

Consumer Perception towards Imported Genetically Modified Food Products in Malaysia

Yap Yan Jun*, Ida Yasin

Putra Business School, 43400 UPM Serdang, Selangor, Malaysia

***Corresponding author**
Ida Yasin

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Abstract: Genetic modification (GM) technology in food is a new variety of food choices for Malaysian consumers. Majority of the consumers have no or limited knowledge on GM technology and food. However, some of the products in foreign countries are GM food, hence, it is important to understand consumers' perception to provide policy makers, government agencies, and industry players a clear view on the effect of imported GM food in Malaysia. Semi structure interview was adopted in this study to have an in-depth understanding on consumers' perception on GM food. Consumers with basic knowledge on GM technology and food were involved in this study. The finding indicated that attitude, relative advantage, compatibility, perceived control behaviors (PCB) and observability in term of information were positively related to adoption intention. Complexity has a negative relation with adoption intention. As majority of consumers have no knowledge on GM food and there are no labeling of GM food in Malaysia market, hence subjective norm, trialability and observability of physical products were not obvious at the time of study. Consumers' perception toward a new innovation is important which all relevant sectors able to generate better strategy plan to promote the new products as well as provide protection to the consumers, in this case, the uncertainty of long term health issues and transparency of information.

Keywords: Genetic modification (GM), compatibility, Consumers' perception.

INTRODUCTION

In the 21st century, biotechnology has been contributing a role in improving productivity in many different industries such as medicine, food and environment. Biotechnology is becoming more commonly use worldwide in the process of gene modification of an organisms to produce food with better quality, improve in production quantity and population's health. Genetically modified food (GMF) was introduced into the market in 1996 and continuous research and improvement on crop until now [1]. The products generated via this technology are being consumed by some developed country such as US, EU and Australia [2]. However, there are still obstacles in obtaining worldwide agreement on the consumption of GMF. Issues related to GM technology, from plantation to marketing and consumption are continuously debate by professional and politician in order to produce a better policy structure as well as to achieve a standard level of understanding on pros and cons of GMF towards human and biodiversity [3, 4].

Background of study

Genetic modification is also known as Genetic Engineering (GE) in which is a process of modifying the genome of certain species; the modification process can be either insertion of one or more new genes or

deletion (remove) of non-favorable gene [5]. GMF or GMO is the food or organism in which the genetic makeup had been intentionally alters by going through biotechnology processes. Transgenic tomato was first commercialized into the US market in 1994. The genetic material in tomato to produce polygalacturonase enzyme had been deleted to prevent softening of tomato fruits; thus enhance the fruit's shelf-life and provide longer duration for the development of its own natural flavor [1].

In most countries, people have the abilities to gain access to nutrient rich and safety foods. However, food security yet is one of the biggest problems in some other nation; according to latest update from World Bank [6], food production is required to further increase by 50% in order to have enough supply to 9 billion populations by the year 2050. With the unpredictable changes of weather and climate, it might affect the agriculture production; with every increase of 2°F in temperature will lead to 5% to 15% reduction in crop yield [7]. As the supply of food reduce, food prices hiked worldwide and especially underdeveloped countries will suffer heavily in gaining access to nutritious and healthy foods.

Furthermore, as statistic report highlighted by World Bank [8], there are approximately 165 million of children worldwide who is under the age of five are stunted growth; chronic malnutrition is the key to low children development rate and cognitive development as compare to the children of same age. This growth failure can be trace back into the food nutrient and quality of the mother before the birth of respective child. Children will determine the future success of a nation, in which with this malnutrition continue, it will impose huge economic and social cost to the country.

With issues above, the adoption of GM technology in the food industry will lead to huge changes for the above issues mention. Firstly, GM technology able to increase the yield of crops by producing quality seeds, thus able to overcome the

increase in demand nationwide as well as the pressure of climate change and land availability for plantation [9]. Second, GM technology able to introduced new traits into the plants. Hence, the micronutrient level of the staple foods will increase to target on the respective population in order to further improve on health issues [10].

From year 1996, GM crops plantation worldwide show an increasing pattern to the year of 2014. As figure below, the global area of GM crops increases from 1.7 million Hectares in 1996 to 181.5 million Hectares in 2014 [11]. In 2014, GM crops was found planted in 28 countries with a total amount of 18 million farmers where about 19.1% of them were from developing country with small scale and resource-poor farmers [11].

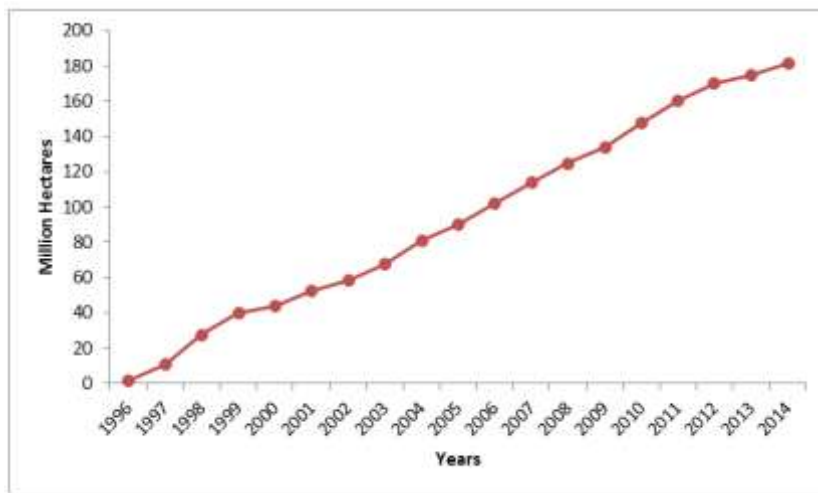


Fig-1: Global area of GM Crops from 1996 to 2014 (Million Hectares) (Source: James, 2014) [12]

Between the year 1986 and 1995, 56 types of GM crops were undergo field tested globally; however, currently, there are only 9 GM crops grown commercially. The major crops are such as soybean, corn, cotton and canola where all involved in animal feed and processed food. Some food such as the GM

papaya (grown in US and China), GM squash and GM alfalfa (grown in US), GM eggplant (grown in Bangladesh), GM sweet corn and GM sugar beet (grown in US and Canada), are consumed as whole foods; however, the plantation area only contribute to about 1% of the GM crops hectareage.

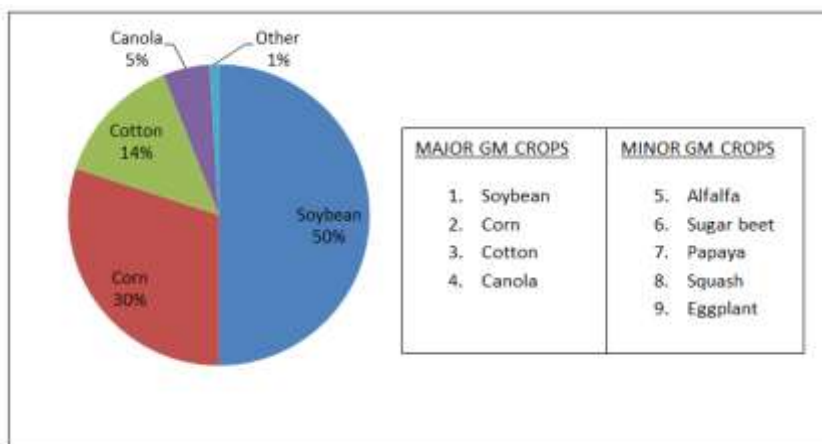


Fig-2: Plantation of GM crops in GM area (in percentage) (Source: CBAN, 2015 [13])

The application of GM technology has been a public concern, especially in the food industry where it faces majority consumer rejection [14]. In previous research shows that worldwide consumer response towards GM food products has been largely negative [15-17]. The most critics towards GMF are the safety issue towards human and other living organism, cross-pollination, alteration of the foods' nutritional quality, potential in creating new toxins and viruses, environmental pollution, limitation in accessing to seed due to patenting of GM plants and ethical/religion concerns [18-20, 9]. Lack of transparency in the information provided regards to production of GMF and safety regulation are the main concern of the consumers [21, 22]. All the aforementioned have lead to an impact toward consumer acceptance of GM products.

All the protest against GM crops are mainly focus on religious, safety and environmental concerns rather than the most important issues in improving food quality, human nutrition, extended product shelf-life [18, 19, 23]. GM crop reduce the use of pesticides and herbicides which lower the production cost; this may favor more farming environment hence able to increase yield to fulfill the needs local demand as well as food shortages around the world [9]. With the reduction in chemicals used, this able to avoid soil contamination, reduce health issue of living organisms as well as capable in lowered the risk of chemicals runoff into groundwater [24].

In the case of Malaysia, it is a developing nation with services industry as the main economy contribution, however, agriculture sector is still remains as the major economic backbone [25]. The status of GM crops in Malaysia is focusing on the research and testing rather than commercial of the GM products. As statistic report summary at the end of 2015, majority of the imported corn and soybean contain genetically engineered content; about 700 thousand tons of soybean for further refine into cooking oil and by product for animals feed as well as 1.3million tons soybean and 3.7million tons corn for animals feed [26]. Approximately 40% of the imported soybean was exported from US. Malaysia does not export GM crops but there might be some ingredients that derived from GM crops in some of the exported processed food.

Currently, no imported GM seeds are approved for planting in Malaysia. GM papaya with the trait in delayed ripening was approved for field trail by Malaysia Agriculture Research and Development Institute (MARDI), according to the Genetic Modification Advisory Committee (GMAC) under Malaysian National Biosafety Board (NBB) [26]. Nevertheless, lack of experience in field trial data collection and funds for continuous research hinder the plantation trial. Palm oil is considered the most important crop in Malaysia, as Malaysia is the top 3

worldwide exporters. But the intention to invest into the R&D of GM palm oil is low as industry fear of the adverse action from processor and buyer; expert mention that the non-GM features of palm oil has been the marketing advantage as compare to GM soy [26].

Majority of the government and public has a negative perception on genetic modification animal production. Thus, to date, there is yet any government or private sector involved in the R&D of GM animals. The latest approval by NBB was to allow the field test of the GM male mosquitoes [27] which was designed to reduce the dengue fever case that is increasing yearly in Malaysia. With the growing concern from various dimensions, organization together with high cost involved, in 2014, MOH announced to discontinue the project.

The labeling regulation of GM food and ingredient was mention to be effective on July 2014; however, it is yet to be implemented at time of writing and there is also non official date mention by the Ministry of Health (MOH). The reasons of the delay is due to the time consuming process in testing the presence of unapproved contents in the imported processed food and also other uncertainty that arise on the handling process [26]. Companies have limited control over the domestic commercial approval; hence they reluctant to seek approvals and end-users remove some ingredients to avoid taking risk. This inconvenient of approval process may sooner become an obstacle to imports.

Need of study

There are many studies have been conducted for GM food such as consumer's risk perception (CRP) [34, 32], the effect of knowledge on attitude [35-37], corporate social responsibilities (CSR) [38, 39, 4], GMF labeling [40, 41], consumer's trust [42-45] and willingness-to-pay (WTP) [46, 47]

However, there are not many studies focus on the in-depth analysis of consumers' perception towards the adoption of GM foods in Malaysia. Hence there is a gap of knowledge to address in this research that focus on the consumer view and the challenges that consumer will faced with the availability of GM foods in their daily food consumption. Furthermore, limited study emphasized on the element of country of origin (COO) effect on consumer perception in the subject of GM foods, thus, COO effect will be included in this research.

Objectives

- To explore consumer's perception on imported GM food.
- To discover the reasons consumers adopting or rejecting GM food.

- To evaluate whether country of origin of the GMF products will have an effect towards consumer's perception.

Industry

With the understanding of the consumers' perception towards imported GM products, the industry, especially importers and exporters will able to recognize the focus points in promoting the GM products which will generate largest impact in the change of consumer's attitude and adoption rate. Through this study, the reasons behind the acceptance and rejection of GM food products can be identify; hence, firms able to come out with the correct marketing tactics to target Malaysia consumers. Furthermore, GM production organization able to identify the behavioral pattern of consumers towards the new technology as well as able to assign the specific phrases use in advertising and marketing that will attract the consumers' attention. By understanding the consumers need, both importers and exporters able to come out with products that will match with consumer demand to be imported into Malaysia. On the other hand, organization, importers and agents should focus in educating and transmitting the correct knowledge and information to the consumers regarding on the pros and cons of GM foods towards the biodiversity.

Government

Government and politician able to come out with a better rules and regulation to protect the low income level local farmers (conventional, organic and GMF farming) to achieve a better economy of scale. Government also able to provide funding and technology support to the local farmer or R&D sector who wish to grow or involve in GM crops production

business. Stringent rules and regulation should also be imposing in any industries (plantation, traders and foreign investment) related to GM product to ensure the safety and health of the citizen is protected. By understanding the consumers' concern towards GM products for examples in regards to food safety and quality, government should come out with the appropriate policy and regulation to restrict GM firms in conducting unethical experiment which will lead to damage to the biodiversity. Moreover, the government needs to ensure the transparency in the release of information regarding on the advantages and disadvantages of GM products towards human and the ecosystem in the short and long run.

