and 36.7% of the French respondents who received the information about environmental benefits were left censored. This would indicate that the French are the most averse to GM products and the most willing to pay for a product which possesses a positive environmental benefit. France appears to be the outlier for both GM and environmental benefits which gives further credence for analyzing the EU on a country by country basis and not as a whole.

B. Regression Results

The interval regression results for the first of the two regression models[40] are presented in Table

[40] As a reminder, in the first model, the variable "treatment" includes 15 categories that account for

18. Regression models were computed for each country and all of the five models/countries included the same six independent variables as defined in equation 1 (intercept of the regression, treatment effect, age category, presence of child less than 7 in the household, education and income).

Model specification

A test of homogeneity was used to determine if the intercepts of the five models/countries are statistically different from each other. Table 17 shows the results of the test of homogeneity for the five intercepts. The values presented in Table 17 have been computed as follows:

$$tvalue_{12} = \frac{(\beta_1 - \beta_2)}{\sqrt{St.error_1^2 + St.error_2^2}}$$

(2)

β_1 β_2 are the regression coefficients for the intercepts 1 and 2.

Table 17: Results of the test of homogeneity for the intercepts of the five regression models[1]

	Belgium	France	Netherlands	Spain	United Kingdom
Belgium	0	**-4.44**	-1.5	-1.59	**-2.03**
France	**4.44**	0	**3.17**	**2.74**	**2.48**
Netherlands	1.5	**-3.17**	0	-0.24	-0.63
Spain	1.59	**-2.74**	0.24	0	-0.35
United Kingdom	**2.03**	**-2.48**	0.63	0.35	0

[1]The "t-values" highlighted in bold indicate a statistical difference between the two intercepts at the 5% level of significance.

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the information provided to respondents as well as the order in which the information was provided (Table 6).

The intercept of the model for France is statistically different from the intercepts of the four other countries (Belgium, Spain, the Netherlands, the United Kingdom). In addition, the intercept of the model for the UK is different than the one for Belgium. This test indicates differences across countries and suggests that the regression model can either be computed for each country separately or including the variable "Country" as a fixed effect. Finally, in order to determine which one of the two options is the most appropriate, a test for homogeneity was performed for random regression coefficients. As an example, the t-value of the test for homogeneity for the coefficient regression of the variable "Env. Benefits" in France (β=-44.8, st.error=3.2) and in Belgium (β=-9.8, st.error=2.4) is equal to 8.74[41] and indicates that and indicates that not only the intercepts of the regression model vary across countries but that the slopes of the linear equations also fluctuate. Finally, significant differences among the demographics and across countries also show important differences between the five studied countries, meaning the impact of a specific demographic variable, such as age, was not equivalent across countries. As such, five different models were constructed, one for each country.

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[41] The regression coefficient is reported in Table 18. For a matter of clarity, the standard errors associated which each regression coefficient are not reported in Table 18 but can be found in Appendix 3.

Table 18: Interval regression results of WTP to consume conventional rice instead of the alternative, by country[42]

	BELGIUM	FRANCE	NETHERLANDS	SPAIN	UNITED
Intercept	10.68**	29.83**	16.02**	16.97**	18.46**
Treatment effect					
GM					
Cisgenic	-7.63**	-15.87**	-6.82**	-1.97	-7.68**
Env. Benefits	-9.82**	-44.88**	-9.15**	-15.43**	-13.93**
Cisgenic - GM	-4.61	-12.60**	-2.35	1.92	-6.03**
Cisgenic Env. Benefits	-8.89**	-23.05**	-9.48**	-10.25**	-10.55**
GM - Cisgenic	0.92	-2.54	-2.17	-1.23	0.64
GM - Env. Benefits	-2.16	-9.27**	-1.13	-3.96	-5.53**
Env. Benefits - GM	-5.79	-26.69**	-7.08**	-11.50**	-5.42
Env. Benefits - Cisgenic	-9.72**	-42.88**	-9.17**	-14.00**	-13.09**
Cisgenic - GM - Env. Benefits	-7.27**	-17.62**	-4.30	-5.96	-8.86**
Cisgenic- Env. Benefits - GM	-6.81**	-19.05**	-9.56**	-7.21**	-7.59**
GM - Cisgenic - Env. Benefits	-4.28**	-9.79**	-3.82	-9.16**	-4.10
GM - Env. Benefits - Cisgenic	-2.25	-12.60**	-0.51	-4.42	-5.02**
Env. Benefits - GM - Cisgenic	-5.78	-24.45**	-3.97	-11.32**	-5.56**
Env. Benefits - Cisgenic - GM	-10.13**	-32.24**	-7.67**	-11.05**	-9.59**

[42] ** Indicates statistical significance at the 5% level

Table 18 (Cont.): Interval regression results of WTP to consume conventional rice instead of the alternative, by country[43] [44]

	BELGIUM	FRANCE	NETHERLANDS	SPAIN	UNITED
Age categories					
Less than 30 years old					
Between 30 and 39 years old	3.11	0.92	1.76	-2.24	-0.11
Between 40 and 49 years old	-1.68	3.15	-5.04**	-5.21**	-4.06
Between 50 and 59 years old	3.18	6.33	-1.16	-1.24	-2.61
60 years old or more	3.03	1.91	-0.99	8.64	-4.72
Children less than 7					
Yes	0.50	6.28**	1.01	-2.78	-0.34
Education					
High school or less					
Undergraduate	1.45	2.62	3.60**	1.16	2.57
Master degree or Phd	3.43	5.84**	0.56	-0.41	5.90**
Income					
Less than €18 000					
€18 000 to €34 999	0.99	2.06	-4.20**	0.08	-0.89
€35 000 to €49 999	-1.11	5.23	-5.41	0.82	-4.95**
€50 000 and more	-2.47	3.86	1.32	-0.26	0.80
Sigma [45]	20.55	31.25	19.82	21.94	23.35

[43] ** Indicates statistical significance at the 5% level

[44] In the United Kingdom, all monetary units were presented in equivalent €

[45] Sigma is equivalent to the standard error of the estimate in OLS regression

Results

Based on Table 18, the mean WTP to avoid a 2.25 kg (approximately 5 pounds) bag of GM rice for the baseline group was estimated to be €10.68 in Belgium, €29.83 in France, €16.02 in the Netherlands, €16.97 in Spain and €18.46 in the UK.[46] These results highlight the extreme variation amongst consumers in the EU to avoid GM food products. It is clear that French consumers have the largest aversion and the Spanish having the smallest aversion to GM food products. These findings are consistent with current attitudes towards GM products in Europe, with Spain being the only out of the five studied country to currently grow a GM crop (maize MON810) and France being the only one out of the five countries in this study to have used the safeguard clause to avoid the cultivation of GM food product (more specifically to avoid the cultivation of maize MON810) on its territory (GMO Compass).

