Examining the Factors Influencing Consumers' Purchasing Intention for Genetically Modified Agricultural Food

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The application of genetic engineering to food is becoming popular worldwide, especially in UK and USA. However, consumers in Asia remain unsure of the risks and benefits of genetically modified food. To measure the purchase intentions of Taiwanese and Vietnamese consumers using an integrated framework of the attitude model and the behavioral intention model, quantitative research was conducted in which the questionnaires were distributed to respondents living in Taiwan and in Vietnam. The results showed that the dependent variable of consumer attitude was positively impacted by three in-dependent variables including perceived risk to health, perceived benefit to health, and perceived benefit to the environment. The other construct showed no significant effect on consumers' attitudes in the two countries. The consistency result in both countries between subjective norm and attitude revealed a positive impact on the purchase intention in descending order, while the variable of perceived behavioral control did not contribute to affecting purchase intention significantly. Finally, limitations and suggestions for future studies are also proposed.

Keywords: genetically modified agricultural food, purchasing intention, perceived benefit, perceived risk

INTRODUCTION

Background

The yearly population growth rate of 1.09%, approximately 83 million people per year, leads to difficulties in adequate food supply. The need to produce higher crop yields and more nutritious foods is

challenging and pressures scientists worldwide to explore new techniques applied to agriculture (Grunert et al., 2003). The modern techniques of genetically modified organisms (GMOs) and genetic engineering (GE) transfer the genes of organisms to living plants, animals, or microorganisms in the absence of natural conditions such as traditional crossbreeding or natural recombination (Isserman, 2001).

In 1996, during the first year of integrating biotech crops (Srivastava et al., 2011) into commercial planting, there were more than 60 countries participating in biotech crop consumption, which has become popular the world over in the 21st century. After 18 years, global biotech crops multiplied over 106 times from 1.7 to 181.5 million, including 20 developing countries and 8 developed countries (James, 2015), increasing in 2019 to 29 countries (ISAAA, 2020) from Europe, South America, Asia, Australia, North America, and South Africa. The technology would become more popular around the world based on some reasonable advantages.

The yearly rise in the percentage of GM crops in developing countries has exceeded that in industrial countries; 85 million hectares were planted by 47% of the collective farmers in Latin America, Africa, and Asia. In addition, the United States is the greatest exporter and producer of GM food with 73.1 million hectares, including over 40% of the cotton, soybeans, and corn. With the 2015 campaign, the numbers of countries participating in commercialized GM crops in Asia and in the world were 8 and 30, respectively (James, 2015). In 2019, this number increased to 42 in the world (ISAAA, 2020). This rise indicates that the model gene technology has impacted global agricultural production significantly in last two decades (Srivastava et al, 2011).

According to the ISAAA (The International Service for the Acquisition of Agro-biotech Applications) (ISAAA, 2016), Vietnam is one of eight countries in Asia and the Pacific participating in growing GM crops (biotech maize) with an area of 3500 hectares in 2015. After a year, events to encourage GM crops increased significantly in the country. The Ministry of Agriculture and Rural Development (MARD) allotted 18 certificates for GM crops including soybean and maize, which had been imported into Vietnam for human consumption, aquaculture sectors, and livestock feed. From 2015 to 2016, GM crops grown in southern Vietnam have increased between 16.5 and 25%. Vietnam has per-formed, together with foreign GE experts in 2008, an environmental risk assessment of genetically modified organisms by considering the challenges and opportunities of GM cotton (Hilbeck et al., 2008; Pham Van Toan et al., 2008). These guidelines were considered for the environmental risk assessment of GMO in Vietnam.

However, the impact of GMO remains controversial, and some scholars think that GMO will bring more risks to humans and the environment than benefits. Domingo (2000) noted that genetically modified food (GMF) may cause unpredictable disruptions of metabolism, for example, through the formation of new or increased toxic compounds in the body. The technology of modified gene location can lead to mutation of genes as well as influence the gene function. Therefore, by rewriting the genetic code, the technology may damage the ecology in the future. However, at the same time, economists have indicated that GMF benefits economic outcomes, especially in the agricultural field (Burachik, 2010). Nap et al. (2003) highlighted that GM crops directly benefit farmers through lower production costs and higher yields in global agriculture and are stable in storage, more nutritious, and benefit human health. Along these lines, Bakshi (2003) revealed that biotechnology plays important role in "resolving the problems of food availability, poverty reduction, malnutrition and environmental conservation in the developing world, as it does not benefit just the farmers who grow crops, but also the consumers who eat genetically modified food."

Although, unlike Vietnam, Taiwan has not participated in growing GE crops, the country was the seventh largest export market for GMF from the US (U.S. Department of Agriculture, Foreign Agricultural Service, 2014). In 2016, GE products were imported into Taiwan totaling over a billion US dollars, approximately a third of the total agricultural import amount from the US (U.S. Department of Agriculture, Foreign Agricultural Service, 2016). In addition, Taiwan Business TOPICS (2015) revealed that 95% of the soy consumed in Taiwan was from the United States, equal to 8 million bushels of soybeans, most of which are known to be GMF. Likewise, 67 other types of GMF have been imported into Taiwan in 2015. In response, consumers have become fearful about the negative effects of GMF, including the risks to human consumption and damage to the environment. The combination of fear and lack of knowledge about

the technology creates significant regulatory obstacles to GMF consumption around the world. People, including some scientists, create the fear themselves without any evidence of damage caused; public health officials, biologists, and agronomists have been trying to communicate to the public that GMF is safe. The products must be examined carefully to make sure they are undamaged before releasing them to the market. Recently, concern over the safety of GMF has increased in Taiwan. Anti-GMF groups have pushed for restricted regulation of GE products, which they believe will damage not only human health, but may also affect nature or the ecosystem. To increase consumer awareness, the Taiwanese Bureau of Food Sanitation has applied strict rules for labeling GM products to help consumers distinguish GMF from non-GMF. Since 2014, GMF has been labeled if the total content is at least 3%, instead of 5% in previous years, including products made from GM raw materials or containing testable GM proteins or DNA. Meanwhile, at present, GM crop technology remains a new concept in Vietnam, which is largely an agricultural country; however, Vietnam spends USD 3 billion to import feed every year. Reports have shown that Vietnam should use this new biotechnology to improve production capacity (Van Toan et al., 2008).

So far, there is little academic research in Vietnam about consumers' attitudes to-ward GMF, leading to limited understanding of this field. Exploring more about the country in terms of consumers' concerns about GMF will be significant. Thus, the pre-sent study differs from previous studies in following respects. First, by applying Theory of Planned Behavior (TPB) (Ajzen, 1991), including attitude, perceived behavioral control, and subjective norm, the three factors for proving people's actions reasonably influence consumer behavior, we can investigate customers' purchase intentions toward genetically modified agricultural food (GMaF). Second, it is known that TPB can be applied to diverse fields in explaining human behavior; however, TPB has also been redesigned and modified by many empirical studies to fit with this study's purpose and circum-stances. With the introduction of external variables related to the research context, TPB can provide more insight into the research context in the field (Taylor & Todd, 1995). Third, in the field of biotechnology, the application of GM crops is closely related to people's daily lives. However, there is no clear evidence in current research reports on the impact of GMF on human health. Therefore, as GM foods expand their marketability, the question of whether legal labeling and regulatory measures are needed to help consumers to decide whether to consume these foods has gradually become more important to the international community, as well as to governments and consumer groups (Yu et al., 2019).

Thus, based on health and environment contextual factors, the present study proposes perceived risks and benefits to health and environment that can differently influence Taiwanese and Vietnamese consumers' purchase intentions toward GMaF. This can be seen as the bridge to connect consumers and producers to have a closer look at its potential features in both countries. Between the risks and benefits, understanding consumers' demands, desires, attitudes, and perceptions toward GMaF is necessary to enhance the product images in the customers' view. Therefore, this study will use TPB to explain the consumers' purchasing behavior and provide more information and suggestions to strategy makers and marketers for creating enhanced strategies to expand the market and proper regulations to protect consumer health, as well as the better adjustment to the demands of consumers by comparing the two countries' respondents.

