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Acceptance of Genetically Modified Foods with Health Benefits: A Study in Germany

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A study was carried out in Germany in order to assess consumers' acceptance of genetically modified (GM) foods with health benefits (bread, yogurt and eggs). Acceptability of GM foods increases when its source does not involve animal products such as eggs. Three factors have been identified as direct antecedents of the acceptance of GM foods: respondents' attitude towards biotechnology, health consciousness, and time pressure, being the first one the most salient one. Price consciousness has an indirect positive impact (mediated by health consciousness) upon acceptance of GM products. Males were more likely to accept GM foods with health benefits.

KEYWORDS GM food, attitude toward biotechnology, time pressure, health and price consciousness

INTRODUCTION

Gene technology was born in 1973 when scientists were able to transfer *in vitro* a gene from one species to another (Scholderer, 2005). Nevertheless,

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it is in the past few decades that GM foods with health benefits (GMFHB) are enjoying rapid growth in many countries to the point that some consider them the fastest-growing technology in the history of agriculture (Klerck & Sweeney, 2007). Global firms involved in the production and distribution of GMFHB would like to repeat the success obtained in the United States in other regions of the globe such as the European Union (EU). These firms in most cases not only offer more variety and assortment of GMFHB products, but also offer them at very competitive prices. This, coupled with the increased standard of living and improved lifestyles of consumers, means target consumers can be exposed to a wide range of GMFHB products. Up to the present, it seems that consumers from different countries have not fully reached any definitive final position on GM food. Therefore, from a marketing point of view, global companies that are operating in competitive domestic and foreign markets such as the EU need to understand consumers' perceptions and evaluations of GMFHB products more than ever before. Understanding the potential GMFHB consumer orientation is the first phase of global corporate learning about how to compete in the world market such as the EU (Craig & Douglas, 1996). Hence marketers and academics have shown greater interest in understanding the variables that affect consumers' evaluation of GMFHB products. However, because of legal restrictions on GM products in the EU countries, commercialization of GMFHB to consumers in member countries such as Germany has been possible only in the past few years.

Genetic modification involves the transfer of specific genes from one organism to another host organism (Burton & Pearse, 2002). The new generation of GM food research is concentrating on attributes of interest for consumer health (Anderson & Jackson, 2005) to improve functionality of such foods. In 1998 the EU forbade the entrance and commercialization of GM products until they can properly assess GM products' effect on human health and on the environment. In January 2004, the EU Commission approved the import and marketing of a type of genetically modified sweet corn, known as Bt11, for human consumption, thus ending a six-year moratorium on GM products.

In anticipation of further liberalization of GM foods, it is the aim of this study to determine some of the factors that influence the acceptability of GM foods, how these factors interact among themselves, and find out if the acceptance of GM foods would increase if they were offered along with added health benefits. The GMFHB products included in this study are: bread, yogurt and egg, which can be obtained by means of three different processes of production, namely, conventional, organic, and genetic modification.

A review of the research literature suggests that a large body of the GMFHB findings have been based on North American consumers. Although European consumers are highly reluctant to accept GM foods (Moerbeeck &

Casimir, 2005), Tsakiridou, Tsioumanis, Papastefanou, & Mattas (2007) report that low income, younger age, and cohabiting Europeans are more willing to buy GM food.

To add to the limited GM foods acceptance literature in Europe, this study focuses on the student consumers in Germany to empirically test GMFBH acceptance. The study deals with the relationship between GMFBH acceptance and German students' food attitudes and demographic characteristics. First, the relevant literature is reviewed and research hypotheses are formulated. Second, the research design and methodological procedures are described. Third, the study findings are presented and discussed. Finally, marketing management implications are highlighted.

LITERATURE REVIEW

Attitude Toward Biotechnology and Genetically Modified Foods

Numerous studies have investigated consumers' preferences regarding GM foods. They have addressed the issue of GM-containing products against the alternative of GM-free products. Gaskell (2000) found that European consumers have a negative attitude towards GM foods and the use of this technology in animals. At the same time, their perceptions of medical biotechnologies (genetic testing, and the production of pharmaceuticals) and environmental biotechnologies (bio-remediation) are very positive. Harrison, Boccaletti, & House (2004) argue that consumers have concerns about GM foods because this technology may have some long-term or unforeseen health risks, and negative effects on wildlife and the environment. The environmental concerns include the potential for GM plants to interact with non-GM plants, leading to the contamination. There are also concerns that foods with transplanted genes may cause allergic reactions in some consumers.

Previous research has focused in a series of different independent variables to explain acceptance of GM food. Bukenya and Wright (2007) report that consumers' attitude and purchase decisions concerning GM foods are generally negative, highly complex, and are based on a variety of factors. Among these factors are knowledge, awareness, and price of GM food (Boccaletti & Moro, 2000; Canavari & Nayga, 2009; Mather, Knight, & Holdsworth 2005; Moerbeek & Casimir, 2005), risk perceptions (Barker & Burnham, 2001), source of the genes used in the GM process (Burton & Pearse, 2002), trust in various information sources (Costa-Font & Mossialos, 2005; Hunt & Frewer, 2001; Kim & Boyd, 2006), demographic variables such as gender (Moerbeek & Casimir, 2005) and age (Tsakiridou et al., 2007), ethical beliefs about the use of GM in food (Moon & Balasubramanian, 2001), and personal values (Tsakiridou et al., 2007). Thus, a whole range of potential interconnected factors may determine the final level of consumers' willingness to buy GM foods.