Academician

This study able to provide researcher the understanding of the accuracy of the information spread within the nation and they are responsible to defend and spreading out the truth regard to the GM products. By understanding the concern faced by the consumers, academician able to come out with formal talks or conference to educate public by providing them with the latest updated information as well as the status of current studies on GMF. More research and development should be conducted to continuous improvement on the genetically modified crops or organisms to enhance the benefits that this new technology will bring to the human as well as the ecosystem in the future. Furthermore, this studies also able for academician to future understanding the behavior of consumer towards genetically modified food in Malaysia and able to develop more effective marketing strategies.

Operation Definition

Terms	Operation definition
Genetically modified food (GMF)	Where novel traits is introduced into animals or crops to enhance the quality of the products/foods.
Transgenic	Organism that contain genetic material of foreign species which is introduced artificially into their genome [49]
Attitude	Degree of favorable or unfavorable appraisals that people make towards a behaviors [50]
Perceived control behavior (PCB)	Degree of personal control perceives to engage in certain behavior [50]
Subjective norm (SN)	Perceived social pressure to carry out the behavior products [51]
Relative advantages	The advantages that an innovation will bring to the users of the innovation [52]
Compatibility	Idea, values of an innovation is being perceived as consistent with pervious innovation by the potential adopters [52]
Complexity	Degree of perceived difficulty in the use and understands an innovation [52]
Trialability	Measure the extent where consumer able to experience or try out, with limited access, before adopting the new innovation [53]
Observability	The level of detail visibility together with effective communication to the prospect adopters [52]

LITERATURE REVIEW

With the process of evolution, for billions of years, has provide an increase in diversify life forms on today's world. This process of natural selection and evolution has leading to the formation of species which content wide range of characteristics and traits; however, by getting the required traits in agriculture products might require longer time of natural production [54]. With the enhancement in technological innovations, research and development process, further improvement in knowledge and understanding of genetic engineering has provide researchers a possible ability in coming out an alternative technique to overcome the time consuming process of natural evolution by manually introducing genetic modification into living organisms mainly animals and plants in the laboratory [54]. These GM food have bring interest in many consumers due to the potential benefits such as increase in nutritious level, disease preventing ability, pest resistance, better flavor and longer shelf-life [18, 19, 23, 55, 33, 4]. Yet there are also growing concern of consumer about the novel food content and the process technology. Several quality criteria such as naturalness, sustainability, safety, environmental and health effects are, in numerous occasions, related to food technology [56, 20, 33, 9]. Despite all benefits of GMF mention, all level of society have rights in having a clear understanding and knowledge toward GM technology before making further decision.

Consumer perception of GM food

Consumer understanding, acceptance and trust are important for consumers' to make informed decision in term of adoption and consumption of novel processing technology in food products such as genetic modification (GM). There are supporters and opponents worldwide towards the application of GE techniques in food that are consumed by human and livestock. There are reasons that lead to acceptance and avoidance of GMF, thus it is important to understand the consumer perception towards GM foods.

In general, as compare the studies between US, Latvian, Turkish, Italy and Japan, from the year of 2012 to 2014, consumer knowledge of GMOs were low; about 54% of the samples have little knowledge of GMO with 25% know nothing about GMO [57]. Based on the study in Malaysia provided by Ismail and colleagues [2] 51.5% of consumer aware that there is presence of GMF, however, only 41.8% have knowledge on the concept of genetic modification. This shown that there are still large portion of consumers in Malaysia does not have any idea on the GM technology and food crops. This research will emphasize on consumers who have and understand the basic concept of GE and GM foods.

Many studies had concluded that, consumer perceived risk increased by the knowledge of the technology and the potential effect towards health [58-61]. Some consumers concern on the allergies effect that may cause by the present of legumes genes contain in cereal and other food sources; yet, there were no issues being reported on the allergenic risks due to GM proteins [62]. However, according to Ronald and Adamchak [63] there were other allergies reports arise cause by *Bt* crops with the existence of bacterial genes.

Other than that, consumer perceived GM food as high uncertainty when come to consideration of long run health effect in human when foreign DNAs being consumed and digested by human or animals [64, 65]. There was experimental result show that rats fed with HT soybeans had contributes to side effect on development and mortality [66]. There should be more reproducible and in-depth research to be conducted by researches to reduce issues related to safety and to enhance consumer perceived trust towards GM food and the GM technology.

Moreover, the accessibility of information, effective information and education will reduce the perceived barrier and enhance the positive attitude towards agro-biotechnology [67, 68]. However, researchers had also come into conclusion in which with the increase in nutritional benefits offer by GM food will reduce consumers' risk perception [69, 61]. In the study of US market, by Darian and Tucci (2011), consumer perceived taste and nutritional values as the significant factors that will be priority consideration before making purchase decision.

From the study of Shaharudin, Pani, Mansor, & Elias [70] mention that consumer will have positive attitude to perform a behavior when they have positive perception that by performing the behavior will benefit to their health. In many studies also found that perceived health benefit was the main concern consumer choose for organic products with the reason of the used of synthetic chemicals [71, 72]. Consumers' perception will change according to the level of awareness, marketing activities and image of the products and organization. Study from Verdurme & Viaene [58], show that the perceived benefits also comes from the positive attitude of the consumers towards science and trust on the GM producers. The study indicated that the higher the knowledge consumers have, higher the perceived benefit as well as trust on the GM organization.

Apart from the above mention, investigation conducted by Pino and colleagues [4] show that corporate social responsibility of the GM firm will also have an effect towards consumer perception and intention. Based on the Carroll's model, consumer's

perception highly associated with the sensory evidence such as observable actions or information of the firm. Since consumer have little or no knowledge on the safety and quality of GM food products, legal responsibility of the GM firm, for example, quality certification was the main items that consumer will look for in order to ensure that the firms compliance with the respective standards [73]. Therefore, legal certification also able to resolved consumer's concerned on the issues of information transparency especially in the production processes hence to influence consumer perceived values of GM foods [74].

Moreover, consumer attitude may have a positive relationship towards organizations' philanthropic responsibility. By showing social care or voluntary actions, it provides a sensory impression towards consumers where by firms' action reached beyond profit maximization [75, 76]. Firms' commitment on social activity and care for the wellbeing of consumers is said to have a positive influence towards consumers' attitude on GM products. However, in the case of firms fulfillment on legal and philanthropic responsibilities on consumers' perception might vary in outcome for different people [73].

Cultural differences influence perceptions

Culture, according to Hofstede [77], is a pattern of behavior which will distinguish members of one group with another group. Previous studies had have take into consideration of cultural backgrounds as an influential factors based on different subjects. Back in 1995, research using Food Choice Questionnaire (FCQ) by Steptoe, Pollard and Wardle was proven that cultural backgrounds have an influence towards food choice. Quantitative and qualitative research has proven inherently related between culture and food choice [78-80]; consumers' with cultural differences shown different focus and perception towards food choice. Some consumers tend to place more focus towards the quality of food, whereas some will place high important in food safety, sources, religion as well as the company CSR claims [81-83].

Different culture will have different in ranking the motives that will influence their food choice. Study based on European country, both the southern and northern contexts display a different set of behavior and culture towards food choice. According to the study of Pettinger, Holdsworth and Gerber [84], Northern countries such as Germany, UK and Scandinavia emphasis more on the animal welfare concern and food safety; whereas, Southern countries focus more on quality of food and dining experience, they are such as France, Italy and Spain. In Asia, Chinese consumer will stress more on health concern, where price will have a significant effect on Japanese and Filipino emphasis more on their mood [85, 86].

In the context of Malaysia, multicultural is the best word in describing Malaysia, however, it also become one of the challenges in order to understand the consumer perception. Based on the latest study by Department of Statistics Malaysia [87], the three main ethnic groups in Malaysia are such as Bumiputra, which consist of 68.6% of Malaysia citizens, follow by the Chinese and India with 23.4% and 7% each. The different in ethnicity and culture provide many different varieties of foods, spices, and cooking processes and techniques. In the study within Malaysia, differences in ethnic group do not display a huge difference in food choice motive factors. However, Malays have the highest familiarity towards the food choice as compare to other races [88]; this might be due to the religious factors. For examples, Muslims are prohibited to consume any non-halal foods and products, they only permissible in consuming those that are allow by the Islamic laws [89, 88]. Hence, the Malays will normally choose from preferable food suppliers which are certified by the authorized body.

Other than religion aspect, Malaysia consumers are more sensitive towards the price and convenience of the food products. As concluded by Mohd-Any, Mahdzan and Cher [90], food at reasonable price and ease to prepare will be the priority factors that current working adult looking into. Another important factor in selection of food in Malaysia context will be the sensory attraction which includes the appearance and colour combination dish will affect the customers' perception towards the taste of the food. However, the awareness of a balanced diet and familiarity were less important towards food choice especially within the young age consumers group in Malaysia. Nutrition and health conscious should be encourage and emphasis during early age in order to reduce the alarming obesity population in Malaysia as well as South East Asia [91].

Consumer perception on country of origin

Production standard, product quality and technology advancement varies between countries; some countries have more stringent rules and regulations and some countries will emphasize on different aspects. Thus, the information provided in the column of country of origin (COO), which can be easily found in any products' label, may be one of the effects which influence the consumer perception towards a product [92]. The use of COO as one of the indicators in product evaluation process has been supported as well as declined by many literature studies [93-101].

COO has two effects on products evaluation such as the halo effect and summary effect in which is highly depend on the consumer awareness towards the country and the products that offered [102]; halo effect is where consumer view towards a brand based on the country image; summary effect is when consumer perception on a country image based on product

characteristic from past experiences [103]. The result as displayed in the food survey conducted by Becker, Benner and Glitsch [104] show that consumer often think that COO is part of the important information for them to response to imported goods.

Consumer perception towards a product comes from two aspects, such as intrinsic (design, performance, quality or taste) and extrinsic (COO, brand name, price or brand reputation) values of a product. Generally, consumer's opinion mainly depend on the intrinsic values of a products; yet, products' extrinsic values are found to be more trustworthy and convincing than consumer's own judgment based on different circumstances [105] such as status and social pressure [106]. Studies show that country image or COO had effects towards consumer perception where as mention by Nagashima [107] and Bhaskaran and Sukumaran [100] consumers tend to associate COO with products. Country image can come from different perspective such as the design, innovation and workmanship [108]. From the study of luxury brand by Haubl [109] and Ahmed and d'Astous [110], consumer's intention to purchase will take into consideration of the COO (country of manufacturing or country of assembly) together with brand characteristic. However, based on the current study by Godet *et al.*, [111], the study from 7 developed and developing countries show that, on average, COO is being rated as the fifth factor out of six that will have an effect towards consumer purchase decision for luxury goods.

Conclusion drawn by Biswas, Chowdhury and Kabir [112] based on the study in developed countries had show that positive perceptions on a country's products will highly relied on the similarity of culture, physical, political and economical factors between both exported and imported countries. Overall, the consumer in developed countries will prefer locally made rather than imported products [113-115]. Unfortunately, the similar result applying to developing countries is still an unknown outcome, whereby imported products from advance countries will have higher demand for consumer in developing countries [112].

From the study of Shahlin, Kazemi and Mahyari [116] on COO with brand equity in Iran, result indicated that COO has strong impact towards perceived quality; consumer purchase decision will be focus on COO when come to identify a products quality. In the example of technical products, countries with higher experiences, better past performance and with advancement in technology will being perceived by consumers as better in product quality. In term of food products, consumers are place higher attention in product quality which include food safety and chemical used. As concluded by van der Lans *et al.*, [117], COO indication has an influence on consumer perceptions towards the quality of a product and hence will also

have an effect on the preferences as well as purchase decision.

However, the similar research conducted by Loureiro and Umberger [118] provide a negative feedback where US consumer place greater important towards the inspection certificate from the government on imported beef rather than the COO information provided in the label. The effect of COO on consumer perception will gradually change over time as and when there are changes in actual product quality.

From the result presented by Gao *et al.*, [119] in the study of French consumers, perceived quality has little relationship towards the geographical information on fresh fruits; however, perceived risk had a significant impact towards COO information, in which more concern will be placed towards where the fruits are from for those consumers who able to identify the risk level of fresh fruits.

GM food in Malaysia

Being a leading nation within the Asian community, Malaysia is heavily involved in the research and development (R&D) in agriculture biotechnology sector. With the current unpredictable change in the weather and increase in plants' diseases, Malaysia food production is unable to support the demand and hence, active involvement in biotech agriculture is to increase yield in order to meet the need of basic food crop required by the local demand [2]. National Policy on Biotechnology has been developed by the government of Malaysia; with this policy, soon understood that the significant of the biotechnology that will later provide an effect to the growth of Malaysia economic and wealth [120].

With the increasing of number of GM foods and food products in the market, it is important for government to provide a set of regulation and standard in forcing those suppliers and producers to label the GM products before distributed to the market. Label is already an important issue in the globe as people has right in being acknowledge and understand the foods and products that they are purchasing and consuming. A set of guideline for biotechnology food and food ingredients labeling was created in Malaysia by the Ministry of Health (MOH) [121]. GM food required to be label only if the GMO contains is more than 3%, otherwise, not applicable. That label shall make applicable to the top three (3) main ingredients in the list, as mention in the MOH guideline.