These results seem to indicate a high WTP to avoid GM food products across all countries. Two possible reasons could explain these high results. First, in the online questionnaire respondents were not given the choice not to buy any rice: they were forced to pick one of the two prices provided to them. Thus, respondents who are not willing to consume a GM or a cisgenic food product had no other choice than to pay €50 to avoid it. As mentioned earlier, there was consideration of whether to restrict the analysis of WTP to respondents who did not reject consumption of GM or cisgenic rice. Because of the survey design, it was felt that the

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[46] The baseline group for the demographics is defined as those respondents less than 30 years old, with a high school education or less, a net annual income less than 18 000€ and with no child less than 7 in the household.

information sets had likely influenced attitudes toward consumption, and that aversion to GM would be captured in the WTP amounts. Therefore all respondents were included in the sample to estimate the WTP model. As reported in Table 14, the proportion of consumers who are not willing to consume a GM food product was approximately 10% of the respondents in Belgium, 31% in France, 15% in the Netherlands, 11% in Spain and 15% in the United Kingdom.

Secondly, previous non-hypothetical studies have shown that European consumers are willing to pay high premiums to avoid consuming GM food. As an example, Lusk (2003) found that French consumers are willing to pay a premium of up to $9.18 per pound of beef to avoid consuming beef fed with GM corn.

Regarding the demographics, France appears to be the only country in which the presence of at least one child less than 7 in the household affects the consumer WTP to avoid GM food product and results in a WTP €6.28 higher than when no child less than 7 is in the household. Furthermore, French consumers with a master degree or a PhD are willing to pay €5.84 more to avoid consuming GM food product than French consumers with an education level equivalent to high school or less. In Belgium none of the demographics are significant. In the Netherlands, income, education and age have an impact on consumers' WTP. In Spain the only statistically significant difference is observed between respondents aged less than 30 and respondents aged between 40 and 49 years old, the latter being willing to pay €5.21 less to avoid a GM food product than respondents aged less than 30. Finally in the United Kingdom income and education are the two demographics that affect the WTP with a higher WTP for respondents with a master degree or a PhD compared to the respondents with an education level equivalent to high school or less (WTP is €5.90 higher for the respondents with a master degree of a PhD) and with a higher WTP for respondents with a net annual income less than €18 000 compared to the respondents with a net annual income comprised between €18 000 to €34 999.

Information effect

By analyzing Table 18, it is evident that in France, Spain and the United Kingdom, consumers are willing to pay the less to avoid the alternative when the latter is presented as "with environmental benefits" compared to the alternative rice presented as "GM" or as "cisgenic". In Belgium and in the Netherlands, the smallest WTP to avoid the alternative rice is in round 3 (when all information has been provided). In all five countries, consumers are willing to pay the highest premium to avoid consuming the alternative rice when they are only provided with the information that the rice is GM.[47]

In France, 13 out of the 14 regression coefficients for the variable treatment are statistically significant at the 5% level and all coefficients are negative. Once again, this highlights that French consumers are sensitive to all of the information sets (positive for environmental and negative for cisgenic and GM). In all five countries, the coefficients for the category "Environmental benefits" of the variable "Treatment" is statistically different from 0 at the 5% level and this shows that, as expected, consumers are willing to pay more for a product labeled as having environmental benefits compared to a product labeled as GM only.

[47] It is important to note that consumers from the UK are willing to pay €0.64 extra for an alternative rice described as GM and cisgenic but that this coefficient was insignificant.

Order effect

In order to determine if the effect in which information was provided to the respondents affected their WTP, a pairwise comparison was performed. As showed in Table 19, for round 2 (round 1 was excluded because only one information set was provided and thus by definition there is no order effect), three different Wald tests were performed to compare the WTP for the alternative rice as a function of the order in which the information was given to each participant. In addition, only one Wald test can be performed for round 3 since the information provided in round 3 is the same for the six treatments. In addition, a Bonferroni test can be performed to ensure the 0.5% level and to control the familywise error rate (FWER)[48]. Table 19 shows the results of the Wald tests and the pairwise comparison.

Table 19: Order effect [a]

Order Effect	Belgium	France	Netherlands	Spain	UK
Round 2					
GM Cisgenic vs Cisgenic GM	5.5	10.1*	0.2	-3.1	6.7*
GM Env vs Env GM	-3.6	-17.4**	-5.9*	-7.5*	0.1
Cisgenic Env vs Env Cis	-0.8	-19.8**	0.3	-3.8	-2.5
Round 3					
Cis-GM-ENV vs Cis-Env-GM	0.5	-1.4	-5.3	-1.3	1.3
Cis-GM-Env vs GM-Cis-Env	3.0	7.8	0.5	-3.2	4.8
Cis-GM-ENV vs GM-Env-Cis	5.0	5.0	3.8	1.5	3.8
Cis-GM-ENV vs Env-GM-Cis	1.5	-6.8	0.3	-5.4	3.3
Cis-GM-ENV vs Env-Cis-GM	-2.9	-14.6**	-3.4	-5.1	-0.7
Cis-Env-GM vs GM-Cis-Env	2.5	9.3*	5.7*	-2.0	3.5
Cis-Env-GM vs GM-Env-Cis	4.6	6.4	9.0**	2.8	2.6
Cis-Env-GM vs Env-GM-Cis	1.0	-5.4	5.6	-4.1	2.0

[48] The results of the Bonferroni test have been adjusted to take into account only the 15 comparisons of interest in this situation instead of the 105 total comparisons (if the 15 treatments categories were compared to each other).

Cis-Env-GM vs Env-Cis-GM	-3.3	-13.2**	1.9	-3.8	-2.0
GM-Cis-Env vs GM-Env-Cis	2.0	-2.8	3.3	4.7	-0.9
GM-Cis-Env vs Env-GM-Cis	-1.5	-14.7**	-0.2	-2.2	-1.5
GM-Cis-Env vs Env-Cis-GM	-5.9	-22.4**	-3.9	-1.9	-5.5
GM-Env-Cis vs Env-GM-Cis	-3.5	-11.9*	-3.5	-6.9	-0.5
GM-Env-Cis vs Env-Cis-GM	-7.9*	-19.6**	-7.2*	-6.6	-4.6
Env-GM-Cis vs Env-Cis-GM	-4.4	-7.8	-3.7	0.3	-4.0

[a] * Indicates statistical significance at the 5% level for the Wald test.
** Indicates statistical significance at the 5% level for the Wald test as well as at the 5% level adjusted for the Bonferroni test.

