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How Does Risk Perception Affect the Purchase Intention of Genetically Modified Food

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Abstract

Since the first case of genetically modified (GM) food appeared in the world, the debate about its risks has followed. Supporters believe that GM food has advantages of rich nutrition, high crop yield and long freshness period, while opponents think that there are many hidden dangers in its safety. This debate will affect consumers' cognition of GM food, and then affect their actual consumption behavior. Therefore, this paper completes a randomized survey of 500 consumers in Shanghai and found that: firstly, GM food is not fully popular and about 5% consumers have not been exposed to GM food; secondly, risk perception plays a suppressive role in both GM food acceptance and purchase intention.

Keywords

Risk Perception; Acceptability; Purchase Intention; Richter Scale.

1. Introduction

With the development of modern medical technology, genetically modified (GM) food industry has developed rapidly. The data showed in the mid-2021 issue of "China Biotechnology" on Global Biotechnology/GM Crop Commercialization Development in 2019 that GM crops have been planted in commercial cultivation [1]. The average cultivated area of gm crops has gradually increased from 1.7 million hectares in 1996 to 190.4 million hectares in 2019, and the cultivated area has increased by 112 times in the past 20 years, accounting for about 13% of the current global average cultivated area. China ranks seventh in China and even the world with 2.9 million hectares of average cultivated area Currently, the most widely planted GM crops mainly include soybean, cotton, corn and rape. Other common crops include papaya, tomato, sugar cane, apple, sugar beet, alfalfa and apple [2].

GM food not only promotes the healthy and sustainable development of agriculture, but also promotes the economic benefits of agriculture. It can also optimize the nutrition of food and has high scientific research and application value. However, due to the uncertainty of GM foods, and everyone’s perception and attitude towards risks are very different, people have questioned GM foods. Such doubts not only affect the people’s trust in related institutions, but also hinder them. The development of GM technology.

The term "risk" belongs to the category of social psychology. It refers to an individual’s perception of various risks that may exist objectively for oneself or the outside world, and it must fully emphasize what the experience gained by the individual through subjective feelings and intuitive judgments will produce knowledge Kind of influence [3]. Pidgeon examined consumers' perceived risk and acceptability of GM foods in the context of social trust and further compared the differences in consumers' perceived risk under different trust models [4]. Lusk elicited consumers' risk perceptions by designing several Likert scale questions about whether consumers agree with the risk of consuming genetically modified foods [5]. Other

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scholars found that if there is a significant correlation between consumers' awareness of GM foods and consumers' risk perceptions of GM foods, the less consumers are aware of GM foods, the higher the severity of these consumers' risk perceptions of GM foods [6]. However, another scholar argued that the more consumers know about GM and the more information they know about GM, the more risk consumers perceive [7]. Zhou thought consumers' education level, knowledge about GM foods, and perception of advantages and disadvantages affect their perceived risk of GM foods [8]. Li concluded that there were very significant differences in risk perceptions and perceptions by gender and age groups, with women and young people over 30 years of age having high risk perceptions, which may be due to their need for chic in their daily lives. assessments also significantly increase respondents' risk perceptions [9].

In a study on a group of consumers in Shanxi, China, it was found that objective knowledge, risk perceptions and willingness to accept GM rice influenced consumers' acceptance of GM rice and willingness to purchase due to their high willingness to accept GM rice [10].Further other scholar found Perceived profitability, risk perception and risk reduction strategies all have significant effects on consumers' purchase intentions, and that the level of perceived competence of a commodity indirectly determines consumers' purchase intentions [11].

Therefore, this article will study two aspects: first, to use various methods such as field surveys to gain in-depth understanding of Shanghai consumers' understanding and cognitive status of GM foods, and to popularize GM production technology and related knowledge of genetically modified foods to consumers. Consumers can understand and accept GM food more deeply. Second, to discuss how consumers' risk perception of GM food affects their acceptance and purchase intention of GM food.