According to the Department of Biosafety of Ministry of Natural Resources and Environment [122], there are 22 types of GM food products approved by the Malaysia government, as of June 2016, can be imported into Malaysia. Majority of these approved GM products are permitted for the purpose of food, feed and

processing (FFP); intentionally introduce into the environment is strictly prohibited. The below table

provide some of the GM food that are allowed to be imported into Malaysia.

Table-1: GM food permitted to be imported into Malaysia for the purpose of food, feed and processing

Food types	Approved GM Food
Soybean	MON 4032 Roundup Ready™ Soybean
	ACS-GM5-3 - Herbicide-tolerant Soybean (A2704-12)
	MON 89788 Glyphosate Tolerant Soybean (RoundupReady2Yield™)
	Imidazolinone-Tolerant CV127 Soybean
	Glufosinate tolerant A5547-127 LibertyLink® Soybean
	Glyphosate and Isoxaflutole Tolerant FG72 Soybean
	SYHT0H2 Soybean modified for tolerance to Mesotrione and Glufosinate
Maize	MON 603 Roundup Ready™ Maize
	MON 810 YieldGard™ Maize against Corn-Borer
	MON 863 YieldGard® Rootworm Maize
	SYN-Bt11-1 - YieldGard™ Maize
	DAS-59122-7 - Herculex™ RW Rootworm Protection maize
Corn	T25 Herbicide-tolerant Corn (LibertyLink® corn)
	TC1507 Insect-resistant and Herbicide-tolerant Corn
	Lepidopteran-protected Corn MON89034
	MON88017 Corn Rootworm-Protected and Glyphosate-Tolerant Corn
	Rootworm-resistant Event 5307 Corn
	Rootworm-resistant MIR604 Corn
	Lepidopteran-resistant MIR162 Corn
	Glyphosate tolerant GA21 Corn
	Thermostable Event 3272 Corn
Oilseed rape	Glufosinate ammonium herbicide tolerance and fertility restored MS8RF3 oilseed rape

Globally, consumers usually associate latest or new technology with high risk and dangers, however, the continuous advancement and improvement in technology is unable to avoid. Hence, is important for country together with respective bodies and societies to discuss and draft a new standard and legal approach for the new invention. National Biosafety Board (NBB) formed by the government represented from seven Ministries and four experts from relative fields [123]. In order to promote the biotechnology industry in Malaysia, the Biosafety Act 2007 was announced and implemented on December 2009; the Act introduced is compliance and far more than just meeting the minimum requirement of the standards set by Cartagena Protocol on Biosafety (CPB) [123].

The Biosafety Act of Malaysia cover wider ranges includes all forms of health issues of human, animals and plants, safety issues of biodiversity and environment and GMOs used in foods and products. Furthermore, BSA 2007 can also be used in identifying any GM goods that will violate the religious rules, for example, the imported goods contain non-halal genes [120]. With straight rule and regulation listed in BSA 2007 that all industry parties comply in will make the local GM products excess the global markets with ease in the future.

Additional to the information outside of Malaysia, in 2015, Vietnam has become the 29h country that allow massive plantation on GM crops. The approved crop at the moment is GM worm resistant corn and estimated to increase in plantation area of GM crops to about 30% to 50% in year 2020 in the categories of corn, cotton and soybean. As mention in the news, Vietnam is currently import large quantity of soybean and corn which include GM crops to process into animal feed. Furthermore, but imposing the plantation strategy, Vietnam has draft food labeling guideline and to record when the GM proportion is more than 5%. According to Mr. Toan, this indication is not to create fear and warning but to increase consumer choice of selection [124].

Theories
Theory of Reason Action

Theory of Reason Action (TRA) is originated from Fishbein theory in social psychology in late 1960s [125] and further revised by Fishbein and Ajzen in 1975 [126]. There are two assumptions lies in the TRA theory which are: (1) Social relevance actions are mainly of volitional control, thus an action is immediate determined by the human intention to carry out a behavior [127, 125]. (2) Human is reasonable and will utilize all available information [127, 125]. As show in the figure 1 below, a person belief will lead to his/her

attitude and subjective norm, which later determine the behavior intention and finally behavior. Behavior beliefs refer to the behavior of interest that leads to expected outcomes. Nominative belief is defined as the person's actions are motivated by a specific group of

people or an individual. Attitude towards a behavior is the individual's judgment in performing the act; where subjective norm is the perception of an individual towards social influences in performing the task [127].

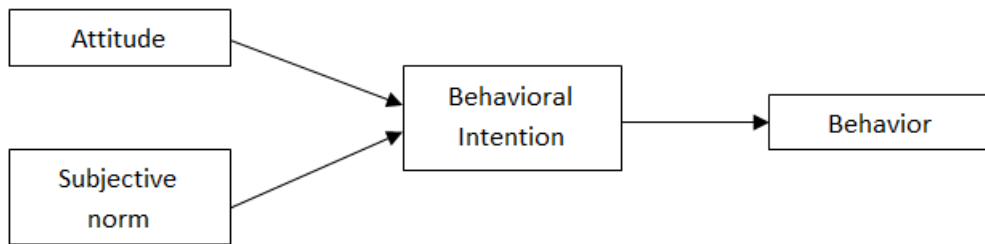


Fig-3: Theory of Reasoned Action (Vallerand & Pelletier, 1992) [128]

Theory of Planned Behavior

Theory of Planned Behavior (TPB) is a frequent used framework in predicting human behavior by linking behavior and attitudes. TPB predicts one's behavior by looking into the intention of one in performing a specified behavior [129]. This model studies the determinants of intention, such as: subjective norm (in which the attitude in carry out the behavior is coupled with the perceived social pressures from those whose opinion that one care most), perceived behavioral control (PBC) and attitudes. The difference

between TPB and TRA models is the additional of PBC determinant in TPB to predict behavioral intention [31, 130]. TPB is a further developed from the Theory of Reason Action (TRA); as mention by Azjen [50], perceived behavioral control added into TRA to further enhance in explaining an individual's intention lead to specific behavior. Perceived control behavior is define as the perceived level of difficulties for an individual in performing the behavior and this perception is affected by the opportunities as well as the resources available [50].

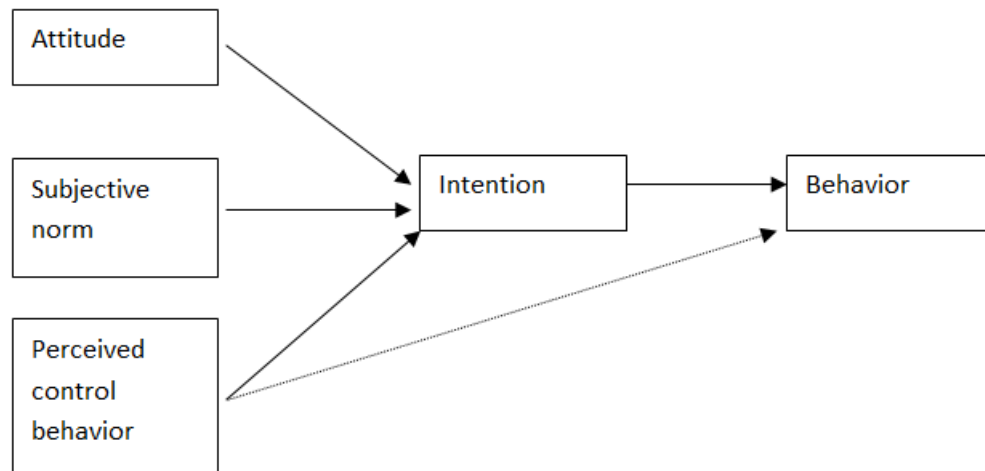


Fig- 4: Theory of Planned Behavior [50]

Diffusion of Innovation Theory

Diffusion of innovation theory (DIT), developed by Rogers [53], in which identified five factors that will influence the adoption of an innovation. According to Rogers, innovation is explain as something that the population or individual perceived as new; which could be an object, idea, behavior or practices [52, 131, 132, 133] . The five characteristics are such as relative advantages, trialability, observables, compatibility and complexity this five characteristic of the innovation will have an influence towards the acceptance and rejection of new innovation. As describe by Rogers [134], the mention attribute aids to reduce

the consumer uncertainty of the innovation and act as prediction tools of adoption rate.

Relative advantages in this theory refer to the perception of individual that the innovation is better than other available options. Triability refers to the accessible of an innovation to be experience by the individual before adopting. Observable is identified as the silent peer pressure which is about the availability of an innovation to be visible by the potential individual [132, 135]. Compatibility refers to the perceived compatible of the innovation with current environment and culture [136]. Complexity means the perceived difficulty in comprehend the innovation [132].

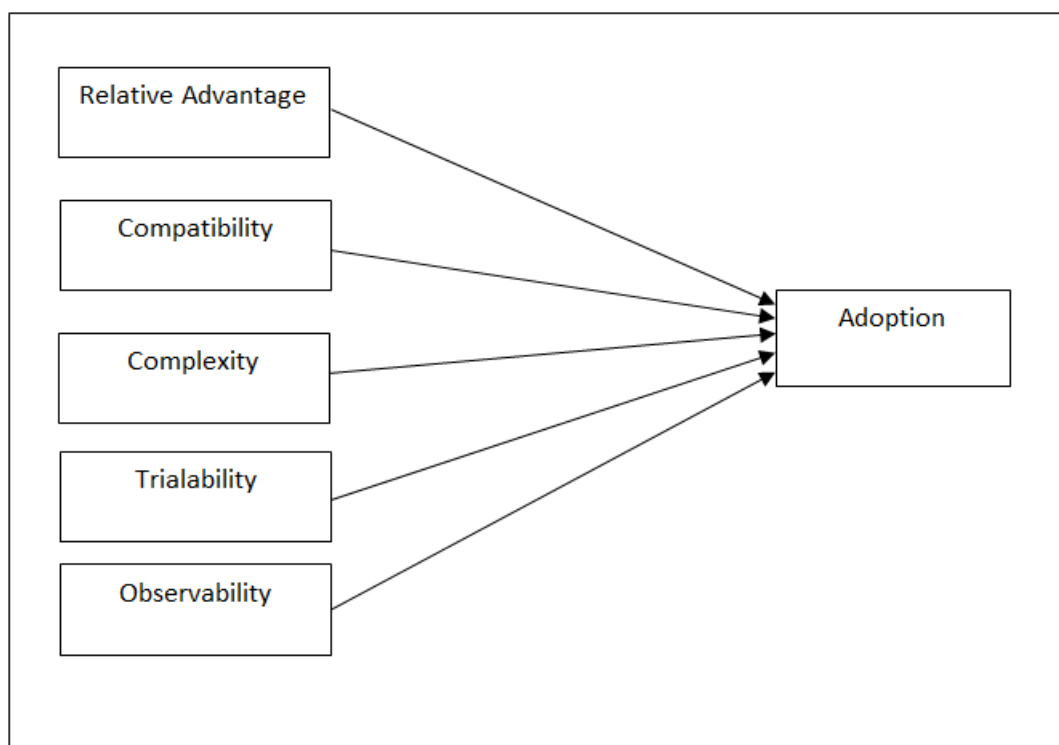


Fig-5: Diffusion of Innovation Theory [52]

Theoretical framework

Attitudes

Attitude, according to Ajzen [50], is referring to the degree of favorable or unfavorable appraisals that people make towards a behaviors; the higher the level of favorable of attitude, the greater a person’s intention to carry out the behavior and vice versa [137]. Thus, attitude is positively predicted intentions where increases in attitude will lead to increases in intention; this explain that attitude of consumers are important towards the purchasing intention.

Many studies proved that the positive relationship between consumers’ attitudes and purchase intention in purchasing organic food, organic personal care products as well as green hotel in different cultures such as Asian and European [137, 130, 51]. For consumers who are carrying the favorable attitude in the case of GMF will depend on the reliability of the organizations’ statements which involve in GM production [31].

However, based on the two behaviors, (1) purchase of food for personal health benefit and (2) purchase of food is perceived as saving the environment will act as the evidence of general attitude which is expected to be related to negative attitude in purchasing of GMF [31]. Studies found that Northern Europe consumers have negative attitude towards the GMF where as US consumers who previously express a neutral attitude was recently reported a slight disagreement in GMF [138]. Whereas previous study

shows that, consumers’ attitudes in the British population were fairly neutral and ambivalent towards GMF products; this result is also consistent with the research done by Spence and Townsend in 2006.

Therefore, to study the attitude towards the purchase intention of GMF is important as different location and culture will result to different attitude of the consumer to try and accept the use of latest technology.

Perceived Control Behavior

Perceived control behavior (PCB) define the degree of personal control perceives to engage in certain behavior; the higher the degree of personal perceive control, the stronger intention in performing the behavior [50]. Perceived barrier and availability of resources such as time, money and knowledge will increase the consumers’ behavioral intentions [51].

Study was conducted where PCB was measure directly by assuming that the only control barrier in the case of ability in identifying GMF. As mention by Eagly & Chaiken [139], PCB act as a mediator of other determinants of intention; although individual have the positive intention to perform a behavior, however, due to the perceived barrier which is unable to identify GMF, individual might not intend to do so. The same report was found in Spence & Townsend [140] study, indicated that the labeling of GMF will increase individual’s behavior control, which result in increase in PCB; therefore, reduce the intention to purchase.