LITERATURE REVIEW

Genetically Modified (GM) Technology

A genetically modified organism (GMO) is any organism whose genetic material has been altered artificially (i.e., not through "natural" breeding), such as plants, animals, and microorganisms, in order to give them a new property through genetic engineering techniques. Genetic modification involves the mutation, insertion, or deletion of genes. The introduction of foreign genes into food plants has been considered to have an unexpected and negative impact on human health, in particular, from the introduction of new allergens and/or for the effects of possible horizontal gene flow or any other unknown and uncontrollable effect of the transferred gene. On the other hand, future GM organisms are likely to include plants with increased nutrient levels, plants producing pharmaceutically important molecules, and plants with improved resistance to diseases, cold, or drought, thus suitable for increasing food security in

disadvantaged areas. Clear environmental benefits of GM crops include the fact that herbicide-tolerant crops allow the adoption of reduced tillage and conservation tillage practices. Similarly, pest-resistant GM crops expressing Bt proteins are environmentally beneficial because there is no need to spray broad-spectrum pesticides onto the plants, thus reducing the use of fuel and avoiding environmental contamination with chemical pollutants (Chaves et al. 2003). GM crops have also benefited the livestock sector as they have increased yields of feed ingredient, have better quality traits, and are safer for livestock. As a source of livestock feed components, the relevant GM crops include corn, canola, cottonseed, soybean, and potato. These crops are principally used in livestock feed rations either as an energy or a protein source.

Some applications to the most targeted animal traits are: animal health (increased neonatal survival (Bleck et al, 1998), disease resistance (Denning et al., 2001), growth rate, improvement of meat and milk composition (Brophy et al., 2003), and increased wool production. In addition, a reduction of the impact of animal culture on the environment has been attempted (Bawden et al, 1995). Another branch of animal modification is molecular farming, also known as "pharming," in which biopharmaceuticals are manufactured in transgenic animals.

Genetically Modified Agro-Food (GMaF)

"Genetically modified foods" (GMFs) were determined by Bredahl et al. (1998) to be products containing or being produced from raw GM materials. In addition, ac-cording to the research, GM foods include genetic materials that have been modified to enhance desired features as well as inhibit undesirable characteristics. The application can include transferring, inserting, or rejecting the target gene from one species such as a plant, animal, microorganism to another living organism, which can cause widely diverse genetic combinations (Koch, 1998). In 2016, Taiwan imported USD 3.34 billion of agricultural products, with the largest supply of GE crops to Taiwan being corn, soybeans, and cotton at over a billion dollars.

Genetically modified (GM) technology focusing on GMaF production is the major application of gene technology, and it has been widely applied in the United States and China since the end of 20th century (James, 2015). The Gene Revolution benefits agronomic traits such as drought tolerance or insect resistance by cultivating GM crops. Thus, the new technology is promising not only for reducing farmers' production costs (Frewer et al., 1997) and by offering competitive prices particularly to customers (Grunert et al., 2003), but also contributes to protecting the environment by reducing agricultural chemical use. Some highlighted applications of GMaF that enhance human life have been explored as corn engineered with human genes (Dow), sugarcane engineered with human genes (Hawaii Agriculture Research Center), corn engineered with jellyfish genes (Stanford University), tobacco engineered with lettuce genes (University of Hawaii), rice engineered with human genes (Applied Phytologic), corn engineered with hepatitis virus genes (Prodi gene), potatoes that glowed in the dark when they needed watering, and human genes inserted into corn to produce spermicide (Responsible Technology).

Theoretical Background

Consumers' purchase intentions have been explored and predicted in many previous studies by applying the TPB (Ajzen, 1991), especially regarding organic food (Magnusson et al., 2001; Tarkiainen & Sundqvist, 2005). The theory has become particularly popular in research on GM food (Frewer et al., 1997; Spence & Townsend, 2006; Mendelsohn, 2003; Zhang et al., 2018). It provides an overview of the factors that affect a consumer's purchase intention regarding GMFs and provides a foundation for further research, including their attitude to purchase, subjective norm and purchase intention. Additionally, intentions can impact on the behavior like motivational factors. For example, higher intentions to purchase GMFs can lead to behavior such as buying or suggesting buying to others.

Attitude Toward GMaF

Tian et al. (2001) defined consumer attitude as the feeling or belief about the features and advantages offered by the specific product. In addition, Hawkins et al. (2001) emphasized the human motivation, emotion, perception, and cognition toward the environmental aspects. The emotions, favorable or unfavorable feelings, or action tendencies toward a specific object can also be seen as the consumer's

attitude, which becomes more resistant to change as a result of direct individual experiences. Attitude can be seen as an important psychological construct affecting and predicting consumers' behavior. Therefore, the more positive the consumers' attitudes toward GMF, the more their positive purchasing attitude will be recognized.

In addition, some studies have recorded more skeptical and negative attitudes toward GM food in female groups (Frewer et al., 1997; Faccio & Guiotto Nai Fovino, 2019; Jurkiewicz et al., 2014). Some cases have shown that age differences create different attitudes to the subject. Although Saba and Vassallo (2002) revealed that an older age group had a more positive attitude toward GM food, the younger generation was recorded as having a more positive attitude in the other study (Sparks et al., 1994). Thus, we found that consumers' attitudes influence their intention to purchase the goods, and the following hypothesis was proposed:

H_1: *Consumers' attitudes will positively impact on their purchase intentions in terms of GMaF in Vietnam and Taiwan.*

Perceived Risks and Benefits of Health

Bredahl (1998) discovered that consumers' perceptions of both risks and benefits have impacts on their attitudes. Consumer perception of the benefits related to health and the environment has a positive impact on their acceptance of a particular object (Kim, 2012). In addition, consumers tend to show higher purchase intentions once they perceive the benefits related to health and environment (Bredahl et al., 1998). However, Lusk and Coble (2005) concluded that, regarding GMF, consumers have shown less acceptance in term of risk perception. It also negatively affects attitude.

Recently, in some studies, people are worrying about the technical risk evaluation in the results and considering uncertainty along with health impacts so far. The consumer attitude toward GM food varies considerably in terms of the demand in different countries and different time periods (Gaskell et al., 2006; Bredahl, 1998). However, consumer attitudes to GM foods are negative on a worldwide basis (Aminet al., 2014; Knight, 2007). According to their perceptions of the risks, they believe that GMFs are damaging once consumed. As reported by Pratt (1964) a significant percentage of consumers around the world suppose that GMF is dangerous to human health. Lusk and Coble (2005) and Petrolia (2016) explained that the main reason for consumers' dread of GMF is the lack of information about the biotechnology. The complicated application of genetics on an organism requires technical skill and professional training that cannot be explained easily and simply. Without knowledge about GMF, consumers have built a self-protective attitude and resist accepting it. Although many scientific studies have asserted that before appearing on the market, GM products must be examined strictly to be guaranteed safe to human health, consumers have negative attitudes toward GM products based on their cognition. In agreement, Frewer et al. (1997) discovered that consumers' behaviors were determined by their own perceptions or beliefs about the risks of GM food in lieu of the products' estimated risks as announced by scientists, researchers, and experts. Whatever the explanations, people's uncertainty about GMF will create challenges to its acceptance. Thus, the following hypothesis was proposed:

H_{2a}: *Consumers' perceived risks to health from GMaF will influence their attitude negatively.*

Some studies have highlighted consumers' attitudes to specific applications rather than to the modern technology. Consumers' attitudes toward GE are more positive for medical purposes rather than for food production purposes (Frewer & Shepherd, 1995; Gaskell et al., 2004). Applications to medical treatment are perceived as more beneficial, less risky, and more ethical than food usage (Frewer et al., 2004). The market share of GM food has a higher acceptance rate in the US compared to other countries (Chen & Li, 2007). It was also discovered that Canadians have a more positive response to GE than Europeans, who are ambiguous about the modern application of biotechnology for enhancing human life (Gaskell et al., 2016). Thus, the following hypothesis was proposed:

H_{2b}: *Consumers' perceived benefits to health from GMaF will influence their attitude positively.*

Perceived Risks and Benefits of Environment

People lack confidence in risk assessments because they do not know whether or not they are conducted properly (Frewer et al., 2004). In addition, the long-term in-fluences of GM foods are not properly identified in these assessments. A survey was made in Europe of 25,000 European consumers to learn their levels of optimism and pessimism toward modern biotechnology. The results showed 52 and 12% for optimism and pessimism, respectively.