Table 19 indicates that there are statistically significant differences across countries in terms of the order effect. Not surprisingly, French consumers displayed the highest responsiveness to the order in which they were presented information. As an example, French consumers who received the three attributes in the order “cisgenic, GM, environmental benefits” are willing to pay €14.6 more to avoid the alternative rice than the respondents who received the information in the following order: Environmental benefits, cisgenic, GM. This would seem to indicate that the initial information and reaction of being environmentally friendly is mitigated completely if French consumers are then informed the product is GM.

In Spain and in the United Kingdom, the only order effects statistically significant are observed in round 2. Spanish consumers are willing to pay €7.5 more to avoid the alternative rice if the first information is GM and the second information set is the environmental benefits than if the information is provided in the opposite order. In France, the same order effect reaches €17.4. Finally, in Belgium the order in which the information is provided to participants did not affect the WTP for the alternative rice.

Policy implications

Table 20 shows the results of the second regression model in which the variable "*treatment*" corresponds to the information provided in Round 1 only (cisgenic, GM, environmental benefits). This regression model analyzes the differences in European consumers' WTP between for a 2.25 kg bag of rice mimicking potential EU labeling laws. The different hypothetical labeling laws have been designed based upon the policies that could potentially be implemented in the EU and which could require food manufacturers to either label their cisgenic food product as such (scenario 2) or as GM (scenario 1) or a policy which would exclude cisgenic products from the current GMO regulation (and therefore not require any specific labeling regarding the breeding technique with which the product has been developed) (scenario 3).

Scenario 1 illustrates the current EU policy towards cisgenic products: cisgenic products fall under the EU GMO regulation and have to be labeled as such if the product consists of or contains more than 0.9% of GM product. "The phrase "This product contains genetically modified organisms" or "This product contains genetically modified [name of organism(s)]" must appear on a label" (Regulation (EC) No 1830/2003).

The second scenario assumes that the EU current policy is modified to take into account the type of GM food product and its specificity. In this hypothetical situation, food companies would be required to label their product as cisgenic but not as GM. While companies would be allowed to explain that the GM in the product is bred cisgenically the words "genetically modified" would *not* have to appear on the label.

Finally, in the third scenario, it is assumed that cisgenic breeding is added to the Annex 1B in

Directive 2001/18 concerning the 'deliberate release into the environment of genetically modified organisms'. The annex 1B is a list of genetic modification processes that do not fall under the GMO EU policy. In this case, there would be no specific labeling regulation concerning the breeding process. Therefore, it is assumed that food manufactures would label their cisgenic food product as "product with environmental benefits".

Table 20: European consumers WTP to consume conventional food instead of rice labeled as GM or cisgenic or with environmental benefits (€)

	Scenario 1	Scenario 2	Scenario 3
	Rice Labeled as GM	Rice Labeled as Cisgenic	Rice Labeled as ENV Benefits
Belgium	10.15 ^{A}	2.52^{B}	0.76^{B}
France	26.38 ^{A}	11.51^{B}	-15.54^{C}
Netherlands	15.68 ^{A}	9.05^{B}	7.02^{B}
Spain	8.94 ^{A}	7.62^{A}	-5.71^{B}
United Kingdom	14.92 ^{A}	7.48^{B}	1.47^{C}

Note: All results are in Euros. The UK respondents answered in GBP but have been converted to Euros using an exchange rate of 0.8431.
For a given country, coefficients followed by the same letter are not statistically different from one another at the 5% significance level.

In Table 20, the coefficients represent the amount of money (€) consumers are willing to pay extra to consume conventional rice instead of rice labeled as GM (scenario 1), cisgenic (scenario 2) and with environmental benefits (scenario 3), thus negative values indicate an associated premium. These values are for the baseline demographic group, i.e. for a respondent aged less than 20, with an education level equivalent of high school or less, an annual net income less than €18 000 and with no children less than 7 in the household.

Table 20 highlights several interesting potential policy findings. First, in every country besides

Spain (who has the lowest aversion to GM products) there is a statistical difference between consumers' WTP for the same product when it is labeled as cisgenic and as GM. In each case consumers are willing to pay less to avoid the product labeled as cisgenic, *ceteris paribus*. On average, across all countries, consumers are willing to pay €7.58 more (scenario 1 – scenario 2) to avoid to consume a product which is labeled as GM compared to a product labeled as cisgenic alone. This would seem to indicate that the mandatory labeling of cisgenic as GM would affect purchasing habits for cisgenic products. While the magnitude of these numbers are large enough to suggest hypothetical bias, it is important to note that as long as the hypothetical bias is consistent across rounds then the relative difference between rounds is still correct. In Spain, consumers were found to have no statistical difference in their WTP for cisgenic rice and rice labeled as GM. This could be due to the fact that since Spain currently produces GM crops, Spanish consumers might view GM products as less of an issue and thus cisgenic products are lumped into a category that they already accept, and thus do not differentiate between the two. In addition, Spanish consumers have the lowest WTP to avoid consuming rice labeled as GM while consumers in the United Kingdom have the lowest WTP to avoid to consume rice labeled as cisgenic.

Regarding the third scenario (rice labeled as "with environmental benefits"), in each of the five countries consumers have the lowest WTP to avoid to consume rice labeled as having environmental benefits compared to rice labeled as GM (scenario 1) or as cisgenic (scenario 2). In addition, in all five countries, the WTP to avoid consuming rice labeled "with environmental benefits" is statistically different at the 5% level than the WTP to avoid consuming rice labeled as GM. Furthermore, in Spain, France and the United Kingdom the WTP to avoid consuming rice labeled as having environmental benefits is also statistically different at the 5% level than the WTP to avoid rice labeled as cisgenic. In other words, the results suggest that Belgian and Netherlands consumers do not differentiate between rice labeled as cisgenic or as having environmental benefits but that they do differentiate between rice labeled as cisgenic or as GM.

Interestingly, while French consumers have the highest aversion to GM and therefore are willing to pay the highest premium to avoid rice labeled as GM, they also have to highest WTP for rice labeled “with environmental benefits”. This results in a negative WTP to avoid rice labeled as having environmental benefits and means that French consumers are actually willing to pay a premium to consume rice labeled as having environmental benefits compared to conventional rice. The same pattern can be observed in Spain.

Conclusions and recommendations

A. Key findings

The aim of the study was to analyze consumers' attitudes towards cisgenic and transgenic rice and to estimate their WTP for rice labeled as cisgenic, GM, with environmental benefits, or as a combination of these three attributes. On the basis of data collected through an online survey that was administrated in Belgium, France, the Netherlands, Spain, and the United Kingdom and was fully completed by 3002 respondents, the key findings of the study can be summarized as follows.

First, there are important differences among countries concerning consumers' attitudes towards cisgenic and transgenic rice as well as concerning consumers' WTP. French consumers have the biggest aversion to GM products: they are the least willing to consume a cisgenic food product, and they have the most negative attitude towards cisgenic food, and the highest WTP to avoid consuming GM product. At the other end of the scale, Spanish consumers seem to be the least averse to cisgenesis and transgenesis.