PCB has a negative relation towards intention in which increases in PCB will lead to reduce the likelihood of consumer to purchase GMF [140].

In the research of Cook and colleague [31], PCB has a stronger determinant of intention compare to social norm. Males have more likelihood to feel in control over the purchase of GMF rather than female and greater PCB was found to be related with lesser time spend in food purchasing decision based on the beliefs weather herbicides or pesticides were used during production. Perceptions of control were positively related with the level of believability of the companies' statements regarding the food offer in the market [31].

To conclude, the study of individual's PCB is important to enhance the understanding of consumers' perception towards the marketing of GMF, hence companies able to modify their marketing strategy to cater the needs of consumers.

Subjective Norm

Subjective norm (SN) refers to the individual's perceived social pressure to carry out the behavior. If individual believe that majority, mainly the people around them, think that GMF is good, that individual will have higher intention in purchasing the GM products [51].

SN has a positive relationship towards intention in the study of skin care products as well as green products [130, 51]. SN is positively predicted intention; hence, the further increase in SN will lead to increase in GMF purchase intention [140]. The positive relation of SN also observed in the study of the reliability of companies' statement towards their GM products, where consumer belief that they have the similar perceived positive opinion towards the issue [31].

However, Cook and colleague [31] study mention that negative relationship was found between SN and purchase intention in regards to the belief of the chemicals used during the production. This increase the possibility in which consumers are expecting the decision make by their friends and family before they engage in the behavior where by the decision to purchasing GMF is supported by the friends and family.

On the other hand, cultural different might also lead to different in relationship between purchase intention and SN. In the study of Alam and Sayuti [141], culture that favor individualistic such as the Western, people prioritized on personal goals more than collective goals and perceived them as independent; this will show a higher personal attitude rather than SN. Where as in Muslim culture where focus more on collectivistic culture, SN in important in determining

the purchase intention where people perceived them as interdependent of each other in the group.

Hence, SN is important in identifying the purchase intention based on the majority consumers' perception towards the GM products. However, the culture of the country as well has an effect towards SN.

Relative Advantages

Relative advantages is where the used of an innovation is perceived to have more advantages compare to it supersedes. It is also mention to have the strongest impact towards the rate of adoption of an innovation [52, 142]; the stronger the relative advantages, the higher the rate of adoption towards. In this study, perceived relative advantage is defined based on the consumer's perceived benefits towards GMF against other food crops.

As for banking industry, perceived relative advantage was found to be positively related to internet banking system [143]. As concluded by Wand, Lin and Luarn [144], the adoption of new innovation by the customers is based on the perceived usefulness rather than the actual benefits that the system will provide to the users. By continuously improve and advertising the usefulness of the internet banking system to the user, will hence improve the rate of adoption of the new innovation.

Relative advantages can be from various dimensions, however, in the study of Eder, Mutsaerts & Sriwannawit [145], reliability, sustainability, awareness and functionality of an innovation were measure. In term of reliability, if a company which unable to fulfilled the promise to the consumer, this will lead to frustration as well as reduce relative advantage and hence lead to slow in adoption the new innovation. Furthermore, organization who able to promise sustainability will also crease value-add in promoting the new innovation. In the case mention by Eder, Mutsaerts & Sriwannawit [145], the organization generates energy by using the available local biomass residues produced by the local farmers and to create additional income for the farmers as well as generating electricity to the villages; thus, lead to the positive attitude of the local users towards the organization. As for awareness, it is mention that, consumers need to be educated in order to have more confident towards the innovation and hence increase adoption rate. Last, the used of biomass to generate energy seem to be more superior to other sources. Local consumer in Uganda perceived high advantages towards the used of biomass energy sources such as health benefits, energy security, safety and able to read at night [146].

Thus, the higher consumer perceived relative advantages of GM food, the higher possibility consumer

will adopt GM food in their daily consumption of food source.

Compatibility

As define by Rogers [52], compatibility is referring to which the idea, values of an innovation is being perceived as consistent with pervious innovation by the potential adopters [133, 147, 142]. Compatibility have a positive influence towards adoption decision; if the individual perceived the innovation is more compatibility with his or her past experience, value system and needs, hence this will increase the rate of adopting the new innovation [52, 143].

In the banking industry, as study from various researchers, perceived compatibility have a positive influence towards the adoption on internet banking system; higher the perceived compatibility with the needs and lifestyle of the customers, the rate of adoption for internet banking will be faster [143]. It is also believed that perceived compatibility contribute significant influence towards behavioral intention in the use of information system [148, 149]. By referring to Chen *et al.*, [148], there are two factors in which affect compatibility in the area of internet banking such as time constrain and the introduction of internet lifestyle; therefore, consumers who are categorized into the above factors will automatically have increase in the level of perceived compatibility with internet banking system, thus have higher potential in adopting the system. As concluded by Eder, Mutsaerts & Sriwannawit [145], the increase in adoption of mobile payment technology in Uganda was due to the factors of time, transparent and security. They use the mobile payment to conduct transaction to their family members and business partners.

Perceived compatibility also found to be positively related to the adoption of innovation in the educational industry. Based on the study from Jwaifell & Gasaymeh [142], all teachers in the study group were found to be positive towards the adoption for interactive whiteboard (IWB). This is due to the values of this IWB similar to the current technology-based environment as well as able to help teacher in time and effort saving and provide an interactive environment for study.

Based on the study of Lin and Chen [133] on cloud computing, compatibility was the main concern in adopting cloud system: (1) the demand and needs of the consumers (2) information system development environment such as time pressure, risky, reliability and stability. Based on the study, software engineers will only consider cloud solution when their customers demand them to use cloud technology in develop solutions. According to Rogers [52], it is mention that with the increase in compatibility will reduce the uncertainty. The concern of compatibility might be varies based on the industry. It was mention that

compatibility should be associated with the company products and services. Since cloud computing is still consider as risky and unsafe, hence this system is hardly to be adopt in aerospace and banking industry where the privacy data and security are highly important in both industry. Based on Grandon and Pearson [150], in term for organization to adopt e-commerce technology, the technology must be compatibility to the organization internal culture. Organization usually focuses more towards organizational practices as well as the infrastructure [151].

Conclusion, higher consumers' perceived compatibility towards an innovation, higher the rate of adoption. Perceived compatibility will be related to the consumers' culture and environment.

Complexity

From the definition by Roger [52], complexity refers to the degree of perceived difficulty in the use and understands an innovation. In term of technology, increase in complexity will have a negative impact on adoption rate. Complexity is the barrier and challenges in improving the successful adoption by consumers [152, 153].

For cloud computing, Vouk [154] summarized that professionals tend to avoid adopting cloud computing when higher technical skills and efforts are required in implementing the technology as solution to the organization. Moreover, the degree of understand of scientific mechanism underlying behind the innovation is also a key point in up taking [153, 136]. Chang [155] mention that if the consumer are unable to obtain complete understanding on the innovation, consumer will perceived it as risky in using it; ease of use in online shopping lead consumer to feel more secure on the privacy data and transaction. Difficulty in the learning process will lead to reduce in adoption rate of an innovation. The adoption rate can be improved as and when the service provider able to make the learning, development and working tools more convenient to use of the innovation [156, 133].

On the other hand, according to Lin and Chen [133] stability and reliability of the innovation are the important features under consumer adoption consideration. Furthermore, as mention by Parwada and colleagues [157], effective communication about the new innovation may reduce the consumers' perceived complexity hence increase adoption. In the business perspective, cost that associate with complexity will render a rejection towards the adaptation of an innovation [158]. External influences such as technological and organizational support have the ability in influencing the adoption of an innovation. With the greater support from all level from the organization, the adoption rate was found to be higher [159, 143].

To conclude, complexity is strongly associated with negative relationship to innovation adoption. The stronger consumer perceived complexity, the lower the rate of adoption. Ease in using and understanding the innovation as well as effective communication will help in consumer adoption rate.

Trialability

As referring to Roger [53] definition of trialability, it measures the extent where consumer able to experience or try out, with limited access, before adopting the new innovation. The real-life experience and feeling of the consumers is important in adoption theory by provide them a true feeling about the new products. There was few previous research show support and reject of trialability characteristic towards adoption of an innovation [159, 160-163].

As reported by Turner and Turner [164], in end user perspectives on the use of computer supported cooperative working (CSCW) show that lack opportunity in experiencing the IT system lead to lack of supportive in up taking. In the study of Lee *et al.*, [165] and Venkatesh *et al.*, [159] provide support that, trialability were one of the factors that will shift the behavioral intention of consumer. Trialability was tested to increase the perceived usefulness where later lead to adoption in users under the subject of e-learning systems.

However, there were also studies neglected the used of trialability as the factors under innovation attribute. This was due to the non-consistent relation between the two mentions and hence most studies excluded trialability for further analysis [166, 167]. Example in the study of Hashem and Tann [168], the adoption of whole ISO 9000 standard unable to be tested in parts, hence the used of trialability in the case is not valid. The same issue in the adoption study of distributed work arrangement where the outcome might cause an irreversible effect which involved restructure of organization chart [169].

As another study of the adoption of online sales channels in the retail industry, trialability was found to be irrelevant in small and medium enterprises (SME) as they had been exposed to the innovation from their peer networks [170]. Plouffe *et al.*, [171] obtained the similar result where involvement of experienced consumer made trialability insignificant. However, the trialability of online channels was found to be applicable to early adopters [170] where this group of consumers focus more towards the functionality of an innovation [145]. A different scenario was observed in the study of Liang and Lu [172] on online tax filling services; trialability has an influential effect on those late adopters rather than early adopters.

Thus, based on the above study, the fitness of the trialability factors is highly depending on the subject of study and targeted sample group.

Observability

Observability refers to the level of detail visibility together with effective communication to the prospect adopters [52]. Communication systems hold an important role in sharing of information and results of an innovation to the public. In previous study from Moore and Benbasat [173], observability was found to be involve in complex construct and later being separated into two categories namely demonstrability and visibility construct; demonstrability refer to the innovation's features presentation whereas visibility refer to the disclosure to potential consumers [174].

By following Moore and Benbasat [173] separation on observability, Almobarraz [175] found that demonstrability and visibility were significant in prediction of internet adoption within Saudi Arabia. Increase in visibility for the innovation will influence the adoption intention of consumers as later, the consumer will realize the important and usefulness of the new innovation. Similar study was also found in Al-Gahtani [176] and Nazari, Khosravi and Babalhavaeji [177] under online database at University in Iran. Yang *et al.*, [178] study provide a result indicated that, increase in the detailed of the products display on the web will increase the cognitive trust of shopper hence lead to increase in shoppers' enjoyment and purchase intention. In the case of cloud computing, Shiau and Chau [179] show that observability had a positive influences toward adoption intention.

Observability appears to be one of the significant predictor in supply chain management. The intention of firms in adopting RFID technology raises was due to the green features of RFID technology that able to provide [167]. The reasons behind where green technology is favorable were highly result from the stakeholders' pressures on waste production, governments' policies on greenhouse gases emission as well as the severity of pollutions and deterioration in quality of the environment [180-182].

Some study was show that observability displays an insignificant relationship in certain subject of study. For example in the study of DWA, management place observability under minimum consideration as the effect of DWA will be on long term [169]. In the banking industry, it was mention by Tan and Teo [183] that, observability hardly applied due to the privacy nature of the industry. Similar to trialability, observability as well found to be irrelevant to consumer who had experience with the innovation. There are also other literature exhibit criticisms towards observability, such as in Slyke, Lou, Belanger and Sridhar [184] stated that both construct (result demonstrability and

visibility) proposed by Moore and Benbasat were contradicting.

Research framework

Based on the above discussion, figure 4 below represent the proposed framework of the study.

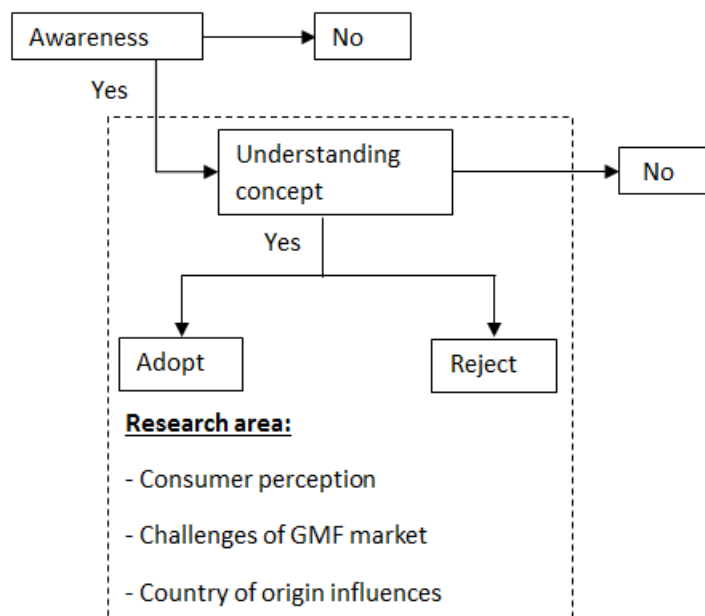


Fig-6: Research model

RESEARCH METHODOLOGY

This study will adopt qualitative and descriptive research design approach to examine consumer perception on imported GM food in Malaysia. A semi-structured in-depth interview was conducted in order to gain deeper intuitive understanding of the study findings. The below sections consist of research methods, population and sampling, data collection methods, ethical consideration and data analysis. Each section will provide a further explanation on the ways study was conducted, the sampling technique used and the number of respondents that obtained for this study.