The development of biotechnology benefits human life, but it may also cause fear if it is perceived as resistant to natural evolution (Amin et al., 2013; Hall & Moran, 2006; McCarthy & Vilie, 2002). Changes to the "order of nature" are considered as risks to consumers. Genetic modification can be seen as particular example. Martinez-Poveda et al. (2009) emphasized that people tend to be scared of the potential harmful effects of unnaturalness. Likewise, consumers are considering the dangers and unpredictable risks of interposing in natural evolution. Opponent groups believe that biotechnology unnecessarily interferes with nature. It can cause unknown and potential damage to an organism's genetics, especially in humans and ecosystems. Another study discovered that the application of biotechnology techniques to animal or human genetics will cause higher risks than applying them to microorganisms and plants (Frewer & Shepherd, 1996). In addition, Frewer et al. (2004) proved that the application can lead to unethical, dangerous, and harmful effects to human and animal DNA. They believe that the safety mechanisms of nature could be beyond scientific control (Mendelsohn et al., 2003). Gene technology is the potential reason for the above consequences. Thus, the following hypothesis was proposed:

H_{3a}: *Consumers' perceived risks to the environment from GMaF will influence their attitude negatively.*

Because of climate change, every year agriculture is faced with losing productivity, with approximately 15% (Barker, 2005) and 40% (Clement, 2008) reductions in maize and soybean yields, respectively. Therefore, identifying the specific key gene to improve the drought resistance of plants as well as to save water is challenging for biotech researchers in that branch of farming. Specifically, the important innovation of "Managing Insect Resistance to *Bacillus thuringiensis* Toxins" has contributed to improving crops' resistance to insects (McGaughey & Whalon, 1992). In addition, some gene-altering applications thus far have tended to improve the characteristics of virus resistance, *Bacillus thuringiensis* (Bt) herbicide resistance, herbicide tolerance, and insect resistance without using pesticides that may damage and pollute the environment. Thus, the following hypothesis was proposed:

H_{3b}: *Consumers' perceived benefits to the environment from GMaF will influence their attitude positively.*

Subjective Norm

Subjective norm is defined as the degree of social pressure on customer intention. Ajzen (1991) defined it as a perceived external factor in performing a certain behavior. In addition, subjective norm has been regarded as a critical impact upon consumers' purchase intention. With the perception of social pressure, people will choose to perform or non-perform the behavior based on other individuals or social consequences. It can also be seen to stimulate the behaviors by way of important relationships such as family and friends. For example, people tend to form higher purchase intention if reliable people have positive attitudes toward GMF (Chen, 2008). In comparison, subjective norm has less correlation than other factors on the models for purchase intention determination (Prati et al., 2012). Therefore, the following hypothesis was proposed:

H_4: *Consumers' subjective norm will positively impact on their purchased intention in term GMaF in Vietnam and Taiwan.*

Perceived Behavioral Control

Some studies discovered that people perceived GMF as posing more risks than benefits (McCarthy & Vilie, 2002; Gaskell et al., 2004; Hall & Moran, 2006; Amin et al., 2013). However, perceptions of both risks and benefits are difficult and complex to conceptualize separately (Amin et al., 2014). While many studies found correlations between them (Schenk et al., 2008; Costa-Font & Gil, 2009; Prati et al., 2012; McComas, Besley, & Steinhardt, 2014), some studies deny any evidence for the correlations (Chen & Li, 2007; Amin et al., 2014). In 1991, Ajzen added a third factor for behavioral intention called "perceived behavioral control," considered to be "the perceived ease or difficulty of performing the behavior." In this paper, it is the consumer's feeling about their controllability over the foods they eat or buy. Moreover, much research has been conducted to examine the correlation between perceived behavioral control and consumers' purchase intentions (Dean et al., 2008). In some views, perceived behavioral control has a positive correlation with consumers' behavior (Saba & Vassallo, 2002), but Spence & Townsend (2006), suggesting that perceived behavioral control negatively affects purchase intention. Thus, the following hypothesis was proposed:

H_5: *Consumers' perceived behavioral control will negatively impact on their purchase intentions toward GMaF in Vietnam and Taiwan.*

Purchase Intention

The research examines the factors affecting consumers' purchase intentions in terms of GMaF, which means the thesis is mainly focused on the intention to buy GMF as a dependent variable. On the other hand, although TPB has been applied widely in exploring consumers' purchased intentions, the authors have tried to develop new models from the original theory to be congruent with the research objectives. In some studies, customers' purchasing intentions toward GmaF was found to be influenced by three factors: subjective norms, perceived behavioral control, and attitude toward purchasing GMF. Moreover, people tend to fear side its effects or unknown long-term effects on human health or environmental problems (Ghoochani et al., 2017; Kim, 2014; Kim, Jang, & Kim, 2014; Patch, Tapsell, & Williams, 2005; Saba & Vassallo, 2002; Sparks et al., 1995). Therefore, this study aimed to confirm whether health and environmental factors influence consumers' purchasing attitudes, which in turn influence purchasing intentions for GmaF, and to explain the decision-making process of consumers purchasing GmaF.

Previous Research Reviews

The research purposes on examining the factors affecting on consumers' purchased intention in term of GMaF, that mean the thesis focusing on intention to buy GMF is dependent variable mainly. On the other hand, although TPB has been applied widely over the world on exploring the consumers' purchased intention, the authors tried to develop the new models from the original theory to seek out to be congruent with the research objectives. In some studies, customers' the purchasing intention in term GMaF was found influenced by three factors as subjective norms, perceived behavioral control and attitude to purchase GMF. Moreover, people tend to be scare of side or unknown long-term effects on human health or environmental problem (Knight, 2007; Amin et al., 2014). Therefore, the study aims to choose both health and environmental concern as selected factors to make predictions about consumers' attitude on purchasing which affects to purchase intention in term of GMaF as well as give reasons for consumers' decision of purchasing GMaF.

The TPB has been applied in research on "Examining Consumer Behavior Toward Genetically Modified (GM) Food in Britain" (Spence & Townsend, 2006). Behavioral intention has been significantly detected in all components, including moral norms, emotional involvement, self-identity, attitude, subjective norms, perceived behavioral control and purchase intention. Uniquely, the authors discovered the relationship between the three factors: attitude, subjective norms, perceived behavioral control and purchase intention, with attitude found to be the strongest predictor of behavioral intention toward GMaF. Zhang et al. (2018) published the article "Application of an Integrated Framework to Examine Chinese Consumers' Purchase Intention toward Genetically Modified Food" with the related finding that attitude

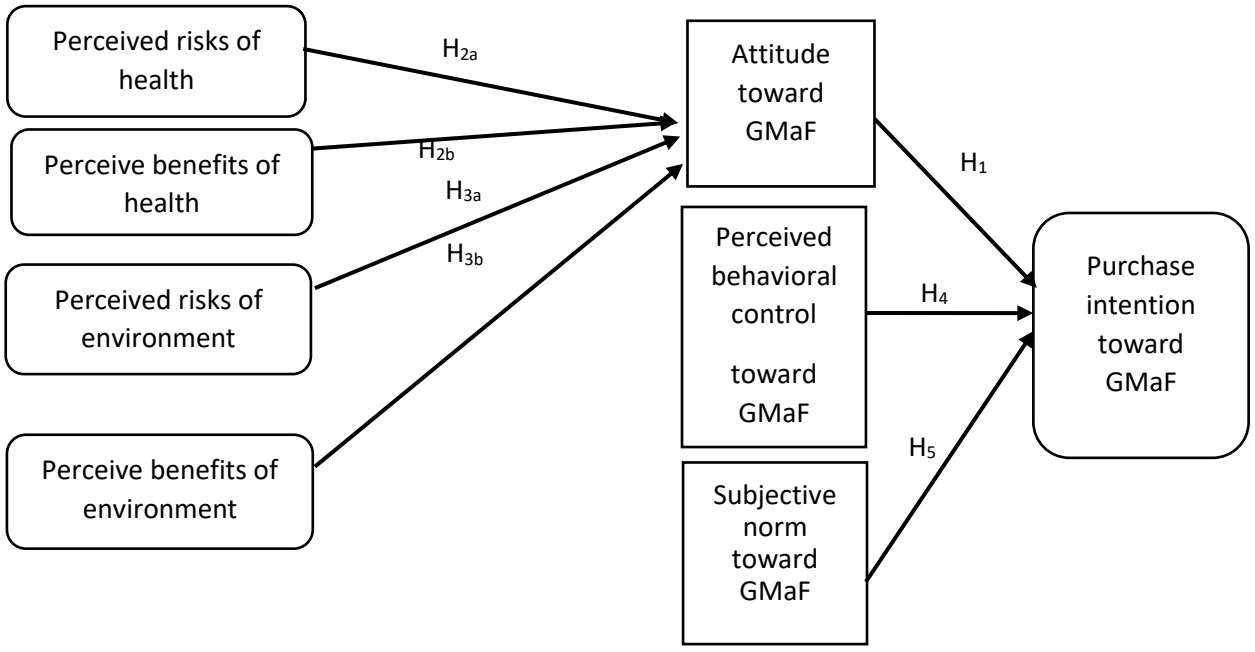
has more significance for predicting the purchase intention toward GMF compared to subjective norms and perceived behavioral control. Kim et al. (2014) confirmed that people with a highly positive attitude, subjective norms, and perceived behavioral control regarding the behavior will have stronger a purchase intention toward GMaF.