Secondly, the statistical analysis of the data shows that consumers differentiate cisgenic and transgenic products. They have different opinions on each of them, with slightly more positive attitude towards cisgenic rice than towards transgenic rice. However, a majority of respondents (84%) still considers that cisgenic product should be clearly labeled as such.

In addition, the survey reveals that many consumers still have uncertain opinions regarding GM, transgenic, and cisgenic products. At least one fifth of the respondents do not have clear feelings about these products, and almost half of them consider that they do not have enough information in order to determine whether they would be willing to eat a cisgenic or a GM food product.

The regression analysis has shown that very few demographics affect the WTP for rice labeled as GM, cisgenic, with environmental benefits, or as a combination of any of these three attributes. Furthermore, the order in which the information is provided to respondents may matter in some instances, but its effect on the WTP is highly variable among countries and depending on the type of information which is provided.

Finally, the data collected through the survey show that in all countries except Spain, the WTP for rice labeled as cisgenic is statistically different from and lower than the WTP for a food product labeled as GM. In addition, it appears that French and Spanish consumers are willing to pay a premium for a product labeled as "with environmental benefits".

B. How to use the findings?

This study provides very useful information for several stakeholders.

Firstly, the results inform policy-makers on the consumers' opinions and help them design and implement an appropriate legislation for the new varieties resulting from new breeding techniques, and more particularly from cisgenesis. This study indicates that consumers seem to differentiate cisgenic and transgenic products. This suggests that specific policies tailored to cisgenesis, should be developed, and that cisgenesis and transgenesis should not be dealt with in the same manner.

Secondly, these results are also of high interest for industries by informing them on the potential existing market for cisgenic varieties and their characteristics. This information can be used to determine the potential profit of a new variety and thus to determine the maximum investment to develop a new variety. Thirdly, the study also provides information for farmers by providing them information to help them decide the rice variety they can grow based on its attributes and its market price.

Finally, the existing literature on consumers' attitudes and acceptance of cisgenic products is rare. This study opens the door for many more studies and analysis of consumers' attitudes and WTP for cisgenic products. The next section presents the limitations and some suggestions for further studies on the topic.

C. Limitations and recommendations for further studies

Several recommendations can be made for further research.

A non-hypothetical study could be made to assess consumers WTP for cisgenic products and to confirm the results obtained in this study. Another way to repeat this study would be to provide all the information about cisgenic product ahead and ask respondents if they would be willing to consume a cisgenic product before the WTP questions. By doing this, respondents who state that they are not willing to consume a cisgenic product are thus not part of the market. Those who are not on the market can be excluded from the sample that estimates the WTP.

While this study focuses on the environmental benefits that could be provided by cisgenic products, it would be interesting to also analyze consumers' attitudes towards, and WTP for, a cisgenic product which would be advertised for its health benefits. As an example, the Simplot's Inate potato variety is a cisgenic variety of low acrylamide potato that brings about health benefits. It has been indeed proven that acrylamide in food product is associated with a higher risk of developing cancer (EFSA, 2011). Previous studies have shown that egoistic motives, such as health benefits, are more efficient incentives in inducing consumers to buy organic foods than more altruistic motives such as, for example, environmental benefits (Magnusson, Arvola, Koivisto Hursti, Åberg, et al. 2003). Thus, it would be interesting to determine if the same trend if observed regarding the purchase of GM food.

Finally, considering the desire of consumers to be more informed about cisgenesis and their mixed or uncertain feelings about cisgenic products, it would be interesting to conduct a survey of consumers' attitudes towards, and WTP for, cisgenic food that would be preceded by an information and Q&A session on the characteristics of cisgenic products.

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Appendix 1

The survey below is presented with Headings for the Information Blocks, along with question numbers that use the form Block#.Question#, (e.g. Q.1). The headings and question numbers as well as italic text are not part of the survey that is seen by the respondent but are used here for organization.

There are 7 information sets presented below, in which respondents make choices between two rice varieties. Each respondent will see 3 of those information sets. There are 6 Treatments consisting of 3 information sets (Table A.1). The treatments are randomly assigned to a respondent in a manner that ensures the same number of presentations of each treatment.

Table A1: Treatments

Random Treatment	Choice Set 1	Choice Set 2	Choice Set 3
1	Cisgenic	GM Cisgenic	GM Cisgenic Environmental
2	Cisgenic	Cisgenic Environmental	GM Cisgenic Environmental
3	GM	GM Cisgenic	GM Cisgenic Environmental
4	GM	GM Environmental	GM Cisgenic Environmental
5	Environmental	GM Environmental	GM Cisgenic Environmental
6	Environmental	Cisgenic Environmental	GM Cisgenic Environmental

Introduction

Q1.1

Consumer buying behavior towards rice

Description*:* In the present study we are interested in how you make decisions on purchasing food products. This on-line survey should require 10 minutes to complete. Your opinions are important to us and we hope that you will take the time to give us your insights on your priorities.

Risks and Benefits: Your participation will assist in the advancement of knowledge of consumer choice behavior. There are no anticipated risks to participating in this study.

Voluntary Participation: Your participation in the research is completely voluntary.

Confidentiality*:* Your responses on the survey will be recorded anonymously. No identifying personal information will be collected on the survey. Only basic demographic information (i.e. age, gender, education etc.) will be collected.

Right to Withdraw: You are free to refuse to participate in the research and to stop filling out the survey at any time. If you have questions or concerns about this study, you may contact xxxxxxxxx. For questions or concerns about your rights as a research participant, please contact xxxxxxxxx, the University's Compliance Coordinator, at xxxxxxx or by e-mail at xxxxxxxxx.

Thank you for your participation! Click the arrow below to begin the survey.

Q1.2

Studies show that people tend to act differently when they face hypothetical decisions. In other words, they say one thing and do something different. For example, some people state a price they would pay for an item, but when this item becomes available in a grocery store, they will not pay the price they said they would pay. We want you to behave in the same way that you would if you really had to pay for the product and take it home.

For the following questions, assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Three comparison sets of rice varieties with different characteristics will be presented. In each set, two rice varieties will be described and we want you to indicate your preferences between the two varieties at different prices.

Cisgenic Rice Information Set

Q2.1

Cisgenic Rice is bred using a process in which genes are transferred between crossable organisms (same species or closely related species). The same result could be obtained by cross-breeding that occurs in nature or by traditional breeding methods but it would require a longer time frame.