One of the factors to be considered is how aware consumers are that they are really buying and or eating GM food products. For instance, in the United States a reduced number of consumers are aware that genetically modified foods are currently sold in supermarkets. This may be so because the labeling of those products is voluntary and no foods have been labeled as GM foods (Chern et al., 2002). A complete different situation is found in Europe and Japan where laws request producers to label the food products as GM if more than 0.9% and 5% of any ingredient is GM-based, respectively (McKluskey, Grimsrud, Ouchi, & Wahl, 2003).

Gaskell et al. (2004) showed that the consumers' reluctance to purchase GM foods is not because there is a misperception of the risks associated with them, but rather a perception of an absence of benefits. They argue that in the minds of a large proportion of the European public, GM foods are a "non-innovation". They also argue that if consumers do not perceive an improvement in terms of price, quality, or other attributes, there is simply no incentive to deliberate further on the issue of GM.

Hallman and Aquino (2003) carried out telephone surveys in the United States in order to track the strength, extent, and persistence of consumers' attitudes towards GM food. They found that Americans remain largely uninformed about GM foods. Only 20% of the respondents had more than one or two conversations about GM foods. The results also suggest that support for GM food has slipped between the years 2001 and 2003. In 2001 59% of the respondents said that they thought that GM would make their lives better, while in 2003 only 39% had a similar response. They also found that there is a lack of awareness about eating GM food. Only 26% of the respondents believe that they have ever eaten a GM food and, only about half of the Americans (52%) are aware that GM food products are currently sold in supermarkets.

Lusk, Jamal, Kurlander, Roucan, and Taulman (2004) carried out a meta-analysis of 25 studies that deal with GM foods. They found that consumers on average placed a higher value on non-GM foods. European consumers placed a higher value on non-GM food than North American consumers.

A survey carried out by International Food Information Council, during the period 1997 to 2001, showed that between 51% to 77% of U.S. consumers were willing to purchase GM foods when they perceived a benefit associated with the technology (Harrison et al., 2004). Boccaletti and Moro (2000) found that for Italian consumers, the rate of acceptance increased when they were presented with a second generation of GM food products that offered the following benefits: (1) lower pesticide use; (2) improved nutritional characteristics; (3) improved organoleptic characteristics; and (4) longer shelf life. While 18% of their respondents stated that they would not buy "generic" GM foods, this percentage decreased to about 12% when additional benefits were offered.

Larue, West, Gendron, and Lambert (2004) compared Canadian consumers' response to GM foods, conventional, and modified organic foods. They found that conventional foods are preferred over modified foods. They also found strong evidence of the existence of small niche markets for both organic and GM foods, regardless of the presence or absence of a functional attribute.

Provision of crucial information has been found positively related to the acceptance of GM food. For example, Kim and Boyd (2006) reported that labeling of country of origin, brand name, GM labeling, safety certification, and traceability were likely to increase Japanese consumers' willingness to accept GM foods. They also found that limited information and lack of understanding among consumers regarding GM food products have a negative impact on their attitudes, perception, and interest in GM foods. A more recent study conducted in Italy by Canavari and Nayga (2009) found that enhancing nutritional information could contribute to a higher acceptance of GM foods, but only if it is a plant-based food product and not an animal-based food product. However, Buchi and Neresini (2002) have reported that in the case of GM foods more knowledge, led to less acceptance. In this line of thought, Canavari and Nayga (2009) conclude that consumers who disapprove of buying GM food products cannot be easily persuaded to accept them even with the additional nutritional information and a lower price. Consumers' refusal of GM animal-based products at a higher level than GM plantbased food products was already reported in late 1990s (Frewer, Howard, Hedderly, & Shepherd, 1998).

Health Consciousness

Food consumers in industrialized countries like Germany have moved up along the Maslow's hierarchy of needs pyramid. Their food consumption, in addition to nourishment is also motivated by higher level of needs such as prestige and self fulfillment (Senauer, 2001; Sijtsema, Linnemann, von Gaasbeck, Dagevos, & Jongen, 2002). These consumers expect foods to be safe, promoting good health, convenient, and easy to prepare. By adding nutritional value and rising sensory quality, the food industry is moving towards a new generation of foods that have additional health-promoting or protecting benefits (Plaami, Dekker, van Dokkum, & Ockhuizen, 2001).

A food can be regarded as functional if it has been demonstrated by sound scientific research to affect beneficially one or more target functions in the body, beyond nutritional effects (Plaami et al. (2001). Frewer, Howard and Shepherd (1996) argue that there is an assumption that consumers will be more accepting of novel foods if there is a concrete and tangible benefit for them. It is thought that the perception of benefits will offset any negative perceptions of risk associated with novel processing technologies. However,

they also argue that the nature of these benefits is problematic. First, health claims are heavily regulated in the United States and in the EU. Second, health claims refer to a benefit that cannot be directly observed by consumers. Health benefits have to be communicated by means other than the product itself. Acceptance of health claims depends on how credible consumers judge the source of that information (Frewer, Howard, Hedderly, & Shepherd, 1996). For instance, Japanese consumers rated academics/scientist as the most reliable source of GM information. The food companies were considered the least reliable (Kim & Boyd, 2006).