In the study "Consumer's Intention to Purchase Green Brands: The Roles of Environmental Concern, Environmental Knowledge and Self Expressive Benefits" (Ahmad & Thyagaraj, 2015), other factors along with environmental knowledge, environmental concern, and self-expressive benefits positively influenced attitude, which in turn became the intention to purchase green brands.

A survey on "Attitudes about Genetically Modified Foods among Korean and American College Students" (Finke & Kim, 2003) affirmed that students in Korea perceived more health risks than American students based on the information about GMOs in the popular press as well as product labeling, with the health concern as 87 and 58% for Korean and American students, respectively.

In taking a survey, the consumer will respond differently in different places and times (Gaskell et al., 1998; Bredahl, 1999). Thus, this study, which updates information about consumer demand in terms of GMFs, will be more significant and crucial in exploring the fields for both Vietnamese and Taiwanese markets. In addition, to evaluate the purchase intentions of consumers in Taiwanese and Vietnamese markets, an integrated framework of the attitude model and the behavioral intention model was created, as seen in Figure 1. In this framework, the attitude variable is measured by customers' perceived levels of health and benefits; meanwhile, the other three constructs of attitude, subjective norm, and perceived behavioral control decide customers' purchase intentions regarding GM food.

FIGURE 1
THE RESEARCH MODEL



METHODOLOGY

Research Design

In response to the research questions and hypothesis-testing mentioned above, our research efficiently adopted the quantitative approach, which describes and explains the observable phenomena and empirical investigations using mathematical or statistical techniques to analyze the collected data for results.

Moreover, the quantitative approach has been used widely because the hypotheses can be tested in a shorter time than in the qualitative method.

The findings are powerful and solid only if the data are quantifiable and reliable. Meaning that the data must be built based on well-designed questionnaires as well as the under-reviewing variables (dependent variables) being answered or measured based on their relationship to independent variables. This study used only primary data, which were gathered via online (by my3q.com website) and paper questionnaires, then analyzed with the Statistical Package for the Social Sciences (SPSS) version 23.

Sampling

Sampling Target

Because of the limitations of time, finances, and logistics, this study focused on Taiwan and a part of Vietnam, Ho Chi Minh City. In the report, around 60% of Taiwanese expressed their concerns about GMF safety through the survey of Taiwan's Department of Health, while Ho Chi Minh City respondents satisfied the conditions and knowledge in terms of GMFs compared to other areas in Vietnam that we chose them to be representative for Vietnam. In some studies, two different age groups have dissimilar attitudes toward GMFs. In a European study, Ceccoli & Hixon (2012) agreed that older age groups have a more positive attitude toward GM food, whereas the younger generation had a more positive attitude in another study (Gaskell et al.,1998). Thus, this study organized respondents from 18 to over 60 years old by dividing into 5 different groups, namely 18–29, 30–39, 40–49, 50–59, and over 60 years—and using Vietnamese and Chinese to communicate.

Sample Frame

This study was suitable for the convenience sampling and snowball sampling methods for these reasons: they are simple ways to collect data, useful for testing studies and for generating hypotheses. In addition, distributing questionnaires and collecting data can be performed in a short duration of time conveniently as well as within a limited resources.

The questionnaires developed by other researchers for specific purposes were used in this study, primarily because of the efficiency. Then they were distributed and respondents were interviewed personally to collect data effectively. In consideration of the efficiency during the survey, this study applied the convenience sampling method, a non-probability sampling method for collecting respondents' answers. On the other hand, we accessed secondary data from the Internet, databases, journals, books, scholars' research, etc., as the references to include in the literature review, as well as for the methodology. Finally, the collected data were analyzed with SPSS.

Data Collection

The necessary data for analysis were collected by surveys of 250 respondents each in Taiwan and Ho Chi Minh City, Vietnam, through physical and online questionnaires (prepared by my3q.com—an online electronic qualitative questionnaire platform in multiple languages that helps respondents to easily access it).

Intentionally, a pilot study with 30 people was obtained to ensure that the questionnaire was readable, understandable, and acceptable by the respondents without any mistakes before releasing the survey. To reach respondents with more accurate and valid data, data collection was focusing on primary data by distributing questionnaires either directly (paper) or online (Facebook, email, or Google drive). For the first way, questionnaires were distributed directly around stores, malls, or supermarkets that sold GMaF, and the author could meet face to face with respondents in Taiwan and in Vietnam. We focused on parks especially, where people exercising were seen as health-conscious, during prime times of exercise such as early morning from 5 a.m. to 7 a.m. or afternoon from 4 p.m. to 6 p.m. and in the evening. In this way, the survey reached target respondents who care about their health. On the other hand, respondents joined the survey via the link on Facebook or by email to answer the questionnaire completely and quickly when far away from the researcher. Nowadays, people are familiar with using the Internet on their smartphones and

computers. This distributed the questionnaire more conveniently and faster than the paper questionnaires method, which took time for responding as well as transporting to different places.

Regarding the collecting time, the author spent 3 months, including designing, testing, revising, and distributing the data for a month and collecting and analyzing the results in the 2 remaining months. To assure the validity and reliability, the pilot test was all-important in identifying deficiencies in the proposed design or procedure, which were addressed and modified before releasing the questionnaire widely (Saunder et al., 2009). Moreover, the author consulted with 4 professors in a Taiwan university with many years' experiences in the research context.

The measurement statements and redundant wording on the questionnaire was modified and removed to reach validity. In addition, the revised questionnaire was translated into both the Vietnamese and Chinese languages with a back translation method to guarantee the conceptual equivalence. This present research applied the back translation with different experts; the original questionnaire in English was in turn translated into Chinese by a native Chinese speaker professor, then translated reversely to English by another associate professor in University, Taiwan. Both translators were proficient in English and Chinese and knowledgeable on the types of statements and methodology used. Similarly, the English version was also back-translated into Vietnamese by a professor and a Ph.D. student from Vietnam, who were proficient in Chinese and Vietnamese.

Questionnaire Design

The study aimed to examine the factors influencing consumers' purchase intentions, with the 6 independent variables mentioned in the questionnaire design section along with items by the author and thesis supervisors. Respondents answered by giving their opinions according to a seven-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = disagree somewhat, 4 = neither agree nor disagree, 5 = agree somewhat, 6 = agree, 7 = strongly agree). In part 1, the sets of screening questions classified the qualifying respondents from the total samples by targeting their knowledge about GMaF. The following part included a series of questions about 5 independent variables of health concerns, environmental concerns, attitudes toward purchasing GMaF, subjective norm and perceived behavioral control toward GMF. Eventually, in part 3, questions evaluated the customer's attitude about the products, including their willingness to buy or recommend to other people the GMF rather than the non-GMF.

To measure the factors that influenced consumers' purchase intentions regarding GMF, the study reused measurement scale references from previous studies, as summarized on Table 1.

TABLE 1
STUDY MEASUREMENT SCALE

Construct	Indicator	Source
Attitude (ATT)	ATT1: Application of transgenic technology is ethically acceptable. ATT2: Application of transgenic technology in the "natural" angle is acceptable. ATT3: Transgenic technology is better than traditional technology. ATT4: Production of GM food can improve current and future social welfare. ATT5: The production of GM food is a necessary activity for society. ATT6: For the whole society, the benefits of GM food are greater than the risks.	Rodríguez-Entrena et al. (2013)
Perceived risks of health (PRH)	PRH1: GMaF will risk to human health. PRH2: I am not willing to consume foods with GMaF ingredients. PRH3: It is important to label GMaF. PRH4: By eating GMaF, a person's genes could be altered. PRH5: The use of GMaF is dangerous.	Chern & Rickertsen (2002)

Perceive benefits of health (PBH)	PBH1: Gene technology can reduce pesticides on food. PBH2: Gene technology can create foods with enhanced nutritional value.	Kimenju et al. (2005)
Perceived risks of Environment (PRE)	PRE1: Growing GM crops will be harmful to the environment. PRE2: Genetic modification of plants can harm the environment. PRE3: There will be negative long-term environmental effects of the use of genetically modified crop.	Chen and Li (2007)
Perceived benefits of Environment (PBE)	PBE1: Gene technology has potential of reducing pesticide residues in the environment. BBE2: Gene technology increases productivity and offers solution to world food problem.	Kimenju et al. (2005)
Subjective norms (SN)	SN1: If my family expects me to purchase GMaF, I will buy it. SN2: If my friends expect me to purchase GMaF, I will buy it. SN3: If the experts expect me to purchase GMaF, I will buy it. SN4: Those who have a significant impact on me when I consume GMaF.	Spence & Townsend (2006)
Perceived behavioral control (PBC)	PBC1: I am confident that I can avoid eating GMaF. PBC2: I can self-monitor a good diet, to avoid consumption of GMaF. PBC3: Whether I will eventually buy GMaF is entirely up to me. PBC4: Although GMaF were available in shops, I can prevent myself to buy it.	Spence & Townsend (2006)
Purchase intention (PI)	PI1: If the quality is better than ordinary food, I will buy GMaF. PI2: I will consume GMaF in the future. PI3: I would buy GMaF regularly. PI4: I will purchase genetically modified food if needed. PI5: I will recommend the purchase of GMaF to others.	Prati et al. (2012) Esch et al. (2006)

Common Method Bias Testing

Owing to that the data were collected via self-report, thus common method bias (CMB) may have occurred. For testing CMB, we conducted Harman's one-factor test by performing an exploratory factor analysis (principle components analysis) with all manifest items (Podsakoff, 2003). The results of the principle components analysis showed that all produced factors had eigenvalues greater than 1, and the first factor accounted for only 31.6 percent and 29.56 percent of the total variance for Taiwan and Vietnam data respectively. It means that no single factor explained the majority of the variance. The result implied that the potential concern of CMB was not significant in this study.