Research method

In order to understand consumer perception, exploratory study was conducted which survey by interview was carried out. Questionnaire survey of consumers’ perception towards GM food in Malaysia was conducted in several researches. However, few potential issues were identified at this early introduction stage of GM food. Firstly, the definition and concept of GM technique and GM food were new or with limited knowledge to many at time the research was conducted. Furthermore, many challenges, benefits and risks are not well understood; hence is difficult to generate specific questions or statements on GM food. This study is also to understand the standpoint and decision in GM food consumption, thus it is important to further clarify and interact with interviewees via face-to-face interview as well as allow them to express their perception in own thought.

Semi-structured qualitative interview was conducted as data collection methods in the research in which able to further understand consumer thought and the reasons behind that lead to the specific perception [185]. Real time interview provide an opportunities for both parties in order to clear up doubts that arise as and when during the conversation.

Sampling

The focus location of this study mainly based in Kuala Lumpur and Selangor; interview will be conducted to those consumers who are located in the two locations. Snowball sampling method was appointed in respondent selection. This sampling method is convenience and is highly relies on the referrals from the initial respondent to obtain the following respondents; since this study only eligible to those who understand the concept of genetic engineering (GE) or GM, hence snowball sampling technique is appropriate and convenience in obtain participants who have the information and knowledge [186].

The targeted population of the survey consisted of Malaysia consumers who have basic understanding of the concept of GE technology and GM food. Thus, before the interview took place, a filter question (“Do you know or understand the concept of genetically modified food?") helped in the selection process for the interviews. A total of twenty participants were interviewed for this research with twelve female

and eight male respondents between the ages of 25 to 55. The purpose and copy of questions were sent to the respondents prior the interview in order for them to decide whether to contribute their thought in the study.

Data collection method

The interviews were conducted between October and November 2016. Interviewer described the research purpose to the respondent and seeks their consent to audio-record the interview session. Participants were assured that their personal information and the recorded conversation were completely confidential and only for the research purpose. The interviews were conducted in an informal and relaxed condition to ensure respondent able to freely express their thought on the research subject. As the research is to identify the consumer view point towards GM foods, hence the interview started with a general question (“What do you think of GM food in general?”) and further probing questions (“By comparing GM animals and GM non-animals food product, in your opinion, which is most acceptable for you? Why?”, “Do you think Malaysia should import GM Food? Why?”) were asked to understand more on their view and adoption (“What is your own opinion on GM Food? Why?”) towards GM foods. Those questions were based on the objectives and conceptual framework of the study.

Researchers actively participated throughout the interview session to obtain more information from participants and required detail and careful listening in order to ensure smooth conversation as well as stable emotion between both interviewer and interviewee. Furthermore, during the interview, interviewer took note on the non-verbal communication to capture the expression of respondent. The interview took about 30 minutes. Participants were given a token of appreciation for their valuable contribution.

Ethical consideration

Ethical research guideline standard adopted to complete a research is an essential practice. Ethic standard refer to the behavior that guide researcher’s conduct with regards to those who is participated in the particular research as well as those who is affected by the research conducted [215]. Considering on the ethical perspective, voluntary and respect of the respondents was the main concern of the research where respondent’s right to participate in the research was respected. They were also given choice to withdraw or

not answering certain questions which they were not comfortable with. Furthermore, sufficient response time was given to respondents in order to avoid false view on the research questions and reduce the possibility in causing stress and discomfort. Clarification with examples was also provided as and when necessary if respondent was confused or unable to understand the questions. Information consent was provided in which to ensure sufficient information and overall understanding of the research were provided to the respondent via email prior the interview. Data provided by respondents will be presented and reported accurately and fully without any alteration and falsified information.

Plan for data analysis

The recorded interviews were transcribed into pattern of answers according to the research questions and match those key words into unique themes that guided by theoretical frameworks in previous literature reviews. The recorded audios were revised several times to ensure all important and related statement was put in writing to ease analysis process. The next chapter presents the research findings obtained through in-depth interview from consumers in Malaysia.

FINDINGS

In this study, consumers who are aware of GM food were interviewed. Majority of the consumers have knowledge on the benefits and risks of GM technology in food source. However, some respondents perceived that GM food is safe to consume and some perceived that GM violated the law of nature. In those respondents who will adopt GM food, majority able to accept GM vegetables rather than GM meat. Lastly, with the effect of country of origin (COO), majority respondent perceived that COO will not be a factor that influences their decision but certified bodies, information and recognized brand. Below discussion and

Perception of genetically modified food

Majority of the consumers who involved in this study able to identified both the pros and cons of GM food. Resistance to diseases, produce better quality crops and increase yield were mentioned by respondents; on the cons side, majority consumers expressed their concern on the long term health issues and a lot more uncertainties behind the GM food need to be solved. Table below provide some perceived benefits and risks of GM food by the consumers:

Table-2: Consumers' perceived benefits and risks of GM food

Perceived Benefits	Perceived Risks
Tolerance to stress	Unknown long term side effects
Resistance to diseases	Negative health issues
Increase yield	Chances of mutation
Better quality	Risk to environment and ecosystem
Delay ripening	Inadequate study
Lesser herbicides and pesticides	Negative image

GM Food concerns

Consumers that support GM crops explained that only small amount of gene is introduced or change to enhance some of the required characteristic; hence it will not cause an adverse effect to human. Some consumers perceived GM plant as normal crop where they contain similar structure as compare to normal plant. As respondent (P10) mentioned:

It is a gene basically you put inside that (food). Everything that we eat contains genes and proteins. By the time we eat, is going to disintegrate in our body anyway. It is not something that you create that out of this world kind of thing. It is still part of something.

One of the respondents (P17) also mentions that the genome modification processes will also happen in the nature, where the result of this event is the different variety of one crop that available in the market:

I think that GM food is everywhere. Whether it is naturally achieved or synthetically achieved. Synthetically means researcher do the modification. But in the natural environment, over time, they (plant) do evolve themselves. Whether you genetically modified it or not, eventually it will happen in nature. So, to say that GM food is like some kind of monster food is not true.

However, there are several consumers opposed to the saying where their perception on GM food is not naturally occur (P8):

It seems that there are also drawbacks to the particular method which the fruits and plants may have disadvantages to our health. It may cause allergy to people and so on, because is like doing something not natural to something natural to get better crops.

Furthermore, some consumers think that price and quality are their major concern in choosing food products. Reasonable pricing, tasty, nutrient content and good quality such as freshness and good physical appearance of the food will be the determinants of their purchase decision. It is stated by participants that Malaysia consumers will make price as the primary consideration due to the current economic situation. Respondent (P16) expressed that:

For me, I not really concern about whether is GM or not, as long as the price is reasonable for me, I think is high quality that I can consume, I just consume. As long as it is the same as conventional, for me I don't mind.

The price is much more important in this kind of situation.

Another respondent (P17) said:

As long as the food is fresh, price, another thing is the lesser it has preservative I will go for that. GM or non GM is not in my list of priority.

Some respondents mentioned Malaysian has limited awareness, information and knowledge on GM in term of the technical processes; hence this might cause fear and rejection of GM food. As mentioned by respondent P8:

As far as I know, (GM) is not really wide known thing in Malaysia. I don't know about Singapore. It is not something that we often talk about but maybe in the University and things like that they know. As a layman they may not know.

Furthermore, some respondents said that public able to access all information from the internet and able to absorb negative information rapidly without further investigation. As expressed by respondent P16:

I think the most important is the awareness of the people about the science of GM, I mean how the technology is made and how the transgenic plant is made. We need to create awareness start from the beginning, start from the school and small children, not only get the knowledge from internet, maybe are wrong, and maybe are right.

Some respondents commented to the low awareness of Malaysian towards GM products is due to the food sufficiency and availability. Due to agriculture industry is the main focus in Malaysia as well as neighboring countries, thus many varieties of food products can be easily found in shelf all years. This situation leads to a conclusion where consumers refused to consider new products or "men made" product as there are still many available food to pick and choose in the market. As respondent P8 stated:

I don't think there is a need, but one day we don't have enough food and Thailand or Philippine and Indonesia cannot export any food to us, maybe one day if we have to import from them maybe there is a need for that (GM food). But otherwise I think, Asian country is still very much into agriculture, so in that sense we are still safe and self-sufficient as a region. So we can still trade with each other.

Without the labeling rule enforcement in Malaysia, majority of the respondents aware that some products available in the market are GM, but consumers lost their rights to choose due to no enforcement of GM labeling. Labeling is an important action but it might create reverse effects to other stakeholders, as mentioned by respondent P20:

What I think is, labeling of GM can be good and bad. The good is consumer right to choose what they want...with condition that people have the knowledge and transparent information are provided by those producers of GM food. If current situation continue, I would say no parties are going to benefit from launching GM. At the end it will only hurt the farmers who plant GM and businesses or sponsors who fund the research.

To conclude, some consumers perceived as normal crops where selection of gene and evolution event happen in a daily basis; yet there were part of the consumers consider GM food as not natural food by its own. There were consumers who will choose any food by placing high important on the price and quality factors. Limited awareness and information on the GM processes together with the spreading of negative information on the internet create fear and rejection towards GM food. With the current situation where consumers have limited knowledge on GM technology, labeling requirement might lead to adverse effects to some stakeholders. The low awareness between Malaysia consumers may be due to the food sufficiency and availability in the market as and when needed.

Health concerns

Health related issue was the major concern of consumer when they evaluate on GM food. Some of the respondents in this study associate GM food with negative health perception such as allergies effect towards human. As stated by respondent P2:

As for my personal effect is that, if I consumed more or less a genetic modified food, I will get the side effect. If I take more grain based or wheat grain based sort of thing, itchininess developed. Than the wound will not be heal easily, if I don't consume it then it won't happen.

However, several respondents argument to the statement of allergy effect as personal body effect to the particular protein in the food. This effect will not only happen to GM crops but in all other type of crop that contain the protein that the individual is allergic to. As indicated by respondent P10:

Ok, they may have or they not have. But the thing is, how do you know it is cause by the

GM? Have you been eating just that (GM food) or have you been eating more than just that? Would it be other things that actually cause your allergy? If you eat normal food is going to cause you allergic as well. Or it is your psychological thing?

Another respondent (P16) acknowledge that:

I think if there is any effect is because of the protein. If you are allergic to certain protein then maybe it is the person who has the allergy to that particular protein. It animals fed with GM feed, the effect I think will be less, is not direct.

Although some respondent associate GM food products with health issue, however, other than allergic effect, no other negative health issues example able to be listed out. Besides, some respondents do not aware on any health issue that might arise from consuming GM food.

Limitation in research and knowledge

In addition to allergic effect as mention before, half of the respondents are fear and concern on the unknown long term effect that will bring to their health. Respondent P1 said that:

However, eating something that is modified; we do not know what the side effect is in the long run. There are some articles that said if you eat products that is modified it might cause some health issues in the future. I don't think so there are a lot of research had been done on the effect of consuming GMO in the long run.

Few respondents mentioned that they have limited knowledge on the actual impacts on how GM food will affect human. Respondents explained that there is no definite evidence to prove that GM is actually bad to human health. As mentioned by P7:

I do have questions like does it affect the health and things like that. What I know is that people do think that because is not natural, so it may affect your health. But then I belief that, there is not enough research be able to show that it really affect your health or not. I don't think that there is any research that can be so certain on this point.

Respondent P13 acknowledge that:

They do have support...they do give some evidence but the evidence are not concrete, not scientific and is very out date. And they don't have the basic scientific knowledge to answer. The GMs are here more than 20 years ago, and then there is no hard evidence or any bad/disadvantages, no concrete scientific evidence to support that.

In the event of no solid evidence on the effect of GM food, respondent argued there is no test being conducted by researchers:

Genetic modified food is not really been tested on human in the sense of long term side effect. The negative side of the genetically modified food is still unknown.

However, few respondents responded that to study the long term effect required time and difficult task when involve human, as commented by respondent P14:

Immediate effect you can get result soon, but long term effect is very difficult. Like you don't really know unless is you just eat that for 5 years then maybe. Other than that it is quite difficult, I mean in term of human. Animal probably is kept on feeding it the same thing. But when you keep on feeding the same thing for a long period of time, that thing is going to get sick, not because of the GM but the other thing. But so far, I mean we don't even know long term whether there will be or there will not be any effects or whether the effect come from the GM or not.

In summary, unknown long term effects of GM food and no test on human being carried out were the main concern for those consumers who reject GM food. However, there were also consumers who accept GM food where there were no strong evidences to prove the actual effect of GM food to human.

Trust on certified bodies

Besides lacking strong evidences on health effect, some respondent belief on the research and the governing bodies that responsible to coming out with the GM food as well as rules and regulation governing the research process in which to produce products that is beneficial to the human. Respondent P19 commented:

I would belief that those governing bodies like biosafety department, they should have set of rules and standard to carry out this GM research or plant it in open area. And there are also no one would like to fund a research or produce something that, at the end is not beneficial and wasting time and money. As a big business company I sure they won't invest in something that will not gain profit.