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) a Cisgenic rice variety

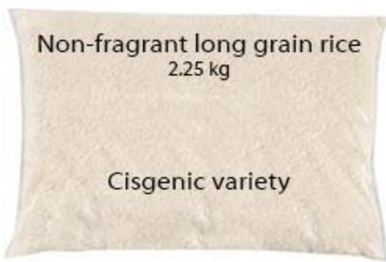
(2) a Conventionally-bred rice variety

Q2.2 *(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)*

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

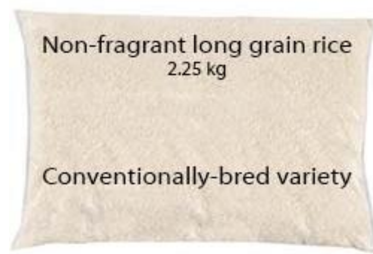
(1) a Cisgenic rice variety

(2) a Conventionally-bred rice variety



Cisgenic variety

€2.25



Conventional variety

€50.00

GM Cisgenic Rice Information Set

Q3.1

Cisgenic rice is a Genetically Modified (GM) rice variety that is bred using a process in which genes are transferred between crossable organisms (same species or closely related species). The same result could be obtained by cross-breeding that occurs in nature or by traditional breeding methods but it would require a longer time frame.

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) Cisgenic rice variety

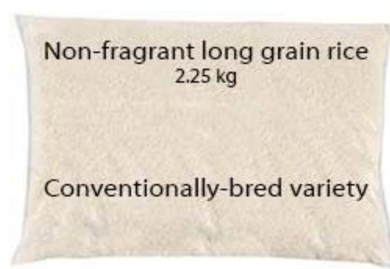
(2) a Conventionally-bred rice variety

Q3.2 *(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)*

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) Cisgenic rice variety

(2) a Conventionally-bred rice variety



Genetically Modified (GM)

Cisgenic variety

€2.25

Conventional variety

€50.00

GM Cisgenic Environmental Rice Information Set

Q4.1

Cisgenic rice is a Genetically Modified (GM) rice variety that is bred using a process in which genes are transferred between crossable organisms (same species or closely related species). The same result could be obtained by cross-breeding that occurs in nature or by traditional breeding methods but it would require a longer time frame.

Cisgenic breeding can result in a rice variety that is resistant to rice blast disease and would not require fungicide sprays. Rice blast is a disease that decreases yields and increases Greenhouse Gas emissions because of the fungicide sprays that are required to treat the disease.

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) Cisgenic rice variety that would not require fungicide applications

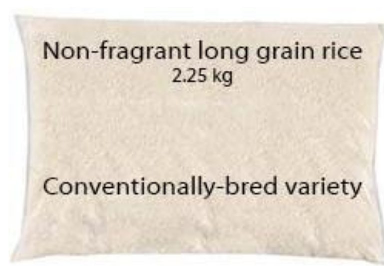
(2) a Conventionally-bred rice variety

Q4.2 *(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)*

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) Cisgenic rice variety that would not require fungicide applications

(2) a Conventionally-bred rice variety



Genetically Modified (GM)

Cisgenic variety

No Fungicide

€2.25

Conventional variety

€50.00

Cisgenic Environmental Rice Information Set

Q5.1

Cisgenic Rice is bred using a process in which genes are transferred between crossable organisms (same species or closely related species). The same result could be obtained by cross-breeding that occurs in nature or by traditional breeding methods but it would require a longer time frame.

Cisgenic breeding can result in a rice variety that is resistant to rice blast disease and would not require fungicide sprays. Rice blast is a disease that decreases yields and increases Greenhouse Gas emissions because of the fungicide sprays that are required to treat the disease.

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) a Cisgenic rice variety that would not require fungicide applications

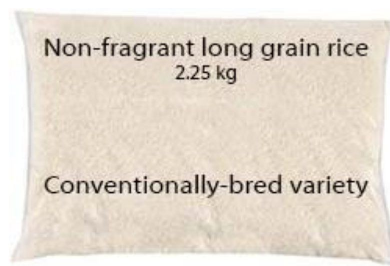
(2) a Conventionally-bred rice variety

Q5.2 *(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)*

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

(1) a Cisgenic rice variety that would not require fungicide applications

(2) a Conventionally-bred rice variety



Cisgenic variety

No Fungicide

€2.25

Conventional variety

€50.00

GM Rice Information Set

Q6.1

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) rice variety

(2) a Conventionally-bred rice variety

Q6.2 *(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)*

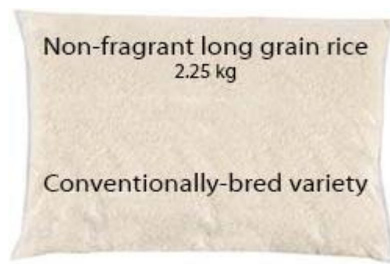
Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) rice variety

(a) a Conventionally-bred rice variety

Genetically Modified (GM) variety

€2.25



Conventional variety

€50.00

GM Environmental Rice Information Set

Q7.1

Genetic Modification (GM) breeding can result in a rice variety that is resistant to rice blast disease and would not require fungicide sprays. Rice blast is a disease that decreases yields and increases Greenhouse Gas emissions because of the fungicide sprays that are required to treat the disease.

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) rice variety that would not require fungicide applications

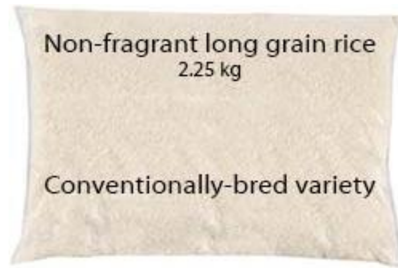
(2) a Conventionally-bred rice variety

Q7.2 ***(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)***

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

(1) a Genetically Modified (GM) rice variety that would not require fungicide applications

(2) a Conventionally-bred rice variety



Genetically Modified (GM) variety

No Fungicide

€2.25

Conventional variety

€50.00

Environmental Rice Information Set

Q8.1

New breeding techniques can result in a rice variety that is resistant to rice blast disease and would not require fungicide sprays. Rice blast is a disease that decreases yields and increases Greenhouse Gas emissions because of the fungicide sprays that are required to treat the disease.