DATA ANALYSIS AND FINDING

Response Rate

Based on the collected results from both convenient and snowball sampling methods, 248 and 203 people participated in answering the survey by Facebook, email and physical questionnaires in Taiwan and Vietnam, respectively. After excluding incomplete answers and screening out respondents who had not heard about GM food, the response rates of Taiwanese and Vietnamese were validated for analysis as 83% (206) and 71% (144), respectively.

Demographic Description

The genders proportion showed female respondents in the two countries comprised a larger percentage with 56.80 and 61.80% in Taiwan and Vietnam, respectively, while men only participated at 43.20 and

38.19% levels. This suggested that women in the two countries had more interest in this topic by their willingness to answer the questionnaire.

Most participants in both nations were from 18 to 29 years old with 38.83 and 64.58% for Taiwanese and Vietnamese, respectively. People in Taiwan younger than 18 years contributed 2.9%, while the same age group in Vietnam was not represented. Moreover, the second ranking for the full sample was held by three age groups between 30 and 49 with percentages of around 10 to 20%. Similarity, Taiwan participants in three groups aged between 30 and 59 years old accounted for third place with rankings of around 15 to 20%. Of those remaining, 17% of the participants occupied the last age group (above 60 years old). Otherwise, respondents in Vietnam from 30 to 39 years old made up 26.39% in the second ranking, which was almost four times the size of the 40–49 years age group (4.86%), followed by 50–59 and over 60 years, both at 2.08%.

Comparing the two, we clearly saw that a significant proportion of respondents received over VND 10 million (38.88%) and more than NTD 30 thousand per month (37.86%), like the full sample record, where the dominant proportion (38.29%) comprised respondents over 30 years old. As the following numbers indicate, in Vietnam 30.55 and 22.91% received income between VND 6–10 million and VND 3–6 million. Finally, the lowest income category was filled by 7.63% with less than VND 3 million. Meanwhile, in the Taiwanese results, 27.18% people had income less than NTD 15 thousand and belonged to the below 18 years old group, following as income ranged between NTD 15–25 thousand and 25–30 thousand NTD.

Among six different levels of education, respondents who almost got BSc degrees were at 47.57, 65.28 and 54.86% in Taiwan, Vietnam, and the full sample, respectively. Likewise, Masters level in three groups took second place in the ranking, along with the high school and college level groups showing the same ranking in both countries with 14.08 and 9.71% in Taiwan and 3.47 and 6.25% in Vietnam. Eventually, below high school and PhD respondents contributed insignificantly to the survey in Taiwan, while the information for below high school level participants was not recorded in the Vietnam column.

Overall, eight categories of occupations, including information technology, student, government staff, military staff, teacher, service worker, manufacturing, business owner, financial banking, housewife and others, indicated that people in the other occupations mentioned in the survey full sample played a dominant role in the study (15.43%), similar to Taiwanese respondents (18.45%). In contrast, the highest proportion in Vietnam belonged to financial banking with 28.47%. On the other hand, less than 1% military staff was interested in the survey in Vietnam, the smallest share along with information technology in Taiwan, contrarily.

This study was implemented in both Taiwan and Ho Chi Minh City, which have many people from different regions. To avoid confusion between the two countries, ambiguous locations in other regions were excluded in the result. Therefore, 144 people in Vietnam were included, with 100% in Ho Chi Minh City. Almost all respondents in Taiwan came from the Kaohsiung area (54.37%), where the survey was collected conveniently. The remaining areas in Taiwan included the Taipei Area, Taichung Area, Tainan area, Ping Dong area, and Tai Dong area, which totaled 45.63%. The respondent profile is shown in Table 2.

TABLE 2
PROFILE OF RESPONDENTS

	Taiwan (n=206)		**Vietnam (n=144)**		**Full sample (n=350)**	
	Num.	%	Num.	%	Num.	%
Gender						
Male	89	43.20	55	38.19	144	41.14
Female	117	56.80	89	61.80	206	58.86
Age						
< 18	6	2.90	0	0	6	1.71
18-29	80	38.83	93	64.58	173	49.43
30-39	31	15.05	38	26.39	69	19.71

40-49	31	15.05	7	4.86	38	10.86
50-59	41	19.90	3	2.08	44	12.57
>60	17	8.25	3	2.08	20	5.71
Income						
<3m VND or <NTD15K	56	27.18	11	7.63	67	19.14
3m-6m VND or NTD 15K-25K	34	16.50	33	22.91	67	19.14
6m -10m VND or TND25K-30K	38	18.44	44	30.55	82	23.43
>10m or >NTD30K	78	37.86	56	38.88	134	38.29
Educational level						
under High School	9	4.37	0	0	9	2.57
High School	29	14.08	5	3.47	34	9.71
College	20	9.71	9	6.25	29	8.29
Undergraduate or BSc.	98	47.57	94	65.28	192	54.86
Master	40	19.42	33	22.92	73	20.86
PhD.	10	4.85	3	2.08	13	3.71
Occupation						
IT	8	3.88	14	9.72	22	6.29
Student	35	16.99	7	4.87	42	12.00
Government staff	10	4.85	4	2.78	14	4.00
Military staff	15	7.28	1	0.69	16	4.57
Teacher	11	5.34	19	13.19	30	8.57
Service	26	12.62	10	6.94	36	10.29
Manufacturing	23	11.17	11	7.63	34	9.71
Own business	10	4.85	18	12.5	28	8.00
Financial banking	12	5.83	41	28.47	53	15.14
Housewife	18	8.74	3	2.08	21	6.00
Other	38	18.45	16	11.11	54	15.43

Descriptive Statistics

The mean values of ATT in Taiwan and Vietnam were 3.83 and 4.12 out of 7, respectively. Most of the participants in Taiwan showed their negative attitude toward GM food slightly for all six items, whereas Vietnamese perception was higher with all items greater than 4, except item ATT3, consisting of the statement "Transgenic technology is better than traditional technology." Specifically, the mean values of item ATT1 got the highest evaluation in both Taiwan (3.94) and Vietnam (4.26). These numbers indicated that most participants agreed with the statement: "Application of transgenic technology is ethically acceptable."

Taiwanese and Vietnamese people showed a high perception of risk to health. In detail, the Taiwanese perception of risk (mean = 4.62) was higher than the Vietnamese (mean = 4.42) with all items over 4, while the Vietnamese sample had items 2 and 5 at slightly less than 4. In item 3 particularly, with the statement that "It is important to label GMaF," respondents in both countries showed the highest evaluation compared to each other.

Participants in both countries expressed their high perceptions of health benefits with all items over 4. Additionally, Vietnamese respondents had a higher result compared to Taiwanese, with mean values of 4.70 and 4.19, respectively.

In the study, there were significant differences in perceived risk to the environment in Taiwan and Vietnam. Based on the mean value, Taiwanese people perceived that GMaF brought risks to the environment; meanwhile, the mean value in the Vietnamese sample was less than 4.

Similar to the perceived benefit to health, the respondents in both countries thought that GMaF affected the environment positively with a mean value over 4 for all items. The Vietnamese sample had moderately higher evaluated point than Taiwan.

The subjective norm result in both Taiwan and Vietnam showed a mean value less than 4. Additionally, all items in the Taiwanese sample were less than 4, while the Vietnamese result showed item 3 at 4.06, as slightly agreeing with the statement "If the experts expect me to purchase GMaF, I will buy it." However, both samples were concluded as disagreeing in general.

There was no significant difference in perceived behavioral control for both countries. People showed their agreement with a mean value of nearly 4.2 for both Taiwan and Vietnam.

Vietnamese people showed their agreement in purchase intention items with a mean value of 4.07, higher than the Taiwanese sample, in which all items were evaluated less than 4.

The means and standard deviations among the variables are shown in Table 3.