2. Data Sources and Descriptive Analysis

2.1. Data Sources

The data in this paper comes from field questionnaire survey. The research object is selected as 16 municipal districts in Shanghai, and six representative districts are selected: Xuhui, Huangpu, Changning, Baoshan, Pudong New Area and Qingpu. In each place , we use random research on consumers and give each participating consumer 10 yuan as payment to ensure that the information filled out by the consumer is serious and reliable, and the experimental part of the experiment is based on the real experimental results to give the researched experimental rewards.

The questionnaire started in October 2020 and ended in December 2020. A total of 500 questionnaires were distributed and 454 valid questionnaires were returned, with an efficiency rate of more than 90%.

2.2. Descriptive Analysis of Consumers' Risk Perception and Purchase Intention

2.2.1. Analysis of Consumers' Risk Perception of GM Food

With the rapid development of economy, consumers pay more and more attention to food quality and food safety, especially the exposure of food safety problems such as excessive drug content in food, gutter oil flowing into the table, melamine, plasticizer and so on, which aggravate consumers' concerns about food safety and quality. According to the survey results in Table 1, people are not optimistic about food safety in China. How do consumers view food safety is still divided into five levels (Very serious problem, Relatively serious problem, general, basically no problem, no problem at all). 9.9% of the people think that China's current food safety is a serious problem, 34.1% of the people think that there are relatively problems with food safety, 37.7% of the people think that the food safety problem is general, 17.7 of the people are relatively relieved about food safety, only 0.7% of the people are very relieved about food

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safety. It can be seen that people are concerned about food safety. In addition, we also designed a question to analyze consumer buying habits: whether consumers look at production dates, expiration dates or ingredient instructions when buying food. Among them, 42.6 percent think they read it every time, 28.5 percent read it often, 22.5 percent read it sometimes, 4.4 percent read it rarely or occasionally, and only 2 percent never read the manual. As can be seen from the statistics, people's consumption habits are relatively good, and people generally pay more attention to food safety.

Table 1. Statistical table of purchasing habits

Questions	Number	Percentage
Food safety		
Very serious problem	45	9.9%
Relatively serious problem	155	34.1%
General	171	37.7%
Basically no problem	80	17.6%
No problem at all	3	0.7%
Whether consumers look at production dates		
every time	193	42.6%
often	129	28.5%
sometimes	102	22.5%
rarely or occasionally	20	4.4%
never	9	2.0%

Data source: Collected from the survey questionnaire.

Due to the uncertainty of GM technology, GM technology may lead to the risk problem of GM food. According to previous literature, risk perception can be divided into multiple dimensions. On this paper, four five-level scale questions are designed using Lusk's method (1-5, respectively, "strongly disagree", "somewhat disagree", "generally", "somewhat agree" and "strongly agree"). In subsequent analyses, we normalized the questionnaire data to zero mean and unit standard deviation and used this statistic as our measure of risk perception for each person.

The four scales represent four dimensions: psychological risk, health risk, environmental risk and social risk. These four dimensions are reflected in the questionnaire as four questions. That is, GM in food production may bring risks to me and my family, GM in food production may bring new diseases to human beings, GM technology may cause genetic pollution or environmental pollution, and national control over the safety of GM food is sufficient. As shown in the following table.

Table 2. Statistical of psychological, health, environmental and social risk perception

Options	Strongly disagree	Somewhat disagree	Generally	Somewhat agree	Strongly agree	Mean	SE	Variance
Psychological risk	4%	18.1%	43.2%	19.2%	15.6%	3.24	1.048	1.099
Health risk	2.2%	14.8%	44.7%	21.8%	16.5%	3.36	0.995	0.989
Environmental risk	4%	25.8%	40.5%	17.2%	12.6%	3.09	1.042	1.085
Social risk	4.4%	20.7%	44.9%	20.9%	9%	3.09	0.973	0.947