Price Consciousness

Boccaletti and Moro (2000) found that one of the main reasons for the low acceptance of GM food products in Italy is the scarce knowledge that the consumers have about this topic, hence affecting their willingness to pay for them. They state that when consumers are given the correct information they are more willing to pay higher prices in order to benefit from quality improvements. According to Boccaletti and Moro, for acceptance of GM foods, practical reasons often prevail over ethical considerations. This may be particularly true whenever the use of biotechnology reduces health risks, such as those caused by the use of pesticides. Results reported by Chern, Rickertsen, Tsuboi, and Fu (2002) and Klerck and Sweeney (2007) confirm these findings.

A recent study found that U.S. consumers were not willing to buy GM tomatoes regardless of the discount offered, and they were willing to pay a percentage premium of around 20% for non-GM tomatoes (Bukenya & Wright, 2007). Similarly, Burton, Rigby, Young, and James (2001) found that organic food buyers were willing to pay considerably more for GM-free than others. In another study carried out in the UK, Burton et al. (2001) found that genetic modification is only one element amongst a number of concerns in forming food preferences. Consumer attitudes differ significantly between technologies through which plants are modified, whether by the introduction of genes from other plants or from animals. The authors state that the attitude towards organic foods is negatively related to attitudes towards GM technology.

A study carried out in Australia by Burton and Pearse (2002) shows that 30% of their sample respondents were not prepared to select a beer with a GM component. A second set of consumers required a price discount to be induced to purchase beer with a GM component, and a third set of respondents were prepared to pay a premium to access a GM product resulting in lower cholesterol.

Grunert and Bech-Larsen (2004) carried out an experiment to find out if a positive sensory experience with GM food products would influence their attitudes towards the use of these products. They found that subjects

in the experimental group (those with positive sensory experience with GM cheese) had a less negative attitude towards GM foods than the control group (no GM).

Time Pressure

Finally, based on time allocation theory, we would like to test the significance of a frequent neglected variable when studying acceptance of GM food. Past research has not studied the effect of time pressure on the acceptance of GM foods. Time pressure may be seen from an economic perspective as something of value (Juster & Stafford, 1991). However, time pressure is also discussed in psychology literature, where it is seen as a cause of differences in decision making compared to situations where the perception of lack of time is absent (Wright, 1974). Time pressure is seen as time duration (i.e., clock time), which causes individuals to relocate activities, reducing the time taken for some routine activities, so as to have more discretionary time available (Rojas-Mendez, Davies, Omer, Chetthamrongchai, & Madran, 2002).

Early general models considered attitudes towards time an important factor when explaining consumption behaviour (Berry, 1979; Sheth, 1983). Howard and Sheth (1969) treated time as a constraint and their consumer behaviour model recognised that "time pressure" affected both purchasing behaviour and consumption. Engel, Kollat and Blackwell (1968) also viewed time as a constraint, and they considered a time budget as being parallel to a money budget. Time-pressured individuals are those who express feelings about the degree to which they feel pressure when they are rushed and at the same time don't have enough time to get things done or to gather the ideal amount of information prior to make a purchase decision (Brodowsky & Anderson, 2000). Previous research has found that limited amounts of time may influence food purchasing behavior (Binkley, 2006). Welch, McNaughton, Hunter, Hume, and Crawford (2008) found that time pressure was a barrier to engage in physical activity and to healthy eating among young Australian women, especially among those having higher educational levels and never married. It has also been found that time-pressured shoppers strive for efficiency and show a high risk aversion by not necessarily resorting to price signalling (Herrington & Capella, 1995; Shannon & Mandhachitara, 2008). Therefore, we should expect a negative relationship between time pressure and acceptance of GM foods and health consciousness.

High time-pressured individuals are not in a position to devote much time to search for external information such as price and promotions when they are carrying out their grocery purchases, especially if this requires visits to multiple stores, or the previous collection of discount coupons (Beatty & Ferrel, 1998). Vermeir and van Kenhove (2005) found that time-pressured

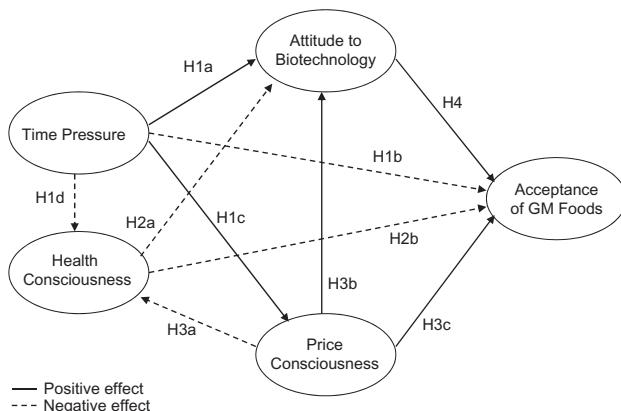


FIGURE 1 Theoretical model of GM foods' acceptance.