TABLE 3
DESCRIPTIVE STATISTICS

	Taiwan (n=206)		**Vietnam (n=144)**			**Taiwan (n=206)**		**Vietnam (n=144)**	
	Mean	SD	Mean	SD		Mean	SD	Mean	SD
ATT	3.83	1.48	4.12	1.52	**PBE**	4.32	1.52	4.65	1.51
ATT1	3.94	1.72	4.26	1.67	**PBE1**	4.22	1.63	4.49	1.63
ATT2	3.86	1.76	4.24	1.78	**PBE2**	4.41	1.68	4.82	1.65
ATT3	3.71	1.67	3.91	1.69	**SN**	3.49	1.44	3.76	1.56
ATT4	3.89	1.74	4.15	1.73	**SN1**	3.34	1.54	3.70	1.66
ATT5	3.84	1.77	4.16	1.74	**SN2**	3.33	1.60	3.59	1.72
ATT6	3.76	1.68	4.03	1.76	**SN3**	3.71	1.62	4.06	1.70
PRH	4.62	1.30	4.42	1.50	**SN4**	3.58	1.62	3.69	1.64
PRH1	4.37	1.64	4.40	1.75	**PBC**	4.2	1.23	4.21	1.35
PRH2	4.45	1.77	3.97	1.90	**PBC1**	3.32	1.48	3.66	1.49
PRH3	5.69	1.52	5.63	1.73	**PBC2**	3.76	1.51	3.92	1.64
PRH4	4.28	1.79	4.13	1.93	**PBC3**	4.95	1.57	4.87	1.68
PRH5	4.32	1.66	3.95	1.89	**PBC4**	4.47	1.64	4.39	1.72
PBH	4.19	1.46	4.70	1.59	**PI**	3.47	1.43	4.07	1.53
PBH1	4.36	1.51	4.72	1.72	**PI1**	3.98	1.65	4.51	1.84
PBH2	4.02	1.63	4.69	1.64	**PI2**	3.51	1.53	4.06	1.67
PRE	4.36	1.49	3.90	1.73	**PI3**	3.00	1.53	3.46	1.66
PRE1	4.29	1.63	3.76	1.80	**PI4**	3.72	1.68	3.79	1.69
PRE2	4.34	1.58	3.92	1.79	**PI5**	3.15	1.71	4.50	1.67
PRE3	4.46	1.62	4.01	1.82					

Reliability Statistics

The inspection of scale reliability test aims at internal consistency among the variables measured in the same concept. This test was based on the analysis results for Cronbach's alpha , where the correlation between the observed variables and the variable total was greater than 0.3. In addition, about 0.3–0.4 correlated with the gross national was removed after considering the very low meaningful contribution to the concept of measurement, and the total of Cronbach's alpha (CA) must be greater than 0.7 (in the case of repeated scales). In addition, by the standards of the scale according to the level of reliability was assessed as follows: CA > 0.9 (Excellent), CA > 0.8 (Good), CA > 0.7 (Acceptable), CA > 0.6 (should be reconsidered), CA > 0.5 (Poor), and CA < 0.5 (unacceptable). Therefore, the standards applied to this study were Cronbach's alpha >0.70 and the correlation with the variable total >0.30 (the variables correlated with gross <0.30 were removed from the scale).

The reliability statistics of the variables are shown in Table 4, including attitude, perceived risks to health, perceived benefits to health, perceived risks to the environment, perceived benefits to the environment, subjective norms, perceived behavioral control and purchase intention for Taiwanese and

Vietnamese samples. Cronbach's alpha reached greater than 0.8 and was evaluated as good scale. The PBC variable for Taiwan was less than 0.8, but higher than 0.7, so it was acceptable based on the standard evaluation above. Therefore, all variables contributed significantly to the scale of measurement.

TABLE 4
RELIABILITY STATISTICS OF VARIABLES FOR TAIWANESE AND VIETNAMESE SAMPLES

	Cronbach's Alpha	
	Taiwan	**Vietnam**
ATT	0.927	0.941
PRH	0.836	0.875
PBH	0.831	0.884
PRE	0.918	0.958
PBE	0.814	0.817
SN	0.924	0.947
PBC	0.798	0.846
PI	0.927	0.938

Correlation Testing and Linear Regression

The relationship between independent variables and dependent variables was tested by correlation testing. The correlation testing results that were used for regression analysis of Taiwanese and Vietnamese samples are in Tables 5 and 6. From the results, it can be clearly sees that in the absolute value of Pearson's correlation in Taiwan, r was greater than 0.146 with significance at $p < 0.05$; meanwhile, it was less than 0.180 with significance at $p < 0.05$ in Vietnam.

In particular, the first dependent variable ATT (attitude to GM food) had a relationship to four independent variables including perceived risks to health (PRH), perceived benefits to health (PBH), perceived risks to the environment (PRE), perceived benefits to the environment (PBE). Meaning that Pearson's correlation between PRH, PBH, PRE, PBE and ATT was relative, corresponding to −0.316, 0.691, −0.265, 0.577 for the Taiwanese sample and −0.192, 0.689, −0.18, 0.647 for the Vietnamese result, respectively.

On the other hand, purchase intention (PI) also had a relationship to three other independent variables inclusive of attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC). The correlation results of ATT, SN, PBC and PI as 0.639, 0.688, and −0.161 for the Taiwanese and 0.808, 0.827, and 0.043 for the Vietnamese showed significant relationships between all independent variables and a dependent variable in the Taiwanese sample; however, excepting ATT and SN, the Vietnamese correlated results for PBC and PI were unrelated with $r = 0.043$ ($r > 0.180$ significant at $p < 0.05$).

TABLE 5
THE RESULTS OF CORRELATIONS TESTING IN TAIWAN

	ATT	**PRH**	**PBH**	**PRE**	**PBE**	**SN**	**PBC**
PRH	-0.316						
PBH	0.691	-0.214					
PRE	-0.265	0.698	-0.239				
PBE	0.577	-0.124	0.736	-0.129			
SN	0.641	-0.325	0.570	-0.298	0.442		
PBC	-0.146	0.489	-0.098	0.529	-0.109	-0.700	
PI	0.639	-0.422	0.508	-0.364	0.467	0.688	-0.161

Note: Absolute value of $r > 0.146$ significant at $p < 0.05$.

TABLE 6
THE RESULTS OF CORRELATIONS TESTING IN VIETNAM

	ATT	PRH	PBH	PRE	PBE	SN	PBC
PRH	-0.192						
PBH	0.689	-0.018					
PRE	-0.180	0.537	-0.005				
PBE	0.647	-0.062	0.816	-0.010			
SN	0.786	-0.144	0.609	-0.111	0.607		
PBC	0.024	0.556	0.107	0.349	0.140	0.118	
PI	0.808	-0.148	0.708	-0.090	0.686	0.827	0.043

Note: Absolute value of $r > 0.180$ significant at $p < 0.05$.

Regression Analysis

The analysis results showed that the F statistic was calculated from the adjusted R square value of the model with very small statistical significance ($p = 0.000$). This means that linear regression models fit multiple data sets and were statistically significant in the Taiwanese, Vietnamese, and full samples, or three models of this study reached statistical significance.

Meanwhile, in the Taiwanese, Vietnamese, and full sample, the adjusted R squares of ATT were 0.509, 0.523 and 0.539, explaining 50.9, 52.3 and 53.9% variability of the dependent variable discretely, or other way, 50.9, 52.3 and 53.9% of the variation in ATT were explained by four independent factors. Therefore, this result showed strong a positive relationship between the variables.

The adjusted R squares for PI independent variables were respectively indicated at 0.546, 0.749, and 0.561 for Taiwanese, Vietnamese, and full samples. Similar to the attitude variable above, the purchase intention dependent variable was explained by the other three independent variables including ATT, SN and PBC with 54.6% (Taiwan), 74.9% (Vietnam) and 56.1% (full sample), respectively. Hence, the linear regression models recorded a strong positive relationship.

Regarding the regression coefficients of the ATT variable for the full sample ($n = 350$), significance values shown in three constructs including perceived risk to health ($p = 0.038$), perceived benefits to health ($p = 0.000$) and perceived benefits to the environment ($p = 0.044$) were less than 0.05, which satisfied the statistical condition of significance result. In addition, perceived risk to the environment showed 0.383 ($p > 0.05$) in significance value, which was insignificant for statistical result. The levels of correspondence from the strong to the weak variable were as follows: perceived benefits to health (0.576), perceived benefit to the environment (0.134), and perceived risk to health (−0.13). It also was noticed that the variable perceived risk to health ($t = -2.093$) caused a reversal in the directionality of the effect.