As acknowledge by participant 9:

There are many criteria and also questions need to be fulfilled and answered in order to get approval for this GM to be planted in a confine area like glasshouse. If you are mentioning to plant in wild, there are a lot more information required. Malaysia has a

very stringent standard and legal for this GM food, I belief other countries as well.

As conclude, consumer belief that, to commercial GM product into the market, stages of research and test is required to be completed during the early phase of study before able to go for large scale production and release into market.

Religion issues

Malaysia is a multiethnic country where majority of the population consist of Muslim. When the subject related to food, Muslim people are more sensitive towards choosing their food products. Halal certified food products will be the only consideration for this ethnic group. Some of the Muslim respondents mention that:

For us Muslim, we have certain things that we cannot consume. So we know the DNA or the DNAs are from certain non Halal, we definitely will not. Halal is very important. JAKIM consider the gene from any of the *Haram* will consider as *Haram*. Most of us, if we not sure, we won't take.

Another respondent supported that:

GM in my religion is permissible because as long as the source is Halal. Again we don't do this for fun, we modified for the betterment of people, to make it healthier, to make people sufficient food in certain country.

However, there is also Muslim that belief food should not be modified, otherwise necessary:

And also in term of religion, there is a lot of debate in Islam that you should not change what God had created on your own.

Lastly, Muslim consumers have much concern on the food they consume and there is no further religion issue was mentioned by other ethnic groups involved in this study. GM food products that are certified Halal by Jakim was acceptable by majority of the Muslim consumers; however, there were other who perceived modification technology should not apply in natural food.

Adoption of GM food

During the interviews, three major groups of consumer were identified. First group consist those who are totally reject GM food and thought that GM food should not be introduced in Malaysia. Their main arguments to avoid GM food are availability of other alternative food, not food by nature, negative and unknown health concern. As expressed by respondent P1:

We do not have any problems. For example in certain countries where there are issue like

people very poor and the children are undernourished and then the plantation or the crop always get attack, so we don't face this type of issues, so our people they have opportunity to eat the non GMO food , so why must we bring in GM food.

However, few participants commented that Malaysia do import food from other neighboring country as well as animals feed. Furthermore, the plant diseases that are happening in Malaysia lead to further reduce in certain food supply. As mentioned by participant P12:

Like plant diseases, they killing a lot of like banana especially the *Berangan* that is very susceptible to certain disease. How can you reach the target of how much you want to produce? And do you know that those Dole bananas that we have in the market is imported? Now we are still facing the issue of declining yield because of the diseases. I don't think there better solution than the resistance variety.

Second group are those consumers who accept GM food confirmed that GM food is safe to consume and that current food that available in the market are also genetically modified but do not carry a label with them. One participant (P7) stated that:

I would like to believe if (the food) is out in the market for sale, it is safe to consume...GM foods and processed food are similar in term that some processes had been introduced, if reject, it might make food decision very difficult...For me being having a background in nutrition, I would say if the USDA guideline come out and say should stop consuming GMO, that is convincing to me.

Moreover, one of the participants mentioned that GM food is actually compatible with personal food choice philosophy P5:

I think food is just to reduce hunger, to give me nutrient and energy, as long as the food does the job, I think it is ok.

As for Muslim participants, Halal will always be the main priority in selecting food source; thus, to those participants who are willing to adopt GM food, Halal certified is significant in their decision making. Other than Halal certified, consumers are more concern on the price and quality of the food; lower price with better quality will be their main priority in purchase decision.

Thirdly and accounted for large number of participants are those who will adopt GM food with certain criteria; the decision of adoption or rejection will based on the evidences and supports from the

recognized organization and authorities on the GM food research. One of the respondents (P9) mentions that:

I have no problem with GMO, but will look for few criteria such as the gene source, where the genes come from and the function of the gene. If it does not cause allergy or have pathogen, it will be ok for me

According to the same respondent, it is also important for the company to provide a transparent report open to public where consumers able to have clear idea on what are the things that they are consuming. As commented by participant P 20:

Other than declaration of GM, the next thing I will look into is what exactly is modified and for what. If like giant pumpkin in US rite, then at least they can say that they had introduced this and this gene to increase the size. So it is specified then we know what exactly is modified.

Furthermore, majority of the respondents will look for other alternative food; they will only select GM food where there is no other alternative in the market to choose from. Respondent (P10) expressed:

Yes, if I am to buy, but if there a choice of course it have to be properly label, there are GM section and non GM, of cause I will go to the non GM first. Because we have alternative...if we do not have alternative like soy are all GM products, I don't mind taking soy-based products that is GM. If have alternative, I'll go for alternative because is more natural. Normally we don't do something or modified something for fun, so of course something is being genetically modified is because of some issues like resistance to pets.

Some consumers will consider the purpose behind the production of GM food. Respondent will consider GM if they think there is necessity in going for GM such as resistance to stress or pest. One of the respondents (P6) mentioned that:

What I will consider is the purpose to do GM. If there is no issue to plant normal crops, there is no need in doing GM by just for the sick of doing it to get profit out of it. If that country facing some problem with the crop and they do GM then will be fine, but again I will look into other alternative of the same crops. If really there is no other choice but GM, then I will take it.

Lastly, some respondents are taking into consideration of the food that is certified by standard governing body:

From my point of view, if the food is FDA approved, I will think that is safe to consume. It is the purpose of FDA to ensure those foods

that available in the market is safe to the public.

To conclude, there are three types of consumers identified in this study. First, consumer who totally reject GM food as they perceived that GM food have negative health issues, not food by nature and there are other alternative food source in the market. Second type of consumers who totally agree in consuming GM food where it is safe and were perceived that GM food is available in the market. Thirdly are those consumers who will go for GM food where there are no alternative food sources, transparent information provided by producers, the purpose of GM food production as well as being certified by recognized bodies.

GM vegetable vs GM meat

Majority of the respondent who accept GM food will be able to accept GM vegetable rather than GM meat; only small number of participants in the study able to accept both GM vegetables and meat.

Firstly, ethical issues is the main concern for consumers who unable to agree with GM animals. The feeling of sympathy towards animals is stronger than plant as it involves lives in research and testing. As responded by participant P17:

I would go for GM crops not animals. If you talk about genetic modified things especially related to animals there will be some ethical concern. And because of those ethical concerns I don't think that I would choose GM animals.

Other than ethical concern, complexity of the research will also affect the respondent decision. As mention by respondent P9:

First I do not have much information on GM animals. Second I think there will be a lot of ethical issues for GM animal. If more which so I also feel pity for them. Third, the genome of animals are more complex than of plant, so the research and all other test will become more complex and more deep research need to be conducted to have more understanding.

As indicated by another respondent P20, ethical concern, purpose of the research and monitoring system will be the main concern which leads to avoidance of GM meat:

What I think is there are a lot ethical concerns towards this testing on animals, as living things. Plant you can easily cut and extract whatever for test, but in animals, you might be creating stress to that particular testing subjects. For me is just not very acceptable. And also need to look into the purpose of the research in GM animals. There must be a clear motive that you want to achieved something

when want to do GM animals. It is very hard to control when you put them back in wild and to monitor their next generation.

Besides that, respondents who do not have any concern on neither GM vegetables nor meats perceived that both technology is similar, hence there are no different between GM products. Based on the expression of participant P7:

If you think about the concept of GM, both are the same, the modifying the gene of plant or animals it will not affect my point of view.

In addition, fulfilling the requirement for the GM process is also one of the factors that allow respondents to willingly consume both GM meats and vegetables. Participant 11 indicated:

I have no concern on GM animals or meats, what I think is if they able to fulfilled all the testing, commercial and import requirement, I belief that it is safe to consume. And of cause if anything that able to be place on the shelf in the market, it should be safe for people.

To conclude, only few participants who will adopt GM food will also adopt GM animals. Majority of the respondents who will adopt GM food will only accept GM crops but not GM meat. Ethical concern, sympathy and complexity of the research were the main issues notified from the consumers.

Effect of country of origin (COO)

Large number of respondents perceived that country of origin (COO) of GM products will not have an influence to their decision for GM. Majority perceived the technology to be similar across the globe, as explained by participant 8:

For me GM is still GM, regardless of COO, I don't think is going to affect my decision. Those products had gone through some kind of process and manipulation. I think still the technology come from US and Euro as well.

Addition to that, some participants will consider the product's information that will be disclosed by the producer or exporters, as express by respondent P9:

Now I think even country like South East Asian country like Thailand and Vietnam also did a lot research on GM and their research also extensive. So I am not very skeptical on it. But they need to be transparent on the report. So far if I can get information and decide, is ok for me.

Besides, regulation bodies also play an important role in consumer decision making rather than COO. As participant P19 said:

For me, as I had mention, if those products can be certified by those well known governing bodies like FDA, biosafety department, USDA all this then it should not have any problem to me. Which country produced will not be my concern. Once the product able to get certified, I will belief that they have done much to ensure the safety of the products.

Company reputation and reliability is one of the factors that respondents are looking into in choosing products. Participant 13 said:

Company must have establish brand that they won't do something like that and trustworthy. If something that I never heard of or a brand that I never come across, I probably will go for another brand that I know of.

When country of origin has an effect towards the perception and decision of consumer, country's regulation is the main factors that respondents looked into; more stringent the regulation will have higher consumer trust towards the products produced by the country. As expressed by respondent P5:

I will probably trust a country that has straighter regulations than a country that doesn't really care so much of it. All this regulation actually helps sometime which ensure people that this is safe to eat.

Country reputation on food safety also has an influence towards consumer perception as it acts as an indication on the level of enforcement action. As stated by respondent P10:

I will be thinking about those countries that have bad reputation like country keep having incident that people get poison by this fake stuff. I will be worry, and obviously they are

not doing a good job in trying to catch this people.

Developed country will provide a perception towards consumer that they are of higher standard and able to produce higher quality products than other developing country. As respondent P12 commented:

Something not from Thailand...maybe something UK...because I belief their standard is higher, I do not know...I think the labeling is more stringent. Because we just do not know how the food is produced, we just read the label. I trust the labeling system in countries like European countries or UK.

Furthermore, level of knowledge of a country and the purpose behind the production will influence consumer perception on GM products from the particular country. Respondent P16 indicated:

Of cause will have effect, I will trust those developed country, the level of knowledge is different. In Europe and US they have more stringent in screening compare to other that maybe just wish to increase their economy and they are not following whatever SOP they have.

To conclude, consumers who are concern on the producer's reliability, information availability and certified bodies do not place high attention to COO of GM products. Besides, country reputation, standard and level of knowledge are those factors that will influence consumer decision on where a product from.

As summary, below table conclude the main issues that have an influence towards consumers' perception on imported GM food in Malaysia

Table-3: Summary of research outcome

Issues	Reasons
Food concern	<ul style="list-style-type: none"> ➤ GM crop is normal crop ➤ Genome selection occur in the nature ➤ GM not naturally happen ➤ Price and quality are main concern in food selection ➤ Low knowledge in GM process lead to rejection ➤ All information available online ➤ Absorb negative information rapidly ➤ Always available food in market ➤ Labeling good to provide consumer additional choice ➤ Labeling is bad when consumer lack of knowledge
Health concern	<ul style="list-style-type: none"> ➤ Allergic effect to human ➤ Allergic effect due to certain protein not GM food
Limitation in research and knowledge	<ul style="list-style-type: none"> ➤ Unknown long term effect to human ➤ No strong evidence to support GM food is harmful ➤ No test on human

	<ul style="list-style-type: none"> ➤ Long term test required time and is difficult task
Trust on recognized bodies	<ul style="list-style-type: none"> ➤ Trust on government bodies ➤ Trust on rules and regulations
Religion issue	<ul style="list-style-type: none"> ➤ Trust on Halal certified by Jakim ➤ Belief food should not be modified
GM adoption	<ul style="list-style-type: none"> ➤ Have other alternative ➤ Not food of nature ➤ Negative and unknown health effect ➤ GM to solve plant diseases ➤ GM food is safe ➤ GM foods are in the market ➤ Compatible with own philosophy ➤ Halal certified is significant ➤ Will go for food that is low price and high quality ➤ Transparency of information provided by producer ➤ The purpose of doing GM food ➤ Certification by recognized department
GM vegetable vs GM meat	<ul style="list-style-type: none"> ➤ Complexity of research on GM animal ➤ Sympathy toward animals ➤ Complex ethical consideration ➤ Purpose of GM animals ➤ Complication in monitoring system ➤ Similar technology ➤ Fulfilling requirement and procedure as required
Country of origin	<ul style="list-style-type: none"> ➤ Similar technology ➤ Product information provided ➤ Certified by regulation bodies ➤ Company reputation and reliability ➤ Country's regulation ➤ Country's reputation and enforcement action ➤ Developed country have higher standard ➤ Level of knowledge of the country

DISCUSSION

This study explores the in-depth thoughts of Malaysia consumer towards adoption of imported GM food. Consumers with basic knowledge of GM technology in food source only were taken into the research. Many articles and papers have been available in the internet and research publication in the past to illustrate the potential benefits and harm of GM food that will affect human and ecosystem. However, some able to accept the benefits of GM food but some reject due to the negative information available. Within this study, several themes were identified as important factors in regards to the adoption and rejection of GM food as discuss below.