Data source: Collected from the survey questionnaire

In terms of psychological risk, 19.2% of consumers agree with GM food and 15.6% strongly disagree with GM food and 15.6% of consumers strongly disagree with GM food. The distribution of health risk perception and psychological risk perception is consistent, the top three are general, accounting for 44.7%, somewhat agree, accounting for 21.8%, strongly agree,

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accounting for 16.5%.GM foods are considered to have certain health risks. The top three environmental risks were general (40.5%), relatively disagreeing (25.8%) and relatively agreeing (17.2%), but strongly agreeing was 8.6% more than strongly disagreeing. In terms of social risk, it is basically normal distribution, with average people accounting for 44.9%, followed by comparative agreement and comparative disagreement which are 20.9% and 20.7% respectively. Thus, people's perception of environmental and social risks of GM food is not high.

The mean value of health risk is the highest at 3.36, followed by psychological risk at 3.24. The mean value of environmental risk and social risk is the same at 3.09, both higher than average. Therefore, consumers have a higher risk perception of GM food on the whole, among which, the risk perception degree of health risk is the highest.

2.2.2. Analysis of Consumers' Purchasing Intention to GM food

In order not to affect consumers' cognition of GM food, the research on consumers' purchasing intention in this paper did not determine the use of a certain product but the general term of GM food. As shown in Table 3.

Table 3. Consumers' views on GM food

Questions	Frequency	Percentage
Will you pay attention to whether the food is GM or non-GM?		
No(0)	116	25.6%
Yes(1)	288	63.4%
Don't know	50	11.0%
Will you buy foods with genetically modified ingredients?		
No(0)	230	50.7%
Yes(1)	88	19.4%
Don't know	136	30.0%
The price of genetically modified food is relatively cheaper, will you buy it?		
No(0)	289	63.7%
Yes(1)	165	36.3%

Data source: Collected from the survey questionnaire

When buying food, 63.4% of consumers will take the initiative to pay attention to whether the food is GM food, and 25.6% will not pay attention to whether the food is GM food or non-GM food. If the food we buy is explicitly said to be GM, only 19.4 percent would go ahead, 50.7 per cent would not and 30 percent would not know whether they would buy it. In terms of the price of GM food, if the price of GM food is cheaper than that of non-GM food, 36.3% of people will choose to buy GM food, and 63.7% will still choose not to buy GM food. According to the purchase intention scale (5-point scale, 1-5 points represent strongly disagree, somewhat disagree, general, somewhat agree, very agree), those who strongly disagree with the purchase account for 24.7%, those who disagree with the purchase account for 27.8%, and those who are general account for 33%, those who disagree with the purchase account for 11.2%, and those who strongly agree only account for 3.3%, with an average value of 2.41. It can be seen that people's purchase intention of GM food tends to be moderate.

3. Impact of Consumer Risk Perception on Purchase Intention

This section mainly analyzes the impact of consumers' risk perception of GM food on acceptance and purchase intention of GM food. According to the above, the explained variables are consumers' acceptance degree and purchase intention (1= strongly disagree, 2= relatively disagree, 3= agree, 4= relatively agree, 5= strongly agree), and the explanatory variables are

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consumers' risk perception of GM food and individual characteristics. As the dependent variable has five grades and the degree is constantly strengthening, it conforms to the ordered Probit regression model, which is commonly seen in the regression model where the explained variables are classified order variables. Assume that the form of regression model is:

$$Y_i = \beta X_i + \varepsilon_i, \quad i = 1, \dots, n \tag{1}$$

Where $Y_i$is the dependent variable, X_i is independent variable which is 1*D-dimensional row vector. β is the regression coefficient, and is the d*1 dimensional column vector; ε_I is the residual term. Model 1 is the regression analysis model of four risk dimensions, and Model 2 shows that the four risk dimensions are adjusted to one risk perception as an explanatory variable for regression analysis.