Therefore, the independent attitude variables of the full sample were explained by the three constructs mentioned above, with the following linear equation based on the beta value:

$$ATT=1.531 -0.13PRH+ 0.576PBH +0.134PBE + Ɛa. \quad (1)$$

Based on the significance values shown in Table 7 for the regression coefficients of the purchase intention variable in the full sample, a significant portion of perceived behavioral control ($0.865 > 0.05$) had no significance compared to the other two constructs, including attitude ($p = 0.000$) and subjective norm ($p = 0.000$). This was because its significance value was 0.865, which was higher than 0.05, moving out of significance level of 5%. Therefore, the dependent variable PI could only be explained relying on attitude (beta = 0.360) and subjective norm (beta = 0.454), the linear equation is illustrated as the following and in Figure 2:

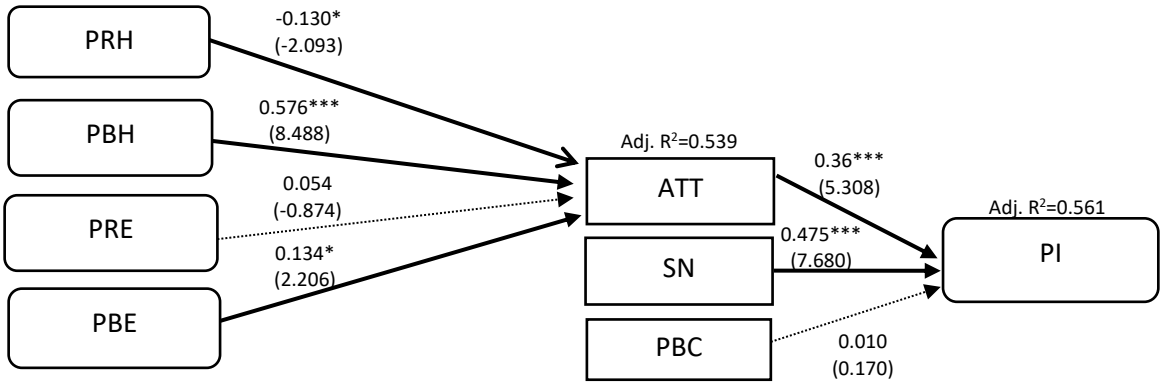
$$PI= 0.642+ 0.360ATT+ 0.454SN + Ɛp. \quad (2)$$

TABLE 7
REGRESSION FOR ATT AND PI

Independent variable	B	Beta	T-value
(constant)	1.531		3.804
PRH	-0.146	-0.130*	-2.093
PBH	0.616	0.576***	8.488
PRE	-0.052	-0.054	-0.874
PBE	0.134	0.134*	2.026
(constant)	0.642		1.730
ATT	0.344	0.360***	5.308
SN	0.453	0.454***	7.019
PBC	0.019	0.010	0.170

Note: *. p<0.05, **. p<0.01, ***. p<0.001

FIGURE 2
PATH ANALYSIS RESULTS FOR THE FULL SAMPLE (N=350)



Regarding the regression coefficients of the ATT variable for Taiwan, the significance results shown in three independent factors, including perceived risks to health (p = 0.005), perceived benefits to health (p = 0.000) and perceived benefits to the environment (p = 0.027), were below the condition of statistical significance (p < 0.05). Meanwhile, the significance value of perceived risk to the environment showed p = 0.768, which was higher than 0.05 leading to the no significance result. The linear equation for attitude in the Taiwanese sample is demonstrated below and Figure 3:

$$ATTt= 1.814-0.196PRHt+ 0.535PBHt +0.161PBEt+ Ɛa \quad (3)$$

Regarding the regression coefficients of the PI variable for Taiwan, the significance of attitude and subjective norm was 0.000 (less than 0.05); nevertheless, the significance value of PBC at 0.093 was higher than 0.05, leading to no statistical significance. Therefore, the equation of consumers' purchase intentions toward GM food could be built based on ATT and by beta value in Table 8 as:

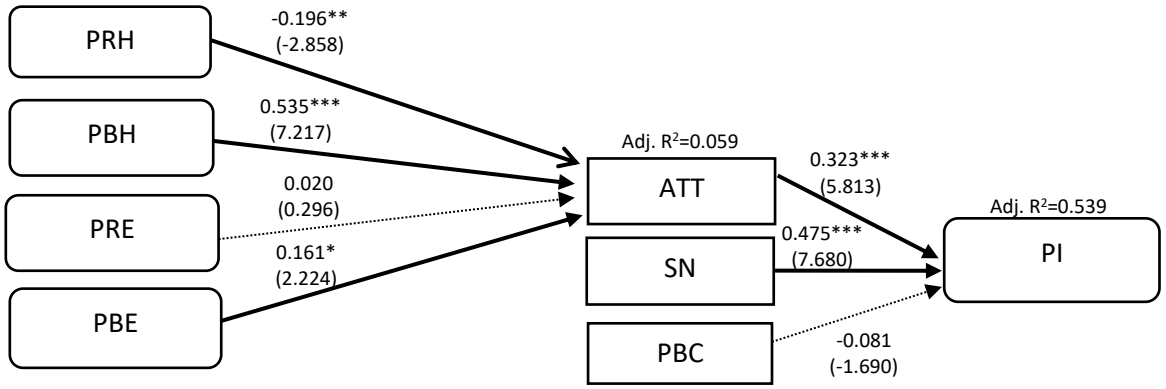
$$PIt= 1.011+0.323ATTt+0.475SNt+ Ɛp \quad (4)$$

TABLE 8
REGRESSION FOR ATT AND PI IN TAIWAN

Independent variable	B	Beta	T-value
(constant)	1.814		4.639
tPRH	-0.221	-0.196**	-2.858
tPBH	0.542	0.535***	7.217
tPRE	0.020	-0.020	0.296
tPBE	0.157	0.161*	2.224
(constant)	1.011		3.119
tATT	0.313	0.323***	5.183
tSN	0.472	0.475***	7.680
tPBC	-0.095	-0.081	-1.690

Note: *. p<0.05, **. p<0.01, ***. p<0.001

FIGURE 3
PATH ANALYSIS RESULT FOR TAIWANESE SAMPLE (N=206)



Regarding regression coefficients of the attitude variable for Vietnam, the independent variable perceived risk to the environment had a significance value of 0.069, larger than 0.05. This meant that the results for the construct faced a statistically insignificant result. Meanwhile, other three constructs, including perceived risk to health (beta = −0.253), perceived benefit to health (beta = 0.488), perceived benefits to the environment (beta = 0.244) could be used to build the attitude linear equation. The linear equation can be explained as following and in Figure 4:

$$ATTv= 1.662 -0.253PRHv+0.488PBHv+0.244PBEv+ Ɛa \quad (5)$$

Matched to Taiwanese results, the perceived behavioral control in Table 9 with *t*-value of −0.690 caused insignificance. Similarly, the two constructs left with *t* values of 5.924 (attitude) and 7.343 (subjective norm) were higher than 1.96 on a 95% confident interval (significance number less than 0.05). This meant that the results had statistical significance. In addition, the beta value showed 40.8% for attitude and 50.9% for subjective norm, which could support forming the consumer purchase intention linear equation:

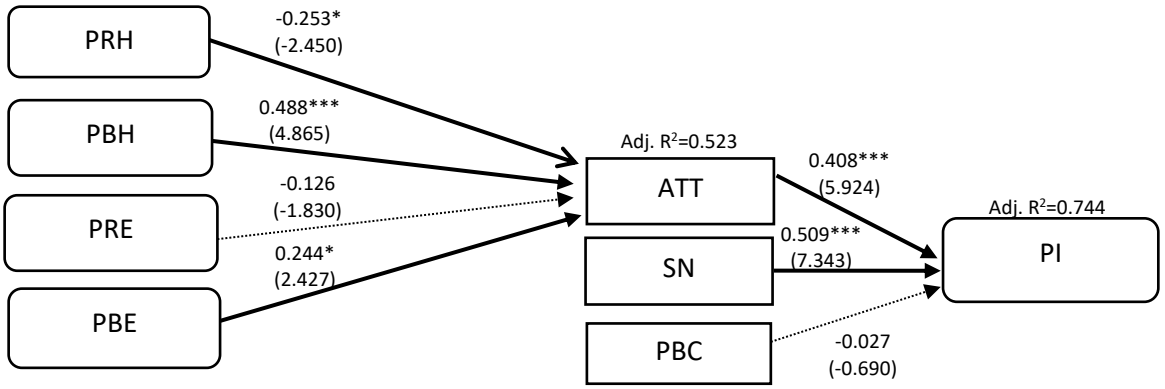
$$PIv= 0.629+ 0.408ATTv +0.509SNv + Ɛp \quad (6)$$

TABLE 9
REGRESSION FOR ATT AND PI IN VIETNAM

Independent variable	B	Beta	T-value
(constant)	1.662		4.118
vPRH	-.101	-.253*	-2.450
vPBH	.466	.488***	4.865
vPRE	-.110	-.126	-1.830
vPBE	.246	.244*	2.427
(constant)	.629		2.318
vATT	.410	.408***	5.924
vSN	.497	.509***	7.373
vPBC	-.030	-.027	-.619

Note: *. p<0.05, **. p<0.01, ***. p<0.001

FIGURE 4
PATH ANALYSIS RESULT FOR VIETNAMESE SAMPLE (N=144)



If lacking the connection between the predicted values and residuals, the P-P plot will disperse very randomly. In this study, the P–P Plot test demonstrated that the data all regressed in a 45 degree straight line, with *y*-axis as the observed data and *x*-axis the predicted data. Therefore, data did not violate the assumption of normality which also means the data follow the symmetric distribution with no significant skewness. In addition, the variance inflation factor (VIF) was larger than 10, leading to trouble as a multicollinearity phenomenon between the independent variables in the model. According to the results, all VIFs in this study were less than 10, meaning that independent variables were not perfectly multicollinear for each other.