Belgium consumers tend to search less for promotional and price information, especially for coupons and in-store specials and promotions. Thus, the relationship between time pressure and price consciousness is expected to be negative.

Thus, the main objective of this article is twofold. First is to investigate the relationship and impact of potential independent variables upon consumers' acceptance of GM foods, and second to identify a potential target market for the introduction of GM foods in Germany.

Hypotheses Formation

Based on the literature review, it is believed that much more research is still needed to better understand consumers' willingness to accept and buy GM food, particularly in the German market. To help in this research, and based on the previous discussion, the theoretical model shown in Figure 1 has been developed. The theoretical model posits the following hypotheses:

- H1a: The more time pressured individuals are, the better their attitude toward biotechnology.
- H1b: The more time pressured individuals are, the lower their acceptance of GM foods.
- H1c: The more time pressured individuals are, the less price conscious they are.
- H1d: The more time pressured individuals are, the less health conscious they are.
- H2a: The more health conscious individuals are, the less positive their attitudes are towards biotechnology.
- H2b: The more health conscious individuals are, the lower their willingness to accept GM foods.
- H3b: The more price conscious individuals are, the lower their acceptance of GM foods.
- H3c: The more price conscious individuals are, the less positive their attitudes are towards biotechnology.
- H4: The more positive individuals' attitudes are towards biotechnology, the higher their acceptance of GM foods.

- H3a: The more price conscious individuals are, the less health conscious they are.
- H3b: The more price conscious individuals are, the better their attitudes toward biotechnology.
- H3c: The more price conscious individuals are, the higher their willingness to accept GM foods.
- H4: The better the individuals' attitude toward biotechnology, the higher their willingness to accept GM foods.

RESEARCH DESIGN AND DATA COLLECTION

Sample Selection

Data for this research were collected through a survey of students at a German university. This sampling frame was chosen because (1) previous studies dealing with the acceptance of GM products indicated that student samples generated valuable estimates on a par with studies using probabilistic samples (Lusk et al., 2004), and (2) university students are expected to have a high level of knowledge of biotechnology and its applications to respond meaningfully to our questionnaire.

Measurement Instrument

The questionnaire was developed in the German language. The questions for this study were generated through a review of the pertinent literature. Questions dealing with the acceptability of different applications of biotechnology were based on Gaskell (2000).

The questionnaire consisted of four sections. The first section dealt with the frequency of consumption of three products evaluated in this study, namely, yogurt, bread, and eggs. In section two, the respondents were presented with cards dealing with each of the three products. The cards requested students to choose between the three options for each food item which differed on the basis of the price and the three processes through which the items were made (conventional, GM, or organic). In section three, attitudinal questions to measure the following constructs were presented: health consciousness, price consciousness, time pressure, attitude toward biotechnology, and acceptance of GM foods. The fourth and last section of the questionnaire consisted of demographic questions dealing with the gender, age, and marital status.

Before collecting the data for the study, a preliminary questionnaire was first tested with a convenience sample of 15 students. Based on their responses, the questionnaire was slightly modified in order to improve comprehension by the respondents.

Data Collection Procedure

The sample respondents were selected randomly, approached by two research assistants at the central lunchroom using the “mall intercept technique.” An intercept study technique entails selecting potential respondents by stopping and interviewing them in a public place (e.g., shopping mall, central lunchroom at a university, etc.). The questionnaire was filled out by the respondents in the presence of the research assistants. In total, 260 students were approached, out of which 183 agreed to respond to our questionnaire, leading to a response rate of 70%, which is considered satisfactory.

RESULTS

Sample Description

The mean age of student participants is 26 years. The sample includes more singles or cohabiting singles (88%) than married (12%). There are slightly more female respondents (54%) than male (46%). Six percent of respondents have children under the age of six.

Attitudes and Perceptions of Factors Associated with Food Products

In terms of their eating habits, the respondents stated that they ate bread almost every day, eggs about once a week, and yogurt about once a month. Their knowledge of biotechnology was somewhat limited.

Table 1 presents results dealing with attitudes and perceptions associated with food products. The results indicate that the most important factor in the purchase of food on a 5-point Likert scale was taste (4.2), price (3.9), quality (3.8), health (3.7) and convenience (3.2). In terms of the respondents' acceptance of applications of biotechnology, the results are positive for genetic testing for diseases (3.7) and introduction of human genes into bacteria (3.5); neutral in terms of cloning with human cells (3.0); negative in terms of agreeing with GM crops (2.7) and agreeing with cloning of animals (2.0).