Risk perception is divided into four dimensions: psychological risk, health risk, environmental risk and social risk. As can be seen from the regression results, the regression coefficient of psychological risk is -0.440, and the P value is less than 0.01. Therefore, psychological risk has a significant inhibitory effect on the acceptance degree to some extent. The higher the degree of psychological risk perception, the lower the acceptance degree. Social risk also plays a significant role in inhibiting the degree of acceptance, because the regression coefficient is also negative and the P value is less than 0.01. However, the regression result of health risk perception and acceptance degree was not significant. The regression coefficient of environmental risk and acceptance degree was -0.175, and the P value was less than 0.05, so environmental risk had an inhibitory effect on acceptance degree. In general, the higher people's risk perception, the lower their acceptance of GM food.

About the return of the purchase intention as a result, can be seen from table4 b The regression coefficient between health risk and gm food purchase intention is -0.376, and P value is less than 0.01, so the health risks of purchase intention has significant inhibitory effect, whether for GM food to oneself health, People have great doubts about whether GM food will bring danger to their health. Therefore, the higher the health risk, the less consumers are inclined to buy GM food. Social risk and acceptance of the regression coefficient is 0.362, and P value is less than 0.1, shows that the social risk perception of consumers also has inhibitory effect on purchase intention, the effect of consumers for the state's control of GM food safety is concerned, consumers perceive the state of GM food safety issues related to policy, Then consumers will not be willing to buy GM food. Psychological risk perception has a significant inhibitory effect on purchasing intention of GM food, because the regression coefficient between psychological risk and purchase intention is -0.545, P value is less than 0.01, indicating that consumers will not try to buy GM food with a higher degree of psychological risk perception, because people are cautious about GM food and do not have high trust, the negative news about GM food in recent years has had a certain impact on consumers. Environmental risk perception and purchase intention of genetically modified food, the regression coefficient is 0.239 between the P value is less than 0.05, shows that environmental risk perception is also significantly influence consumers purchase intention of GM foods and have an effect of inhibiting purchase intention, this may be due to some environmental problems which occurred in recent years, environmentalists advocate vigorously protect the ecological environment, The environmental pollution theory of GM food is also a controversial part of GM food. Therefore, consumers' perception of the environmental risk of GM food is gradually increasing, thus affecting their purchase intention. The risk perception of the four dimensions of psychological risk, health risk, environmental risk and social risk has a significant inverse correlation with the purchase intention of GM food. Among them, the psychological risk perception has the greatest influence on the purchase intention, indicating that people are greatly influenced by subjective thoughts when buying GM food.

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Table 4. Regression results of risk perception on acceptance and purchase intention of GM food

	Acceptance		Purchase intention	
	Model I	Model II	Model I	Model II
Gender	-0.157	-0.155	-0.134	-0.111
Age	-0.024***	-0.025***	-0.014**	-0.101
Education level	-0.150***	-0.15	-0.104	0.364
Income	0.012	0.009	0.042**	-1.524***
Psychological risk	-0.440***		-0.545***	
Social risk	-0.320***		-0.362***	
Health risk	-0.133		-0.376***	
Environmental risk	-0.175**		-0.239***	
Risk perception		-1.036***		-0.276***

The measurement of risk perception in this paper includes four dimensions, namely, psychological risk, health risk, environmental risk and social risk, which respectively represent four scale questions. Genetic modification in food production may bring risks to me and my family, genetic modification in food production may bring new diseases to human beings, the promotion of GM food may cause genetic pollution or environmental pollution, and the state's control over the safety of genetically modified food is sufficient. Social risk and the other three variables are reverse variables, which need to be reverse-coded to be consistent with the other three variables. Then the scale of these four dimensions is coded into a new scale, namely the risk perception of consumers.