Attitude

Overall, respondent in this study exhibit a positive attitude towards the adoption of GM food. Knowledge on the GM technology and regulation is one of the important factors in determining consumer decision and attitude. Consumers who perceived more understanding on the GM process and procedure perceived less negative attitude on GM food as compare to those who have little knowledge and hence higher the adoption rate. The result obtain was similar to Mc Comas, Besley and Steinhart [187] research where consumers with higher knowledge of GM technology

view GM from the perceptive of solution to crop sustainability problems with higher perceived benefits to the human and economical values.

Furthermore, negative emotional experience of consumers such as feeling of fear and being highly uncertain on the effect toward health and safety of GM food contribute to the negative attitude of consumers in Malaysia. Information nowadays can be easily obtain from the internet, there are majority negative information pop-up when search for GM food. Lacking of strong support that GM technology will bring benefits to human lead to the feeling of fear in consumers. Respondents perceived Malaysian consumers capable in absorbing negative information rapidly without further investigation on the truthfulness of the details. The negative emotions of consumers are important factors in contributing to negative attitude towards GM technology and adoption on GM food, as supported by Sorgo, Jausovec, Jausovec, and Pukeh [188].

High uncertainty on the long term health effect, lead to consumer lacking confident against GM technology in food. As mention by Ye [189], advance technology exhibit an uncertainty characteristic with the

pervious example of DDT insecticide which was found to be very effective at the beginning and more damage realized later to human and ecosystem due to the synthetic chemicals presented. Consumers will apply the same mindset from their previous experience into GM technology, thus it is important to increase awareness and transparency in the distribution of information to avoid such conflict.

Majority of the participants in this study were unfamiliar with GM animals in Malaysia as similar result was obtained by Amin, Azad, Gausmian and Zulkifli [190] who study Malaysian consumer within Klang Valley. Thus, majority respondents in this study were found to have negative attitude and avoidance toward GM animals. Other studies acquired similar result where consumer worldwide less willingly to accept GM animals [191] Limitation exposure to the information related to GM animals was the main factors that lead to rejection on GM animals [190]. The purpose of conducting research on GM animals was identified as one of the factors which will influence consumers' adoption decision toward GM meats; beneficial need and motive in applying GM technology on animals will have more influences towards adopting GM meats.

Moreover, ethical consideration was another issue that consumers in Malaysia when compare between GM animals and GM crops. From the study of Frewer, Coles, Houdebine and Kleter [28], Asia have higher ethical consideration on GM animal as compare to Europe who perceived higher in risk. GM animals are perceived as ethically unacceptable to those who have positive attitude and opinion on GM crops, the similar perception where found in the USA by Knight [192] and Ma [193]. Some consumers have no doubt on the safety issue of GM animals but the feeling of sympathy in using animal as a test object related to the ethical consideration which influences their decision on GM animal. By fulfilling the requirement and procedure in the process of generating GM animal, is the only criterion for those respondents who do not have issue with GM animal.

Subjective norm

In the case of GM food, SN was not the major focus in this study [194]. Majority of the consumers perceived that science evidence are based on facts and figures. Consumer have more trust and confident on the research outcome that generated by the researchers rather than following what others belief. However, for those consumers who perceived GM food as harmful, they feel fear in providing food that is highly uncertain to their family [195]; otherwise it is completely proven to be safe to consume, with strong supporting evidence, consumer will change their attitude towards GM food.

Perceived control behavior

As mention by Kim and Chung [51], resources that consumer have will determine the perceived control and hence influence the intentions. Resources such as knowledge, information and money were determined in this study of GM food in relation to consumer behavioral intention toward GM food [194]. Consumers with higher knowledge and more information on GM technology in food, they have more control over the purchase on GM food. Several consumers with more awareness on GM perceived GM technology as a useful technology in helping to solved some of the agricultures problems which unable to be solved by conventional methods. Moreover, consumers who have less concern on the risk that GM food will contribute to human, the intention to adopt GM food was stronger.

Information was an important indication to help predict the behavioral control of consumers. Available in accessing information other than show in the labeling will help consumer to understand more on the products they consume and hence assist in decision making. Consumers perceived that if more transparent information provided by government and producer of GM food products, consumers able to performed adoption decision easily as they have higher control toward GM food. By exhibiting the production process, rules and regulation of GM technology to the public, will reduce consumer's fear towards the new innovation applying into food sources; lack of understanding together with other negative information spread in the internet create rejection of GM food.

Monetary value of a product is the main obstacle in the purchasing decision of purchasing decision [194]. Malaysia consumers were sensitive towards pricing; respondent in this study mainly favor low price, hence, when GM products out in the market, the pricing strategy need to be competence with other conventional products in the market in order to increase adoption rate. For consumers who have no concern on GM food, if the price of GM food is overrated, even with positive attitude, consumer will not purchase GM food and favor to other alternative food sources [51]. Furthermore, PCB factor was able to apply into the consistency attitude of Muslim consumers in searching for Halal food [141]. Muslim consumer putting high effort in choosing Halal food source, hence if GM food certified with Halal certification, Muslim consumers will perceived higher trust and reduce uncertainty toward GM food which lead to increase in adoption rate.

Relative advantage

With understanding in the concept of GM technology, consumers able to listed out several benefits example of applying GM technology in the food sources. When higher the perceived relative

advantages, consumer tend to be more adoptive [70]. Furthermore, as mention by Eder, Mutsaerts & Sriwannawit [145], reliability, sustainability, awareness and functionality of GM technology in food have an effect to the adoption of GM food. The four sub-themes as mention above were found in this research.

Firstly, functionality of applying GM technology in food crops was one of the considerations those consumers focus on. The need of conducting GM research such as defeat plant diseases, better yield to fulfilled demand and health improvement example in medication_sector has a positive correlation with adoption intention. Besides, applying GM technology in food crops without a solid purpose, perceived relative advantage will decline and adoption rate of alternative food source increase. In addition, consumer who perceived GM as a useful tool that help in overcome the sustainability issues which due to environmental stress, pest and diseases attack tended to accept GM food easily. Sustainability of the main economic food crops was found to be priority for developing countries as these crops able to bring economic advantage_to Malaysia by trading with other countries [15].

As for reliability, certified bodies, government institutions and evidences were mentioned the most by the consumers. Trustworthy and transparency of the information provided by company were value added into the adoption rate of GM food. Supportive evidences by the reliable organization from the government bodies have an influential effect towards the decision making process. Moreover, food products that are certified by recognized bodies such as FDA or USDA as well have an effect towards consumer decision. As studies from Chen and Li [42] and Prati, Pietrantoni and Zani [196], consumer trust was the great predictor for both perceived risk and benefits for GM food. Hence, it is further acknowledge that, other than the characteristic of technology, regulatory bodies that help in monitoring and governing are too taken into consideration.

On the other hand, improve nutritional qualities in food by using GM technology has no influence on consumer decision who found reject GM food in the first place. In the study of Lusk, Jamal, Kurlander, Roucan and Taulman [197], with the improvement in food nutrients enhance the acceptance of GM food. However, as similar to the study of Turker *et al.*, [198], consumers' decision remains unchangeable with the use of modification process for nutrient improvement purpose. Malaysia consumers who have the exposure to large variety of food choice perceived that sufficient nutrients able to be obtained from multiple food sources available in the market, therefore, there is no need for further nutrient enhancement in specific food source. Consumers expressed countries

that have high malnutrition rate should adopt this beneficial technology rather than Malaysia.

Lastly, the more awareness consumer has towards the GM technology, higher the adoption rate of GM food products. In this study, although consumer has basic knowledge on the pros and cons of GM food, however, there is still much uncertainty that consumer unable to identify. For those consumers who are aware on the GM technology processes and legal regulation have more confident towards GM food as compare to those who have limited information on the regulation parts.

The more awareness on the benefits of GM technology consumer have, higher GM food adoption rate; however, if consumer perceived GM food as risky especially towards human_health, adoption rate decline [2]. Consumer will not accept GM food until more research and evidences to be reviewed by recognized organization and government bodies. This statement was supported by pervious study from Font and Gil [199] where perceived risk was good indicator in predict consumers attitude. Nonetheless, other studies indicated perceived risk as poor indicator to consumer attitude [200, 2]. Low specificity knowledge on the processes and regulation of applying GM technology in food crops might be factor contributed to the contradiction [201, 2, 57]. In this research, participants perceived, from the science perceptive, no strong evidences to proved GM food is harmful as a good sign which it does not contribute negative effect to human health; this might not be the case for those consumer who has lower risk tolerant.

Complexity

Complexity, as according to Roger [52] is the perceived difficulty in the understanding of an innovation, in this case GM food; more complex the GM research is, adoption rate decrease. For example, as compare between GM animals and GM plant, majority consumer prefer GM plant. This result was found similar with consumers in US, in the study of Lusk, McFadden and Rickard [202]. The reasons of low acceptance for GM meat were due to the animals' genome_which is known to be closer to human (Zimmer, 2016), hence more intense study and research are required to provide solid understanding on GM animals and all other effects that might associate. In the study of Kapoor, Dwivedi and Williams [147], more complex the technical knowledge needed in understanding an innovation, higher the adoption barrier. Furthermore, complexity in ethical consideration was included into the purchase decision making process. Therefore, consumer's perceived complexity have an influence toward adoption of GM food.

Compatibility

Compatibility was found to be positively related with adoption; when consumer perceived the GM food as more compatible with own needs and value system, adoption of GM food increase [133, 143, 147]. For consumer who perceived the function of food is to provide energy and avoid starvation, they tend to adopt GM food easily as there are no much different in between GM and non GM food. Furthermore, consumers who value GM as good and safe technology have a positive relation to adoption of GM food. Consumers who place high important on food safety have higher adoption rate when GM food is being certified by recognized certification bodies. However, consumers who place high priority on health and perceived the effect of GM food as highly uncertain will reject GM food as consuming GM food does not compatible with their food choice philosophy. Therefore, compatibility of GM technology with consumers' needs, values, experience and culture have a positive relation with adoption decision.

Trialability

In several studies, trialability was found to be both significantly and insignificantly related to adoption of GM food. Trialability does not fit well in all subject of study, for example the ISO 9000 standards in the Egyptian context (Kapoor et al., 2014), it is believe that the whole system cannot be pretested in partially and hence no trial test can be conducted and lead to irrelevant for the subject. In term of GM food in Malaysia, since there is no labeling enforcement, there is no information on any GM food available in the market. With this, it is difficult for consumers to try GM products. However, there were several consumers who perceived that there are several food products such as soy milk is produced from GM soy, which some of them do not have an issue in purchasing this product.

In addition, as per the study of Lin and Chen [133] and Eder *et al.*, [145], functionality of an innovation was the main focus for consumers. Majority of consumers were found to be accepting GM food will first consider the function and necessity of the GM application on the particular crops. Consumers will only consider GM food if and only if there are no other alternative of the particular food they needed. With the similar characteristic for the same food products, consumers have higher possibility to go for non-GM food, as they do not feel the necessity in producing GM food products. Furthermore, GM food is known to be increase production yield and nutrient enhance [10, 2], as a result, some consumers notice those benefits are more relevant to those countries whom suffer from nutrient deficiency among public and have troubles in growth crops. There were also arguments from the consumers who perceived that since the stability of GM food is yet to clarify, introduce of GM food into the

market will lead to the creation of more health problems to human. Thus, in order for an innovation to be successfully adopted by consumer, producers need to specify clearly the functionality and purpose for the creation of GM food.

In addition to this study, consumers who found to have higher knowledge of GM technology as well as those that strongly believe in authorized certification bodies will tend to have higher trust towards GM food and made adoption decision easily. However, for consumers who perceived GM food is risky to their health, the intention for trial will be low and further reduce adoption rate. For consumers who have basic knowledge on GM technology and able to access to other information from the internet, negative information spread on the internet will further reduce the intention for adopting GM food. As other scholars had mention, the overall cost (pros and cons) for the adoption of such new innovation will affect the trialability rate [133, 136, 145].

Observability

As mentioned, since there is no labeling of GM food in Malaysia, observability in this case, not well fit as GM product is not physically visible for the consumers [183, 171, 161, 169]. Furthermore, when consumers perceived GM food negatively, without further confirmation of positive information published by recognized organization, consumers will not accept GM food products even if highly visible in the market. However, a scenario was created during the interview section, whereby having GM and non-GM side by side at the grocery; for consumer who able to accept GM food partially will choose that with lower price and better physical appearance. Price and quality of products were the main concern for Malaysia consumers as they would like to maximized the used of cash for better food products [90].

Other than the physical products, visibility of information provided by trusted bodies was listed in the observability factors. Some consumers will look for further information such as Halal certification for Muslim consumers, percentage of modification, gene source and functionality of the gene modified. Although it was understood that, with limited space in product's labeling, not much information able to be presented. Hence is important for government or producers able to make that information transparent and available for public view to reduce the feeling of unsure or doubt. Consumers required more transparent information to make an informed decision toward their food choice decision.