Respondents were asked to show their willingness to consume GMFHB. In conformity with their generalized negative perception of GM technology, respondents were negative towards consumption of the three individual GMFHBs included in our study, namely, bread, yogurt, and eggs ($\bar{x} = 2.8$, 2.7, and 2.5, respectively). The respondents were somewhat less negative towards consumption of bread and more negative towards the consumption of eggs. If we split the sample by gender, we see that females ($\bar{x} = 2.4$, 2.4, and 2.1) are significantly less willing to buy the products when compared with their male counterparts ($\bar{x} = 3.1$, 3.0, and 2.9). ANOVA tests revealed

TABLE 1 Attitudes and Perceptions of Factors Associated with Food Products

Variables	Score	Questions asked in the questionnaire
Food Purchase Factors		Importance (1) Which factors play the greatest role in your food purchase decisions?
Taste	4.2	
Price	3.9	
Quality	3.8	
Health	3.7	
Convenience	3.2	
Accept Biotechnology		Agreement (1) Do you agree with the following applications of biotechnology?
Genetic Testing	3.7	
Obtain Medicines	3.5	
Obtain Human Cells	3.0	
Obtain GM Crops	2.7	
Cloning Animals	1.8	
Obtain GM Foods	2.4	
Consume Health GM Food		Willingness to consume GM (2) How willing are you to consume the following GM foods if they taste and cost the same as regular (non-GM) food, but have the specific benefits of additional omega-3 fatty acid, which reduces the risk of having a coronary heart disease?
Bread	2.8	
Yoghurt	2.7	
Eggs	2.5	

(1) Based on a 5-point Likert scale, strongly disagree to strongly agree.

(2) Based on a 5-point scale, ranging from 1 = completely unwilling to 5 = completely willing.

that such differences are all significant at $p < 0.01$. Respondents were also asked to chose between the conventional, organic, and GM. It is interesting to note that conventional foods were most preferred, to be followed by biologic (organic), and GM. This preference was noted particularly for bread, followed by yogurt and eggs.

To meet our objective of finding out if a potential market for GMFBH foods exists, we compared the degree of GM foods' acceptance between males and females. Thus, the mean score for acceptance of GM foods factor was computed, and t-tests were used to find any differences between genders. Although scores for both groups can be considered low, they show a significant difference, and in the expected direction according to previous studies. Males (2.79) score higher than females (2.16) in acceptance of GM foods ($p \leq 0.01$).

Structural Equation Model Results

The model proposed in Figure 1 was tested using Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM). Multivariate normality was assessed by comparing Mardia's coefficient of multivariate kurtosis against its critical ratio (Byrne, 2001). All scales data were found to be acceptably normal. The total number of indicators used for each of the constructs left in the model was also reduced in the purification process (Joreskog

& Sorbom 1988), leaving the most salient ones to measure the constructs in the final model. Table 2 lists all the items used to measure each of the dimensions. All the scales, with the exception of health consciousness ($\alpha = 0.63$), achieved good levels of Cronbach alpha reliability coefficients, ranging from 0.75 for Price Consciousness to 0.88 for Acceptance of GM Foods. To confirm discriminant validity among the constructs, correlations among all the variables were examined and contrasted with the Cronbach alpha coefficients. It was found that the constructs are by far more intra-correlated than inter-correlated, thus confirming discriminant validity (see Table 3).

TABLE 2 Constructs Used in the SEM Model and Their Indicators

Item	Construct	Cronbach's Alpha Coefficient
<ul style="list-style-type: none"> I think that biotechnology will benefit people like me in the near future The application of biotechnology is (useful = 1, worthless = 5) (R) The application of biotechnology is (safe = 1, risky = 5) (R) Biotechnology is (morally acceptable = 1, immoral = 5) (R) 	Attitude towards Biotechnology	0.81
<ul style="list-style-type: none"> For me, it is important to have a balanced and varied diet When I prepare something to eat, the taste is more important than if it is healthy (R) For me, cooking is important because I can use the right ingredients to have a balanced meal I prefer to buy food of which I am sure of its origin and processes 	Health Consciousness	0.58
<ul style="list-style-type: none"> I am too busy during the week to cook as I would like I am often juggling my time between too many things, so I do not have time to prepare a proper meal during the week “So much to do, so little time,” this saying applies very well to me I do not have enough time for cooking during the week 	Time Pressure	0,84
<ul style="list-style-type: none"> When shopping food, I look carefully to find the cheaper products The food products on discount are usually my choice The degree that price plays a role in your food purchase decisions (1 = lowest, 5 = greatest) 	Price Consciousness	0.75
<ul style="list-style-type: none"> GM food should be allowed I dread the introduction of GM food (R) I agree with GM crops I agree with GM food 	Acceptance of GM Foods	0.88

R = Item needs to be reversed in order to properly reflect the corresponding construct.