Finally, the Durbin–Watson test detected autocorrelation condition between variables. Based on the results shown in the regression tables above, all Durbin–Watson values were in the range of 1.5 < D.W. < 2.5. Therefore, the data did not show an auto-correlated relationship.

CONCLUSION AND RECOMMENDATION

Conclusions

The study aimed to evaluate consumers' purchase intentions toward GMaF using the Theory of Planned Behavior, targeting the Taiwanese and Vietnamese markets. Using the statistical analysis program SPSS to analyze 206 and 144 respondents who had heard about GM food in Taiwan and Vietnam, respectively, the results were recorded for both countries and the full sample consistently.

In conclusion, according to the regression analysis with seven hypotheses, the results are summarized as followings. Firstly, similar to previous studies from Chern et al. (2002), Costa-Font and Gil (2009), Faccio et al. (2019), Hilbeck et al. (2008), attitude and subject norm showed their positive impacts upon purchase intention toward GMaF. In addition, similar to the research results of Bredahl (1998), Frewer et al. (1996), and Gaskell et al. (2004), consumer attitude was positively impacted by three independent variables: perceived risk to health, perceived benefit to health and perceived benefit to the environment. However, the other construct (perceived risk to the environment) showed no significant effect on consumers' attitudes in both countries. Although perceived risk to the environment can be an important factor in measuring consumer attitude, according to the regression analysis in Sections 4.5 and 4.6, the t-value was lower than 1.96 (the minimum value to reach a significant result). To explain this finding, people in the two countries may not be interested in environmental protection or lack knowledge or in-formation about the impact of GM food on the environment. Besides that, consumers' purchase intentions were positively influenced by subjective norm and attitude con-struct. In addition, the standardized beta value of subjective norm was higher than the attitude construct for both countries, with 0.475 and 0.323 in Taiwan and 0.509 and 0.408 in Vietnam, respectively. Therefore, Taiwanese, and Vietnamese people tend to buy GM food based on other references mainly including their family, friends, and other reliable people.

Moreover, the other dependent variable (perceived behavioral control) did not contribute to forming the pathway with the significance values of 0.093 for the Taiwanese sample and 0.537, which were larger than 0.05, better than statistically significant. One aim of this study was to use the planned behavior model to evaluate consumers' perceptions of the ease or difficulty in forming the purchase intention behavior by perceived behavioral control. However, the respondents in the two target countries showed an insignificant result for this construct. The solution may come from clarifying the characteristics of GM food. People perceived GM food as a risk to their health in the finding above; however, the products are required for their daily meals or include ingredients in high demand for daily life, such as soybeans, tofu, tomatoes, etc., which are popular in the Taiwanese and Vietnamese markets mentioned in Section 3, meaning that consumers cannot avoid using or reject the food directly.

To test the consumers' ATT and PI, the process of subgroup comparison in two countries was applied to evaluate the difference in each path based on the equation below. Table 10 shows the subgroup analysis results for the Taiwanese and Vietnamese samples. The calculated t-spooled values for all results showed strong paths significantly, or the compared means for both countries as all means of constructs had a high significant level.

$$t = \frac{PC1\text{-}PC2}{\left(\sqrt{\frac{N1-1}{n1+N2+2}}\,xSE_1 + \sqrt{\frac{N2-1}{N1+N2+2}}\,xSE_2\right) x\sqrt{\frac{1}{N1}+\frac{1}{N2}}} \quad (7)$$

Here, PC_1 is the beta value of the Taiwanese sample; SE_1 is the standard error of the Taiwanese sample; N_1 is the Taiwanese sample size; PC_2 is the beta value of the Taiwanese sample; SE_2 is the standard error of the Vietnamese sample; and N_2 is the Vietnamese sample size.

TABLE 10
SUB-GROUP ANALYSIS BETWEEN TAIWAN AND VIETNAM

Path	Path coefficient				$T_{spooled}$
	Taiwan		Vietnam		
	Beta	S.E.	Beta	S.E.	
H_{1a}	-0.196	0.077	-0.253	0.070	8.54***
H_{1b}	0.535	0.075	0.488	0.096	3.65***
H_{2a}	0.02	0.068	-0.126	0.060	14.89***

H_{2b}	0.161	0.071	0.244	0.101	6.43***
H_3	0.323	0.060	0.408	0.069	8.70***
H_4	0.475	0.061	0.509	0.068	3.47**
H_5	-0.081	0.056	-0.027	0.048	6.77***

In conclusion, Vietnamese consumers did show higher willingness to purchase GM food, with a mean value of 4.07, than Taiwanese consumers (mean = 3.47). They felt more anxious about their risks than benefits, and their perception of risk to health value was 4.62, which was higher than 4.19 (perceived benefits to health). In contrast, perceived benefits to health was higher than perceived risk to health in Vietnam with 4.70 and 4.42 for the two constructs, respectively; however, both values were higher than 4, meaning that Vietnamese people were also aware of risk associated with the products.

Recommendation

Based on the research result, to enhance Taiwanese and Vietnamese consumers' attitudes and purchase intentions toward GM food, the following recommendations were clarified. First, people in the two countries responded highly to perceived risk to health. This means that people are showing caution toward GM food. Therefore, companies and manufacturers should focus more on the products' quality in order to build their reliability for consumers. To expand the GM food market widely, firms can educate people with more information about completely safe and healthy vegetables through advertising on television, radio, or the Internet, after releasing a health examination test of the product to create confidence-for a better perspective on the product. However, doing research for the health examination may take time and money, which requires more support from the government or biotechnological companies in both countries. Moreover, the collaboration between companies and government in implementing promotional campaigns will improve people's awareness of food safety and strengthen the consumer's belief in the products. For example, in both countries, although many official government websites provide accurate information about GM food, because of the lack of multiple information sources about GM food, the single source of information for the public is not effective. It is recommended that the government work with companies to promote correct information about GM food through multiple channels, e.g., social media websites, public hearings, and educational institutions. The government should also take responsibility in monitoring for bias to avoid misleading information about GMaF.

On the other hand, the research results indicated that consumer purchase intention was most significantly influenced by subjective norm. This implied that Taiwanese and Vietnamese decisions can easily be affected by reliable people such as families, friends, or experts. By way of explanation, Taiwan and Vietnam are evaluated as collectivisms with scores of 17 and 20, respectively. The word-of-mouth can be used to encourage more consumers effectively. To take advantage of this, companies along with governments should promote more attractive campaigns for people by giving them opportunities to try or interact with GM food.

Furthermore, since people still have risk concerns about GMaF, generally, most of the food on the market is labelled as genetically modified food. If the government sets up a legal certification mechanism for companies to apply for their GMaF certification issued by government and labeled as "GMaF certificated by the government," this will reduce public concern about GMaF.

Limitation and Further Research

The present research represents careful efforts to incorporate factors from TPB within the context of the GMaF purchase intention. However, this study also presents limitations in some respects.

First, by using convenient and snowball sampling methods, the survey was mainly distributed randomly to respondents with higher concern about health. Therefore, the major proportion of the respondents come from large cities in Taiwan and Vietnam; thus, the attitudes and purchase intentions of the respondents cannot fully represent the entire country. In the future, we suggest that more data should be collected to show the power for the analysis and try to measure the mediating role of purchasing attitude.

Furthermore, employing cluster analysis is recommended to create categories based on gender, age, occupation, and educational degree when analyzing the relationships between demographic variables and types of purchase to demonstrate the attitude toward GMaF. Moreover, social influence conditions can be added into the discussion of repurchase intention through e-commerce websites.

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