Culture

Malaysia is a multiethnic country. Each ethnic group has different perception and concern towards food selection mainly influence by religious rites of the

respondent [190]. Primarily, Muslim consumers contribute to the majority population in Malaysia; hence high demand for Halal (permissible) products especially processed food and meat. Large number of Muslim consumers in this study does not have much concern towards GM crops or vegetable. However, there were some concern of the introduction of foreign genes that are non-Halal (not permissible) into GM crops. Worries were focus toward GM meat and processed food that contain GM meat; proper labeling and illustration of "Halal" certification provide Muslim consumers more confidence in choosing GM products. Without Halal certification, it increase doubt in Muslim consumers, lead to negative attitude and hindering adoption of GM products [2].

Furthermore, some Muslim belief human should no 'play God' in modifying food or life that provided. However, there are also Muslim consumers, who perceived if the advantages of GM food overweight the disadvantages, they will be able to accept GM food that will bring more benefits than harm. Some consumers belief that GM technology should apply to those countries that in real need, such as having problems with food scarcity and nutrient deficiency rather than Malaysia. As studies from Ismail *et al.*, [2], based on the saying from Islam rules of permissible food, acceptability of GM food highly relay on the potential advantages to human and society. Other ethnic group who refuse to accept GM food perceived GM food as not natural food and associate GM food with negative health issues hence lead to negative attitude and perception towards GM food.

In the study of food choice, price and quality were involved in the selection of daily food choices. In the study of Mohd-Amy *et al.*, [88], price and sensory appeal were significant factors in food choice for Kuala Lumpur consumers. As suggested, economic situation in Malaysia contribute to the price concern within Malaysian consumers. In term of quality, higher the perceived quality, lower perceived risk, hence influence consumer's adoption intention of GM food [2, 196]. When both GM and non-GM have the similar price and characteristic, consumers' decision was to select non-GM food over GM food [193]; this was further explained by the purpose in creation of GM food. Necessity in generating GM food was found to be redundant if there is no value added to the existing food available [136].

In addition, balanced diet was included as the less significant contribution factors [88] and this finding was supported in this study as consumers lack considers on the diet issue (such as low fat) when choosing daily food intake. However, originality of food was one of the concern consumers have; this was due to emerge of food security issue that alarm consumers. Thus, fake food, additive, preservative, coloring and synthetic

flavor were being listed where more attention will be placed into the above content rather than whether is GM or non-GM. To conclude, cultural, religion, and food product circumstances have an influence to consumer food choice.

Country of origin

In consideration of imported products, country of origin (COO) is one of the information that can be found on the label; hence COO effect were being associate with influencing factors toward consumer perception for a specific products [203]. The effect of COO is increasingly significant due to the advancement in transport system and globalization in which different stages of process can be done from different countries. Thus, in this study, COO effect towards purchase intention was conducted to identify consumers' opinions on the issue mention.

COO effects to products evaluation, halo effect, in which country image will have an effect towards brand evaluation, were identified between Malaysia consumers. However, this country image has been associated with other cues in order to make further decision. Cue is all information that available for consumers before decision made [204]. Country reputation was the main issue that will influence consumers' adoption intention towards GM food. Food safety is being an issue world-wide which alarm consumers in making food choices. A country that being surrounded with food safety issues, such as fake and toxic food was found to have an influence toward the product evaluation [204, 203]. Consumers tend to have fear and will further consider in order adopting food products from those countries. Hence, country image is seem to effect consumers' confident and attitude towards a brand or product.

Other cues that will eventually affect country image were country regulation system and action. Strong regulation system and stringent law enforcement of a country lead to consumers' perceived higher trust toward products that are manufactured from the particular country. Hence, perceived trust toward the country regulation willingness will have an effect in adoption of GM food [205]. Thus, part of the consumers perceived that COO has an effect toward purchase decision.

Furthermore, general country image such as country's economic development, history and level of knowledge [205] have an influence towards adoption. Consumer perceived that developing country usually place major focus on economic development rather than other activity such as stringent the regulation and following SOP. Level of knowledge such as expertise in the particular field was found to have an effect in consumer decision where developed country being perceived as having the more advancement in

technology and able to produced higher quality and standard goods. Level of expertise in COO effect vary across industry [206], hence in term of technology, consumer will have more confidence in developed country as compare to developing country.

There are several studies proved that COO image has a strong influence toward product evaluation [207], however, there were consumers who perceived higher important in branding and company image. Brand equity for example quality, reputation and popularity were significant in determining consumers' adoption intention. Company that has good reputation in products quality tend to build more confident in consumer's mind [208, 209]; consumers often purchase from a recognized producer rather than other new or unrecognized company. As mention by Godey *et al.*, [210], the important of COO will be neglected if the brand image is strong.

In addition, consumers who perceived COO as unimportant perceived other factors were more significant need to be taking into consideration into the decision making process. Recognized authorized certification bodies were being considered as an additional protection factors where consumers will consider. For example, Halal certification by JAKIM provide confident for Muslim consumers and FDA approval certification as well served the purposed of confirmation in safety and quality of respective products. Furthermore, for consumer who has specific knowledge of GM, transparency in evidence and information from the producers was required for further decision making. As supported by Hazae & Khosrozadeh [204], more knowledge consumer have towards a product, the information search behavior will be different and hence lead to influence the adoption decision process. Moreover, there were consumers who perceived that the GM technology is the same across countries, hence for those who accept GM food found no issue with COO effect on their decision; yet for those who opposed GM food will say no to GM food.

RECOMMENDATION

This study provides important insights for the producers, traders, marketers, academician and policy makers. Firstly, with current genetic modification knowledge Malaysian consumers have, it will create more fear and rejection when GM food products to be introduced into the market. Further understanding and familiarity of the GM technology need to be reinforced to educate consumers on overall GM technology, safety and quality standard, regulation and legal enforcement in applying GM to food. Exhibition and seminar need to be conducted in term to increase consumer knowledge on GM food which will later influence the consumer attitude toward GM food [211, 17].

In addition, government agencies should come out with a platform which gathers all information of GM products that are in the markets. Information such as exporting country, producer, types of modification, gene source and other recognized certification (eg: Halal, FDA, USDA). With the sufficient information, this will reduce the uncertainty effect and consumers able to make informed decision on their food choice as well as to reduce the allergic effect according to different individuals. Labeling of GM food should be made available as to provide additional food choice selection and acknowledge consumers on the food that they are consuming. Furthermore, government agencies need and policy makers to ensure straight regulation in applying GM technology into food products to build trust within consumers toward the technology. Government should also restrict import of GM food products from countries that have low regulation enforcement to avoid unwanted issues arise such as food safety.

With the understanding of consumer perception on GM food, academician should conduct more R&D and study to proof that GM food is safe to consume by human without severe side effect to the health and ecosystem. Transparency of information such as research data and facts need to be discussing with consumers in order for them to have a clearer understanding on the processes conducted in the food. When conducting GM in particular food products, researchers need to take into consideration several criteria such as economic advantages of the crops, functionality and the purpose of the research. Other alternative food will be the first priority when consumers choosing food products rather than GM food. Hence, researchers need to communicate well to the public on the need of generating GM food type. Ethical consideration need to be considered when coming out with GM animals as animal's welfare is the concern of consumers' attitudes for GM animals.

Ethic concern also applicable to producer of GM food which includes transparency, reliability and validity of the information transmitted out to the public. Truthfulness of the message need to be exposed to consumers rather than focus on profit maximization for own organization growth. All necessary information needs to be declared to increase attitude, trust and control for consumers. In addition, the functionality of the GM products as well need to be considers to those countries that really in need for sustainability of the people. Price is the main concern for Malaysia consumes, hence producer need to come out with reasonable pricing strategy when targeting Malaysia as importing country. Products that are recognized by authorized bodies such as FDA or Halal will influence consumer attitude and provide relative advantages to producers in increasing consumers' confident. By getting those certification, more stringent standard need

to be fulfilled hence create a positive emotion in consumers.

As for traders or importers, understand local consumers needs and culture are important for targeting and generating marketing strategy to attract local consumers. Understand countries rules and regulation on GM technology and food safety regulation will also help in promoting GM food products that being imported into Malaysia. Country and producer image and reputation such as quality and safety issues should be place close attention; Malaysian consumers place high expectation on the food safety and quality. Producers which certified by recognized bodies will have more competitive advantages in Malaysia market as consumers perceived higher standard and trust toward products with such certification. Lastly, transparency of information is the most important factors which all level need focus on where consumers depending on the information provided as well as other information easily available on the internet to make adoption and purchase decision.

Limitation of study

In term of sample selection area, this research only focuses on the consumer within Kuala Lumpur city. It is recommended for future study to perform the similar study in other state within Malaysia where it provides higher representation of Malaysian consumers. Additionally, consumers with knowledge of GM technology or GM food will only be included in this study; therefore the sample size is limited. However, in order to get the overall consumer behavior toward GM food, all consumers, with or without GM knowledge should be involved in order to gain real consumer's perception. A basic briefing and introduction of GM technology in food should be informed to the respondent before the interview to help them in understanding GM food.

Lastly, in this study, no measurement was taken in order to determine the level of knowledge that respondents have related to GM food and technology. Hence, it is recommended in the future studies, self-reported awareness, scientific knowledge, educational background and work relation to biotechnology should be taking into consideration to further understand the relation between knowledge and attitude [212-214].

CONCLUSION

The purpose of the study is to understand the consumer perception toward imported GM food products in Malaysia. Specifically, this study interview consumers who have at least basic knowledge on GM foods. Based on this understanding, consumers only will be able to make adoption decision and to examine the reason behind the intention of the decision. Moreover, the effect of COO was also evaluated to identify whether the production country will have an

effect on consumer purchasing decision. From the Roger's theory of diffusion on innovation [53], Ajzen theory of planned behavior [129] and theory of reason action by Fishbein and Ajzen [126], several factors were identified which potential recommendations were made from the research finding to overcome existing barriers. Consumer perceptions on the technology were found to be highly influential in decision making. As for Malaysia consumers, there were several factors that will influence consumer perception. Larger the knowledge gap, higher the chance of negative attitude on GM food. Unfamiliar and uncertainty were found in many interviews that lead to rejection of GM food. Furthermore, negative information on the internet was also factors which influence consumers' perception. Consumers with minimal knowledge on GM technology tend to believe information provided in the internet without further identify or acknowledge the truth and reliability of the information provided. Complexity in the overall study and research were also contributed to the avoidance of GM meats. Consumers who lack understanding and perceived that animals have more complex system lead to the rejection to GM animals. More complex the overall understanding of GM, consumer will create negative attitude towards adoption intention.

Additionally, higher the perceived advantages create a higher adoption rate of GM food. Consumer who perceived GM food as safe and useful technology will adopt GM food easily as compare to other consumers. Recognized certified bodies such as Halal and FDA certification will improved consumers' perceived trust on GM products. Consumers who able to accept GM foods, with the support of before mention certification, consumers have more confident in adopting GM food. The purpose of generating GM food was found to be important in adoption intention. Increase economic advantages, fulfilled consumers needs and to meet market demand to solve crop diseases were the main factors that able to create positive attitude in consumers and thus increase adoption of GM food. It is found that, higher the perceived advantages, lower perceived risk and hence more positive attitude that consumer have which promote adoption intention.

Majority of the consumers have no knowledge on GM food, hence discussion among friends and family were restricted. Therefore, subjective norm have limited influence towards the consumer decision intention in this study. Furthermore, consumer who perceived GM food as risky to the health of the family will not adopt unless there are further evidences from reliable sources which able to provide clearer view to their doubt and worries. The higher control consumers have, will improve the adoption rate. Control such as the transparency of information available to the public, products quality, recognized certification, as well as

monetary values of the products have an influence towards consumer adoption intention. With sufficient information consumers able to obtain, this aids in making informed decision on the adoption of GM food.

As there are no labeling of GM food products, trialability was less influence in this stage of study. However, as mention above, higher the perceived benefits consumers have on GM food, trialability will increase as consumers less negative attitude and emotion toward GM. As for observability, with current limited knowledge among consumers will create fear in consumers to observe the GM food in the market. However, consumers who have no knowledge or awareness on GM food might not have any effect on the GM labeling other than price concern. Observability of information and evidences has an influence on adoption decision. More confident and positive evidences regards to GM food will create more positive influence on the adoption intention. Lastly, in-depth understanding consumer perception is important in introducing a new innovation into the market. All sectors and agencies need to work together in order to feed consumers with quality information and knowledge as well as other food alternative which will create benefits to human and ecosystem.

APPENDIX

Interview questions

This interview will focus on consumer's perception on GM food and the concern that influence the adoption of GM food. Structure of question as below:

1. What effect do you think applying gene technology in food products will have to the environment, yourself and other people that are importance to you?
2. By comparing GM animals and GM non-animal food products, which is the most acceptable to you? Why?
3. Do you think Malaysia should import GM food?
4. To what extend do you think a country should adopt GM technology in food?
5. How consuming GM food compatible with your own philosophy?
6. Do you think current information available for GM food actually sufficient for consumer to make an informed decision? Any suggestion to improved the situation?
7. Do you think labeling requirement imposed by the government is the right thing to do?
8. Majority GM food products in Malaysia are imported. Will country of origin change your thoughts about the GM product?

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