In the next questions we want you to indicate your preferences between two rice varieties at the indicated prices:

(1) Variety A that would not require fungicide applications

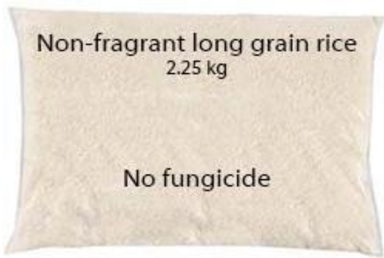
(2) a Conventionally-bred rice variety

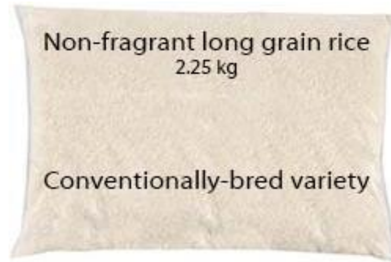
Q8.2 *(The same choices are repeated with decreasing prices for Conventional variety until Conventional variety is chosen: € 20, € 15, € 10, € 8, € 5, € 3, € 2.25, € 2, € 1, € 0.5)*

Assume that you are buying non fragrant long grain white rice and need a 2.25 kg bag. Indicate your preferences between two rice varieties at the indicated prices:

(1) Variety A that would not require fungicide applications

(2) a Conventionally-bred rice variety





Variety A

No Fungicide

€2.25

Conventional variety

€50.00

Consumption And Purchasing Practices

Q9.1

Had you heard of Cisgenic breeding prior to receiving this survey? Yes / No

Q9.2

Do you eat rice? Yes / No

Q9.3

In the last 14 days how many times did you eat rice? 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 1 0 / 11 / 12 13 / 14 / More than 14

Q9.4

Do you purchase any of the groceries for your household? Yes / No

Q9.5 *(Asked only if "Yes" to 9.4):*

How important are the following when you purchase groceries?

	Not at all Important	Slightly Important	Moderately Important	Very Important	Extremely Important
Price					
Brand Name					
Origin of Production					
Organic Status					
Nutritional Content					
Taste					
Product Quality					

Q9.6

What percent of your household food purchases are organic?

	0%	1-24%	25-49%	50-74%	75-99	100%	Not applicable
Fruits, Vegetables and	○	○	○	○	○	○	○
Meat	○	○	○	○	○	○	○
Dairy	○	○	○	○	○	○	○

Q9.7

Would you be willing to consume a Genetically Modified (GM) food if it were available?

Yes / No / Not enough information to decide

Q9.7.a *(Asked only if "No" to Q9.7)*

How important are the following factors in your decision **not** to consume a Genetically Modified (GM) food product?

	Not at all Important	Slightly Important	Moderately Important	Very Important	Extremely Important
Effects on the environment					
Effects on health					
Ethical debate around genetically					

Q9.8: Would you be willing to consume a Cisgenic food if it were available?

Yes / No / Not enough information to decide

Q9.8.a ***(Asked only if "No" to Q9.8)***

How important are the following factors in your decision **not** to consume a Cisgenic food product?

	Not at all Important	Slightly Important	Moderately Important	Very Important	Extremely Important
Effects on the environment					
Effects on health					
Ethical debate around Cisgenic foods					

Q9.9: Have you ever knowingly eaten a Genetically Modified (GM) food product? Yes / No

Opinions About GM

Q10.1

We would like your opinion about **Genetically Modified (GM) rice**. Indicate the degree to which you agree or disagree with the following statements.

	Totally Disagree	Tend to Disagree	Tend to Agree	Totally Agree	Don't Know
GM rice is good for the national economy					
GM rice helps people in developing countries					
GM rice is safe for future generations					
GM rice is fundamentally unnatural					
GM rice is safe for my health and my family's health					
GM rice does no harm to the environment					
The development of GM rice should be encouraged					
I am in favor of allowing GM rice to be sold in my country					

Opinions About Cisgenic and Transgenic Rice

Q11.1

Researchers have discovered new ways of controlling common diseases in rice – things like blast. There are two new ways of doing this, both of which use Genetic Modification (GM). Both mean that the rice could be grown without fungicides, which lessens the Greenhouse Gas emissions of production. Both methods mitigate yield losses from blast which can be over 50% and can threaten the food security of the roughly 3.5 billion people who depend on rice in their diets.

Q11.2

The first of the two methods is called **Cisgenic breeding**, which introduces a gene from a wild rice species into a commercial rice variety to make it resistant to rice blast disease.

Rice blast is a disease that requires fungicide sprays and decreases yields. Yield loss can be over 50% and can threaten the food security of the roughly 3.5 billion people who depend on rice in their diets.

For each of the following statements about this new technique please tell me if you agree or disagree.

	Totally Disagree	Tend to Disagree	Tend to Agree	Totally Agree	Don't Know
Cisgenic rice is good for the national economy					
Cisgenic rice helps people in developing countries					
Cisgenic rice is safe for future generations					
Cisgenic rice is fundamentally unnatural					
Cisgenic rice is safe for my health and my family's health					
Cisgenic rice does no harm to the environment					
The development of Cisgenic rice should be encouraged					

I am in favor of allowing Cisgenic rice to be sold in my country	

Q11.3

Which of the following statements is closest to your view?

○ Rice created by Cisgenic breeding is Genetically Modified (GM) rice and should be clearly identified with a special label.

○ Rice created by Cisgenic breeding is the same as ordinary rice and would not need special labeling.

Q11.4

The second method is called **Transgenic breeding**, which introduces a gene from another species into a commercial rice variety to make it resistant to rice blast disease.

Rice blast is a disease that requires fungicide sprays and decreases yields. Yield loss can be over 50% and can threaten the food security of the roughly 3.5 billion people who depend on rice in their diets.

For each of the following statements about this new technique please tell me if you agree or disagree.

	Totally Disagree	Tend to Disagree	Tend to Agree	Totally Agree	Don't Know
Transgenic rice is good for the national economy					
Transgenic rice helps people in developing countries					
Transgenic rice is safe for future generations					
Transgenic rice is fundamentally unnatural					
Transgenic rice is safe for my health and my					

family's health	
Transgenic rice does no harm to the environment	
The development of Transgenic rice should be encouraged	
I am in favor of allowing Transgenic rice to be sold in my country	

Q11.5

Which of the following statements is closest to your view?

- ○ Rice created by Transgenic breeding is Genetically Modified (GM) rice and should be clearly identified with a special label.
- ○ Rice created by Transgenic breeding is the same as ordinary rice and would not need special labeling.

Demographics

Q12.1

In what country do you currently live?

- ○ Belgium
- ○ France
- ○ The Netherlands
- ○ Spain
- ○ The United Kingdom
- ○ Other Country [ ]

Q12.2

How would you describe your living environment? Very rural / Somewhat rural / Suburban / Somewhat urban / Very urban

Q12.3

What is your age?

Q12.4

What is your gender? Male / Female

Q12.5: Do you live alone or with others? Live alone / Live with others

Q12.6 ***(asked only if "Live with others" in Q12.5)***

How many people in your household are in the following age categories?

Adults and children age 15 and older	▾
Children age 7 to 14 years old	▾
Children age 0 to 6 years old	▾

Q12.7

What is your highest education level?

- ○ Primary school diploma
- ○ General Certificate of Secondary Education
- ○ Sixth Form

- Undergraduate at university
- Master's degree at university
- Doctoral degree (PhD)
- Higher education (not university)

Q12.8

What is your total net (after tax) household income?