TABLE 3 Correlation Matrix for the Theoretical Constructs

Construct	1	2	3	4	5
Attitude Toward Biotechnology	(1) 0.81				
Health Consciousness	(2) -0.19*	0.58			
Time Pressure	(3) 0.06	-0.37**	0.84		
Price Consciousness	(4) 0.06	-0.35**	0.17*	0.75	
Acceptance of GM Foods	(5) 0.67**	-0.33**	0.06	0.17*	0.88

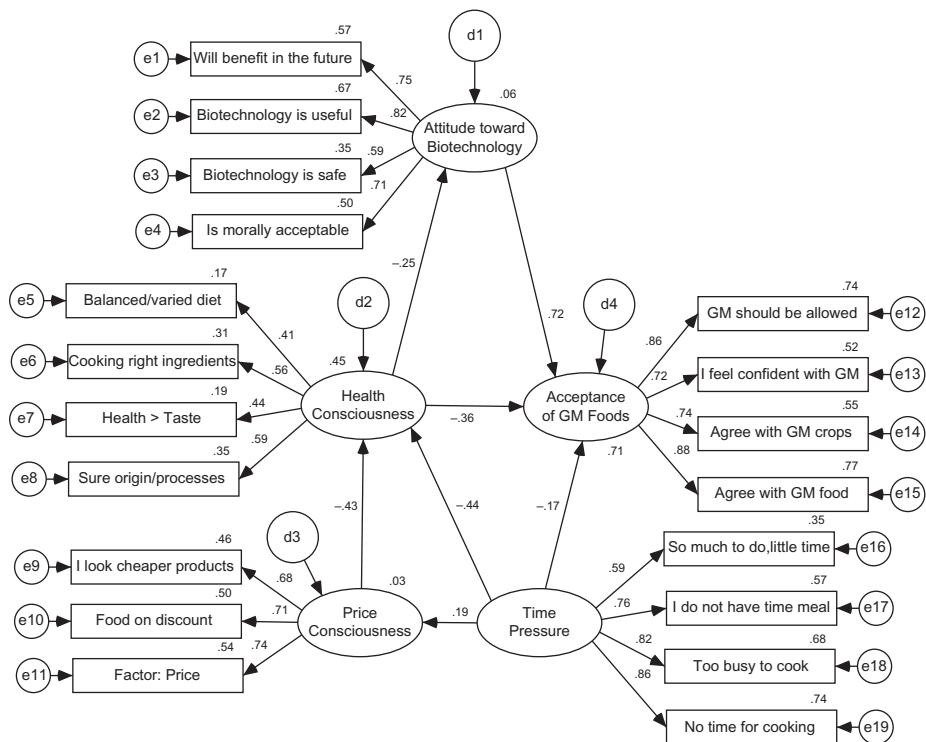
Note: Diagonal entries are Cronbach's alpha coefficients; all others are correlation coefficients.

* Significant at $p <= 0.05$

** Significant at $p <= 0.01$

The development of a robust conceptual model needs to be verified with three types of fit measure: absolute, incremental or comparative, and parsimonious (Tanaka, 1993). Absolute fit statistics compare the hypothesized model with no model at all. However, they are used as the first step in developing new models. The absolute fit indexes of the combined model—Root Mean Square Error of Approximation (RMSEA) = 0.05; Goodness of Fit Index (GFI) = 0.90; and Adjusted Goodness of Fit Index (AGFI) = 0.87—indicate that our hypothesized model fits the sample data in an acceptable way. Comparative or incremental indexes of fit are based on a comparison of the hypothesized model against a baseline model, also called the independence model. From the comparative fit indices—Normed Fit Index (NFI) = 0.86; Incremental Fit Index (IFI) = 0.96; and Comparative Fit Index (CFI) = 0.96—we can see that the hypothesized model also represents a good fit to the data. Finally, parsimonious fit indices take into account the complexity (i.e., number of estimated parameters) of the hypothesized model in the assessment of overall model fit. From the parsimonious fit indexes our results indicate that we can once again conclude that our hypothesized model fits the sample data fairly well: Parsimony Normed Fit Index (PNFI) = 0.73; Parsimony Comparative Fit Index (PCFI) = 0.82; and Parsimony Goodness of Fit Index (PGFI) = 0.69.

Looking at the standardized estimates of the model, it appears that the three factors that have direct effect on the acceptance of GM food are attitude towards biotechnology, time pressure, and health consciousness (see Figure 2). The first construct has a positive influence over the acceptance of GM foods, while the last two exercise a negative effect, as expected. Results reveal that the total standardized effects of the independent variables are Attitude toward Biotechnology (0.72), Health Consciousness (-0.36), and Time Pressure (-0.17). These results indicate that the attitude towards biotechnology overwhelms the effect of health consciousness and time pressure in the acceptance of GM foods. Price consciousness has no direct effect on acceptance of GM foods. As a consequence, in the absence of a favorable attitude towards biotechnology, lower prices may not necessarily result in the purchase of GM foods by German consumers. These results are similar

**FIGURE 2** Acceptance of GM foods.

to those reported by Canavari and Nayga (2009) in the Italian market, where price was also not significant. However, totally different results have been reported by Mather et al. (2005) from a study conducted in New Zealand. They found that resistance to GM products appears to be compensated by competitive pricing strategies.

Overall, this final model predicted a high level of the variance in acceptance of GM foods ($R^2 = 0.71$).

Hypotheses Testing

The proposed hypotheses were tested by examining the standardized coefficients and the critical ratios for each hypothesized link in Figure 1 (see Table 4). H1a hypothesized that time pressure will be exercising a positive effect on attitude toward biotechnology. H1a was not supported, since no relationship was found between the two constructs. H1b predicted a negative impact of time pressure upon acceptance of GM foods. H1b is supported. This means that individuals who lack time are not willing to trade off with more acceptance of GM foods. H1c hypothesized that time pressure exerts a positive effect on price consciousness. H1c was not supported.