As can be seen from model II in table5, risk perception has a significant inhibitory effect on acceptance willingness of GM food. The regression coefficient is -1.036, and the P value is less than 0.01, that is, the higher the degree of risk perception, the less likely GM food will be accepted. On the contrary, the lower the degree of risk perception, the stronger the acceptance willingness of GM food. This may be because people tend to be more open to new things when they perceive less risk to the outside world. In model II, the significance of regression results between risk perception and purchasing intention of GM food is less than 0.05, indicating that risk perception also has an obvious inhibitory effect on consumers' purchasing intention of GM food. The regression coefficient between risk perception and consumers' purchasing intention of GM food is -1.524. It indicates that there is a reverse correlation between risk perception and purchase intention, that is, the higher the risk perception is, the higher the degree of risk sensitivity is, the lower the consumers' purchase intention of GM food is; on the contrary, the lower the risk perception is, the higher the consumers' purchase intention of GM food is. Risk perception means a kind of subjective feeling of external risks, people risk perception around low means for their living environment is more trust, did not feel the potential risks, so for anything in the lives of more trust, lead to the low degree of risk perception of consumers are more likely to buy has the excellent properties of genetically GM food, On the contrary, consumers with higher risk perception are more cautious about life, especially controversial products like GM food, so consumers tend not to buy GM food even though it has better characteristics.

4. Conclusions and Policy Implications

4.1. The Main Conclusions

In this paper, 500 consumers in Shanghai are surveyed in the form of questionnaire, and consumers' risk perception, acceptance of GM food and purchase intention are extracted through the Richter scale method. The main conclusions are as follows:

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First, from the analysis of individual characteristics, it can be seen that only 19 respondents have not heard of GM food, accounting for 4.2% of the sample, indicating that GM food has not been fully popularized to the majority of consumers. More than half of the people learn about general knowledge about GM food, while only 10.6% of the people know more or very well about GM food. Therefore, there is still a long way to go for the popularization of GM food.

Second, risk perception is divided into four dimensions: psychological risk, health risk, environmental risk and social risk, among which social risk needs reverse coding. Psychological risk, environmental risk and social risk perception significantly inhibited consumers' acceptance of GM food, while health risk perception have no significant correlation with consumers' acceptance of GM food. The four perceived dimensions of psychological risk, environmental risk, health risk and social risk have an inhibiting effect on the purchasing intention of GM food, namely, the higher the risk perception level is, the lower the consumers' purchasing intention of GM food is; conversely, the lower the risk perception level is, the higher the consumers' purchasing intention of GM food is.

Third, the psychological risk awareness, the health risks associated with perceived risk, environment risk awareness, social perception encoded into a new perception of risk variables, reverse coding social risk perception, the results showed that the risk of consumer acceptance of GM food perception and purchase intention has inhibitory effect on the perceived risk is higher, the lower the consumer acceptance of GM food, On the contrary, the lower the risk perception, the higher the acceptance of consumers.

4.2. Policy Implications

First, to promote the market of GM foods and improve the scientific cognition of consumers. To further strengthen the all-round publicity of GM foods, relevant units can carry out a variety of publicity and education activities to enhance consumers' knowledge and awareness of GM foods.

Second, to strengthen the supervision of online GM food information to ensure the scientific and accuracy of the information. It is necessary to strictly manage the dissemination of genetically modified information in online media, meanwhile, to ensure the accuracy and scientific of the content, and guide consumers to correctly understand and learn about the development of genetically modified food.

Third. government departments should continue to intensify their efforts to strictly supervise the GM food and genetically modified agricultural technology that has been allowed to enter commercial cultivation in my country, so that consumers can know and understand them, and they will feel what the government has done for this. Efforts will enhance the confidence of consumers and better promote the healthy development of genetically modified foods.

Fourth, genetically modified technology is controversial, and the country should pay more attention to the mutual exchange and relevance between its technology and society while vigorously developing genetically modified technology. Integrate technological development into the background of social development, and carry out overall planning and development.

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