- Less than 18 000 €
- 18 000 € to 34 999 €
- 35 000 € to 49 999 €
- 50 000 € to 64 999 €
- 65 000 € to 79 999 €
- 80 000 € to 99 999 €
- 100 000 or more €

Appendix 2

Table A2: Consumers attitudes towards cisgenic and transgenic rice - Belgium (%)

	Totally disagree		**Tend to disagree**		**Tend to agree**		**Totally agree**		**Do not know**	
	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran
1. Cisgenic/Transgenic rice is good for the national economy	3.4	3	7.8	7.2	44.6	43.2	10	9.4	34.2	37.2
2. Cisgenic/Transgenic rice helps people in developing countries	3.8	3.2	8.4	7.6	41.6	43	20.4	17	25.8	29.2
3. Cisgenic/Transgenic rice is safe for future generations	3.8	4.6	7.8	6	37.2	38.6	10.8	10.4	40.4	40.4
4. Cisgenic/Transgenic rice is fundamentally unnatural	4	5.2	28	26.2	27.6	25.4	9	9.4	31.4	33.8
5. Cisgenic/Transgenic rice is safe for my health and my family's health	3.6	4.2	5.8	5.6	37.8	39.4	9.8	7.4	43	43.4
6. Cisgenic/Transgenic rice does no harm to the environment	4.4	3.4	8.2	8.6	37	37.2	9.6	9	40.8	41.8
7. The development of Cisgenic/Transgenic rice should be encouraged	4.2	5.6	10.8	7.8	37.4	39.2	11	10.6	36.6	36.8
8. I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	5.4	6	7	7.4	39.2	40.2	12.2	10.8	36.2	35.6

Table A3: Consumers attitudes towards cisgenic and transgenic rice - France (%)

	Totally disagree		**Tend to disagree**		**Tend to agree**		**Totally agree**		**Do not know**	
	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran
1. Cisgenic/Transgenic rice is good for the national economy	11.73	14.4	11.73	14.4	38.4	31.87	12.53	12.4	25.6	26.93
2. Cisgenic/Transgenic rice helps people in developing countries	11.2	12.8	11.87	13.87	38.8	35.2	17.47	14.93	20.67	23.2
3. Cisgenic/Transgenic rice is safe for future generations	17.2	20.27	17.2	18.8	21.2	17.73	8.13	6.93	36.27	36.27
4. Cisgenic/Transgenic rice is fundamentally unnatural	10.27	11.73	19.6	18.4	28,0	26.27	18.27	19.47	23.87	24.13
5. Cisgenic/Transgenic rice is safe for my health and my family's health	16.93	19.47	16,0	19.07	23.47	19.2	7.73	7.07	35.87	35.2
6. Cisgenic/Transgenic rice does no harm to the environment	15.2	18.53	16,0	18.27	29.33	23.73	10.8	8.8	28.67	30.67
7. The development of Cisgenic/Transgenic rice should be encouraged	18.27	20.67	17.07	20.8	28.13	23.07	9.33	7.47	27.2	28,0
8. I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	20.4	24,0	17.07	17.87	26.4	22.8	10.13	7.47	26,0	27.87

Table A4: Consumers attitudes towards cisgenic and transgenic rice - Netherlands (%)

	Totally disagree		**Tend to disagree**		**Tend to agree**		**Totally agree**		**Do not know**	
	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran
1. Cisgenic/Transgenic rice is good for the national economy	3.32	3.65	8.14	7.64	43.52	40.53	9.97	11.46	35.05	36.71
2. Cisgenic/Transgenic rice helps people in developing countries	3.65	3.65	7.81	8.47	45.18	45.35	16.94	12.62	26.41	29.9
3. Cisgenic/Transgenic rice is safe for future generations	3.32	4.15	7.14	6.31	38.21	36.38	11.13	10.96	40.2	42.19
4. Cisgenic/Transgenic rice is fundamentally unnatural	4.65	4.82	22.76	20.1	28.24	28.24	8.31	9.3	36.05	37.54
5. Cisgenic/Transgenic rice is safe for my health and my family's health	4.32	4.49	5.48	7.31	36.71	34.22	9.14	8.8	44.35	45.18
6. Cisgenic/Transgenic rice does no harm to the environment	4.65	4.32	7.48	9.97	38.21	32.89	9.47	10.13	40.2	42.69
7. The development of Cisgenic/Transgenic rice should be encouraged	4.32	4.65	7.48	7.64	38.54	36.88	10.96	10.47	38.7	40.37
8. I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	4.65	4.98	7.48	7.14	39.7	36.54	10.8	11.63	37.38	39.7

Table A5: Consumers attitudes towards cisgenic and transgenic rice - Spain (%)

	Totally disagree		**Tend to disagree**		**Tend to agree**		**Totally agree**		**Do not know**	
	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran
1. Cisgenic/Transgenic rice is good for the national economy	4.76	6.02	7.52	11.53	39.6	35.84	26.82	25.31	21.3	21.3
2. Cisgenic/Transgenic rice helps people in developing countries	4.51	5.76	8.02	8.77	34.09	37.34	36.34	32.08	17.04	16.04
3. Cisgenic/Transgenic rice is safe for future generations	4.51	7.52	9.77	11.78	35.59	35.84	27.32	22.81	22.81	22.06
4. Cisgenic/Transgenic rice is fundamentally unnatural	11.28	10.03	23.81	21.55	31.33	33.83	15.29	18.3	18.3	16.29
5. Cisgenic/Transgenic rice is safe for my health and my family's health	5.01	8.02	9.27	12.53	38.1	36.84	24.56	20.05	23.06	22.56
6. Cisgenic/Transgenic rice does no harm to the environment	6.02	8.52	9.02	10.03	32.33	32.33	31.08	28.07	21.55	21.05
7. The development of Cisgenic/Transgenic rice should be encouraged	6.52	9.52	7.52	11.28	36.34	36.09	28.82	23.81	20.8	19.3
8. I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	5.26	9.52	10.53	11.28	35.09	32.83	27.57	26.82	21.55	19.55

Table A6: Consumers attitudes towards cisgenic and transgenic rice – United Kingdom (%)

	Totally disagree		**Tend to disagree**		**Tend to agree**		**Totally agree**		**Do not know**	
	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran	Cis	Tran
1. Cisgenic/Transgenic rice is good for the national economy	5.06	6.13	7.72	6.92	41.94	39.81	18.11	17.98	27.16	29.16
2. Cisgenic/Transgenic rice helps people in developing countries	4.79	5.06	7.32	7.19	36.62	35.02	29.69	27.56	21.57	25.17
3. Cisgenic/Transgenic rice is safe for future generations	7.32	7.19	7.19	9.05	33.42	29.43	17.04	15.45	35.02	38.88
4. Cisgenic/Transgenic rice is fundamentally unnatural	6.39	5.59	23.57	20.11	29.83	31.69	16.38	15.31	23.83	27.3
5. Cisgenic/Transgenic rice is safe for my health and my family's health	6.79	7.32	7.06	8.39	34.62	30.63	16.25	15.05	35.29	38.62
6. Cisgenic/Transgenic rice does no harm to the environment	6.13	6.66	9.32	9.45	33.69	32.22	18.11	16.38	32.76	35.29
7. The development of Cisgenic/Transgenic rice should be encouraged	7.99	8.12	8.12	9.19	34.22	30.49	20.77	19.97	28.89	32.22
8. I am in favor of allowing Cisgenic/Transgenic rice to be sold in my country	9.05	9.19	8.12	8.79	36.09	31.96	20.11	19.97	26.63	30.09