TABLE 4 Hypotheses Testing

Hypotheses	Standardized Regression Weight	Critical Ratio	Confirmed
H1a: The more time pressure are individuals the better their attitude toward biotechnology.	-0.15	-1.139	No
H1b: The more time pressure are individuals the higher their acceptance of GM foods.	-0.18	-2.005	Yes
H1c: The more time pressure are individuals the lower price conscious they are.	0.18	1.964	No
H1d: The more time pressure are individuals the less health conscious they are.	-0.46	-3.384	Yes
H2a: The more health conscious are individuals the less positive their attitudes are towards biotechnology.	-0.43	-2.208	Yes
H2b: The more health conscious are individuals the lower their willingness to accept GM foods.	-0.40	-2.930	Yes
H3a: The more price conscious are individuals the less health conscious they are.	-0.45	-3.189	Yes
H3b: The more price conscious are individuals the better their attitudes toward biotechnology.	-0.10	-0.684	No
H3c: The more price conscious are individuals the higher their willingness to accept GM foods.	-0.04	-0.415	No
H4: The better the individuals' attitude toward biotechnology the higher their willingness to accept GM foods.	0.69	7.866	Yes

Contrary to the expectations, our results show that individuals who lack time are also looking for products on sale and are trying to save some money when buying food. H1d stated that time pressure will exercise a negative effect upon health consciousness. H1d was also supported. People having the perception of time scarcity are less worried about their health than those individuals not experiencing such a feeling.

Hypotheses 2a predicted a negative impact of health consciousness on attitude toward biotechnology. H2a was supported. Individuals who score higher in health consciousness tend to have a less positive attitude toward biotechnology than those who score lower on it. H2b hypothesized a negative impact of health consciousness upon acceptance of GM foods. H2b was supported. This means that individuals who worry more about their health are less willing to accept GM foods.

H3a predicted a negative effect of price consciousness on health consciousness. H3a was supported. Individuals looking for sales and lower prices tend to care less for their health than those who are not low-price

TABLE 5 Direct, Indirect and Total Standardized Effects upon Acceptance of GM Foods

Dependent Variable	Independent Variables			
	Time Pressure	Price Consciousness	Health Consciousness	Attitude toward Biotechnology
Acceptance of GM Foods	Direct	-0.169	-. .	-0.360
	Indirect	0.282	0.235	-0.182
	Total	0.113	0.235	-0.542
				0.722

oriented. H3b and H3c hypothesized a direct positive effect of price consciousness on attitude toward biotechnology and acceptance of GM foods, respectively. Both hypotheses were not supported by the data, not even in the predicted direction.

H4 posited that attitude toward biotechnology will exert a positive effect on acceptance of GM foods. H4 was supported. The more positive the individual's attitude toward biotechnology, the more GM foods are accepted.

Finally, in order to better understand the total effects of the hypothesized independent variables, we calculate the direct and indirect effects of each of them upon the dependent latent variable acceptance of GM foods. Table 5 shows that three factors (i.e., excluding price consciousness) have a direct effect over the acceptance of GM food: attitude towards biotechnology, time pressure, and health consciousness. When adding the indirect effects it is possible to see that price consciousness also exerts a positive impact on acceptance of GM foods, which is mediated by health consciousness. Looking at the total standardized effects on the dependent variable, it is clear that attitude toward biotechnology is by far the most influential (0.722), followed by health consciousness (-0.542), price consciousness (0.235), and time pressure (0.113).

SUMMARY AND DISCUSSION

This study gives a good insight on to how the different factors that shape the acceptance of GM foods interact, and to the direction and magnitude of the causalities that finally determine acceptance of GM foods.

Overall, based on our results German consumers are negative and remain extremely apprehensive toward biotechnology and GM foods. They are reluctant to accept most of the benefits claimed by science and they prefer most of the time to stay away from GM products. It is clear from our results that, even if the European Union liberalizes the sale of GM products and GMFBs were allowed to be widely sold in Germany, the task of introducing GMFBs in the German market is not going to be easy. The majority of the respondents remain extremely apprehensive towards GM products. There is great deal of resistance to change.

One explanation for this tendency may be found in the cultural dimensions that are prevalent in the German society. According to Hofstede (2001) the score of Germany on the value dimension of "uncertainty avoidance" is 65, thus indicating it is a very risk-averse culture and therefore their low level of acceptance of GM products is no surprise. Similar results have been found in Australia, which scores 51 in the same cultural dimension.

The results of this study show that although our respondents agree that biotechnology is useful and morally acceptable, they are opposed to the application of biotechnology when it involves GM foods. Similar findings have been reported by Gaskell (2000) on German consumers. Moreover, when these results are compared to the willingness to consume GM food with enhanced health benefits, we found that the acceptance of these enhanced food products increases only if this technology does not involve its application on animals. When our respondents were asked about their willingness to consume three different kinds of GMFHBs, there was a higher level of acceptance for those products that did not involve the use of biotechnology on animals, as compared to generic GM foods. These results coincide with those reported by Hossain, Onyango, Schilling, Hallman, and Adelaja (2003), who found that consumers are more willing to accept GM foods if they offer functional benefits to the consumers provided no animals are involved.

Conventionally grown foods are preferred even over modified biologically grown food products. If GMFHB foods would be allowed to be introduced in the European market without drawing attention to genetic modification involved in these products, it would be a preferred approach. Otherwise, the preferred approach to introduce GMFHB will be to target a segment of the German market that will be more welcoming to GM products. Fortunately our research shows that such a segment does exist. In terms of the demographic profile, male consumers have a more favorable attitude toward biotechnology and therefore are more likely to adopt GMFHBs than their female counterparts. However, both groups constitute a difficult market for GM foods producers and sellers. Thus, media sources that are consumed by males would prove to be effective in reaching potential target market.

An overall conclusion derived from the present study is that the acceptance of GM foods is strongly influenced by the attitude toward biotechnology. Therefore, understanding how such an attitude is formed and how it can be improved should be of great interest for stakeholder groups. At this point it must be recognized that such attitude might be a very abstract concept for German consumers due to their lack of familiarity since GM foods is an infant industry available to them. Kim and Boyd (2006) suggest that limited information or lack of understanding among consumers have a negative influence on their attitudes, perception, and interest in GM foods. It is expected that more knowledge about biotechnology leads to more acceptance of GM foods (Moerbeek & Casimir, 2005).

Thus, one approach recommended to improve the attitude toward biotechnology and the acceptance of GM foods is to launch GMFHB products accompanied by relevant objective information about its impact. Two alternative focuses may be considered here. The first one is to provide objective information about the *benefits* of the use of biotechnology to add health benefits to food products. However, previous studies have found a reduction on purchase probabilities for GM foods when consumers are exposed to benefit argument communications (Frewer, Scholderer, & Bredahl, 2003; Scholderer, 2005). Thus, the second focus, which constitutes our recommendation, is to attempt improving attitude toward biotechnology by providing objective information related to the *absence of risks*, particularly if such information comes from a credible source such as scientists and/or academics (i.e., quality and safety certifications and traceability information) to avoid the perception of biased information. This last recommendation is especially important when we face the fact that consumer behavior is determined less by how much consumers know, and more by what they believe (Barker & Burnham, 2001). Any advertising campaign should emphasize not only functional aspects of GM foods, but also safety. Educating German consumers about the real nature of GM technology may reduce their resistance to GMFHBs.

As our respondents were particularly resistant to GM foods that used genes from animal sources (i.e., eggs) to modify foods, only GMFHBs that depend on non-animal gene sources to modify food should be introduced in the beginning. As consumers become more familiar with GMFHBs and more accepting of GM technology, more and varied GM products can be introduced. FFs provide an easy means to provide health benefits with basic food items as is the case of breads enriched with vitamins. Therefore, convenience aspects of GMFHBs may also be emphasized in the promotion. Practical reasons are more important in the acceptance of GM products than ethical reasons (Boccaletti & Moro, 2000).

Is it possible to overcome consumers' resistance to accept GM foods by means of lowering the products' prices? Our study did not identify any significant direct effect of price consciousness over the acceptance of GM foods. However, positive indirect effects mediated by health consciousness were found. German consumers that are low price seekers will be more willing to accept GM foods, although the impact is not very high ($\beta = 0.24$).

To the best of our knowledge, this is the first study that tests the effect of perceived time pressure on acceptance of GM foods models. Our results reveal that time-pressured individuals are less conscious about their health condition, and they are more willing to look for lower prices when buying food, which can be true as a result of their tight budget due to being students. No doubt the direction of this relationship is surprising in view of the results reported by previous studies (i.e., Welch et al., 2008), but probably this relationship turns negative when individuals are in the labor force earning a regular and attractive income.

Also, the higher the perceived time pressure the lower the willingness to accept GM foods. So, it seems that the strong apprehensive view of biotechnology and the GM foods and the lack of time to further search for information predispose consumers to not accept GM food products, although to a limited scope ($\beta = -0.17$). Nevertheless, when considering the indirect effects of perceived time pressure upon acceptance of GM foods mediated by price and health consciousness, the total effect turns to be positive, although very low ($\beta = 0.11$). An overall conclusion related to German time-pressured individuals may indicate that producers and distributors in particular should use point-of-purchase information displays to reduce the negative view of GM foods by these busy customers. As a result of these findings, researchers are encouraged to include time pressure as an important variable in futures studies dealing with GM food acceptance.

Limitations and Further Research

Since the sample is not probabilistic, the results obtained cannot be generalized to the whole population in Germany. In addition, one has to bear in mind that the sample consists of university students, who have a higher level of education as compared to the general population.

We used a survey technique to elicit respondent acceptance of GMFBs by student respondents. Future studies may use experimental methods with a general population. In addition to finding out the acceptance level of GMFBs, it may test for efficacy of different product introduction strategies. It may uncover such practical information as price elasticity of demand and financial viability of various product introduction strategies. Finally, futures studies should also focus on improving internal consistency of the construct health consciousness.

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