Appendix 3

Table A7: Interval regression results of WTP to consume conventional rice instead of the alternative, by country

	BELGIUM		FRANCE		NETHERLANDS		SPAIN	
	Coeff	**St Error**	**Coeff**	**St Error**	**Coeff**	**St Error**	**Coeff**	**St Error**
Intercept	10.68**	2,48	29.83**	3,53	16.02**	2,55	16.97**	3,09
Treatment effect								
GM								
Cisgenic	-7.63**	2,12	-15.87**	3,06	-6.82**	1,89	-1.97	2,77
Env. Benefits	-9.82**	2,41	-44.88**	3,20	-9.15**	2,12	-15.43**	2,70
Cisgenic - GM	-4.61	2,78	-12.60**	3,77	-2.35	2,48	1.92	3,75
Cisgenic Env. Benefits	-8.89**	2,80	-23.05**	3,90	-9.48**	2,27	-10.25**	3,17
GM - Cisgenic	0.92	2,02	-2.54	2,60	-2.17	1,86	-1.23	2,46
GM - Env. Benefits	-2.16	1,88	-9.27**	2,96	-1.13	1,84	-3.96	2,77
Env. Benefits - GM	-5.79	3,15	-26.69**	3,73	-7.08**	2,55	-11.50**	3,16
Env. Benefits - Cisgenic	-9.72**	2,90	-42.88**	3,82	-9.17**	2,63	-14.00**	3,68
Cisgenic - GM - Env. Benefits	-7.27**	2,85	-17.62**	3,82	-4.30	2,70	-5.96	3,61
Cisgenic- Env. Benefits - GM	-6.81**	3,15	-19.05**	3,96	-9.56**	2,37	-7.21**	3,50
GM - Cisgenic - Env. Benefits	-4.28**	2,12	-9.79**	3,07	-3.82	2,05	-9.16**	2,45
GM - Env. Benefits - Cisgenic	-2.25	2,22	-12.60**	3,33	-0.51	1,84	-4.42	2,77
Env. Benefits - GM - Cisgenic	-5.78	3,13	-24.45**	3,99	-3.97	2,85	-11.32**	3,34
Env. Benefits - Cisgenic - GM	-10.13**	2,81	-32.24**	3,95	-7.67**	2,64	-11.05**	3,90

Table A7 (Cont.): Interval regression results of WTP to consume conventional rice instead of the alternative, by country

	BELGIUM		FRANCE		NETHERLANDS		SPAIN	
	Coeff	**St Error**	**Coeff**	**St Error**	**Coeff**	**St Error**	**Coeff**	**St Error**
Age categories								
Less than 30 years old								
Between 30 and 39 years old	3.11	3,04	0.92	3,21	1.76	2,94	-2.24	2,72
Between 40 and 49 years old	-1.68	2,25	3.15	3,08	-5.04**	2,13	-5.21**	2,65
Between 50 and 59 years old	3.18	2,72	6.33	3,54	-1.16	2,45	-1.24	3,72
60 years old or more	3.03	2,74	1.91	3,99	-0.99	2,46	8.64	7,48
Children less than 7 in the household								
Yes	0.50	2,81	6.28**	3,26	1.01	2,51	-2.78	2,64
Education								
High school or less								
Undergraduate	1.45	2,40	2.62	2,83	3.60**	1,76	1.16	3,29
Master degree or Phd	3.43	2,19	5.84**	2,72	0.56	2,28	-0.41	2,31
Income								
Less than 18 000€								
18 000€ to 34 999€	0.99	2,25	2.06	2,56	-4.20**	2,05	0.08	2,40
35 000€ to 49 999€	-1.11	2,72	5.23	3,35	-5.41	2,20	0.82	3,17
50 000€ and more	-2.47	3,04	3.86	4,21	1.32	2,86	-0.26	3,63
Sigma	20.55	1,12	31.25	1,04	19.82	0,05	21.94	0,06

Table A7 (Cont.): Interval regression results of WTP to consume conventional rice instead of the alternative, by country

	UNITED KINGDOM	
	Coeff	**St Error**
Intercept	18.46**	2,93
Treatment effect		
GM		
Cisgenic	-7.68**	2,12
Env. Benefits	-13.93**	2,15
Cisgenic - GM	-6.03**	2,62
Cisgenic Env. Benefits	-10.55**	2,68
GM - Cisgenic	0.64	1,90
GM - Env. Benefits	-5.53**	1,91
Env. Benefits - GM	-5.42	2,90
Env. Benefits - Cisgenic	-13.09**	2,69
Cisgenic - GM - Env. Benefits	-8.86**	2,78
Cisgenic- Env. Benefits - GM	-7.59**	2,92
GM - Cisgenic - Env. Benefits	-4.10	2,11
GM - Env. Benefits - Cisgenic	-5.02**	2,02
Env. Benefits - GM - Cisgenic	-5.56**	2,84
Env. Benefits - Cisgenic - GM	-9.59**	2,79
Age categories		
Less than 30 years old		
Between 30 and 39 years old	-0.11	2,59
Between 40 and 49 years old	-4.06	2,49
Between 50 and 59 years old	-2.61	2,57
60 years old or more	-4.72	2,79

Table A7 (Cont.): Interval regression results of WTP to consume conventional rice instead of the alternative, by country

	UNITED KINGDOM	
	Coeff	**St Error**
Children less than 7 in the household		
Yes	-0.34	2,36
Education		
High school or less		
Undergraduate	2.57	1,98
Master degree or Phd	5.90**	2,00
Income		
Less than 18 000€		
18 000€ to 34 999€	-0.89	2,08
35 000€ to 49 999€	-4.95**	2,41
50 000€ and more	0.80	2,68
Sigma	23.35	0,04

October 22, 2013

MEMORANDUM

TO:	Lawton Nalley Diana Danforth Anne-Cecile Delwaide
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	13-10-185
Protocol Title:	*Consumers' Willingness-to-Accept Cisgenically Bred Rice*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 10/22/2013 Expiration Date: 10/21/2014

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (http://vpred.uark.edu/210.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 3,000 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu