UNIVERSITI PUTRA MALAYSIA

CONSUMER PERCEPTION TOWARDS GENETICALLY MODIFIED FOOD IN THE KLANG VALLEY, MALAYSIA

BASHIR IBRAHIM MUSE

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By

BASHIR IBRAHIM MUSE

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

December 2013

DEDICATION

To My Mom whom I love her the most

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

CONSUMER PERCEPTION TOWARDS GENETICALLY MODIFIED FOOD IN THE KLANG VALLEY, MALAYSIA

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BASHIR IBRAHIM MUSE

December 2013

Chairman: Golnaz Rezai, PhD
Faculty: Agriculture

Gene technology in Agriculture is rapidly increasing in the world, through which the latest modern biotechnology and best techniques is used to exclusively change the genes of one organism to another one, resulting in benefits to the world's fastest growing population by ensuring sustainable food production. Genetically modified foods consist of food producing plants and animals which have experienced gene manipulation. The overall concept behind genetic modified food is the changing of the traits of genes in animals and plants in a way that results in greater production.

From the ongoing GM development in terms of production has been progressive in the world especially in the developing countries. These developments came as a result of many advantages emphasised by several scientists and crop producers around the world in applying biotechnology techniques in the food industry. The benefits, though many, include the possibilities of finding a better solution to the existing and growing fear of world's hunger problem by producing food that have high quality and longer shelf-life.

However, the controversies in agricultural biotechnology scenario are mostly considered as a consumer related issue. The lack of reliable information on biotechnology may cause exaggeration from the public, especially when GM Food opposing parties raise their voice to aggravate certain emotional response from the public. It is understood in the past decade that lack of efforts and attention paid in scoping, caterogizing and most important explaining what is and not GM Food by the experts resulted more confusion among the public and tends to resist GM Food products consumption.

As a result of these issues, this study aimed to determine Malaysian consumers' perception towards genetically modified foods. To achieve this objective, a survey was carried out in Klang Valley, Malaysia, on which one thousand two hundred and twenty seven respondents were interviewed by structured questionnaire to gather information on their perception, awareness and knowledge towards genetically modified foods. Behavioural perspective model is applied in this study. A seven point Likert scale from "Strongly Disagree" to "Strongly Agree", were used to measure consumers perception. Descriptive statistics, chi-square, factor analysis and binary logistic regression were used to analyse the data obtained after collection.

The analysis of the data shows that most of the respondents are aware of the existence of the GM food in Malaysia, though the majority of consumers hardly buy GM labelled foods or GM food products. The study indicates that the majority of the consumers were concerned with the GM food risks, heath-related effects resulting from GM food consumption and the long-term side effects from GM planting. In addition, the study highlights the existence of a relationship between consumers' socio-demographic characteristics such as income, education level, gender, race, lifestyle and area with consumer awareness towards GM food, their concern towards risk and benefit from GM food consumption.

Based on the factor analysis, six factors were identified that had influence on the consumers' perception towards GM food. These factors included; food safety concern, consumer learning history and society impact, consumer awareness and belief of GM food, information about GM food, consumer utilitarian and consumer aversive. Moreover, the results from the binary logistic shows the presence of significance correlation between most of the consumers' socio-demographic variables especially age, income and education level with the dependent variables which were consumers' awareness and perception towards GM foods.

With respect to the increasing consumer awareness on the food safety and health consciousness towards genetically modified foods, it is then essential that marketing strategies should be developed to cope with the changing phenomenon by the respected government bodies or other respective organisations. However, understanding consumer awareness and understanding of the biotechnology foods or foods produced using biotech techniques is very vital to the food industry or food marketers.

Furthermore, the market for GM foods is still a new concept to Malaysians, more effort should be carried out to disseminate the genetically modified food products concept and the consumption of biotech food to Malaysians in general. Therefore, food producers or marketers need to understand consumer behaviour and how Malaysian consumers purchasing behaviour is affected by their socio-demographic characteristics.

Abstrak tesis ini dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PERSEPSI PENGGUNA TERHADAP MAKANAN UBAHSUAI GENETIK DI LEMBAH KLANG, MALAYSIA

Oleh

BASHIR IBRAHIM

Disember 2013

Pengerusi: Golnaz Rezai, PhD
Fakulti: Pertanian

Teknologi gen dalam pertanian semakin berkembang pesat di seluruh dunia, di mana bioteknologi moden terkini dan teknik terbaik digunakan u secara ekslusif menukar gen satu organisma antara satu sama lain, ini memberi faedah kepada penduduk dunia yang sedang pesat berkembang untuk memastikan pengeluaran makanan yang mampan. Makanan yang diubahsuai secara genetik terdiri daripada tumbuh-tumbuhan dan haiwan yang telah mengalami manipulasi gen. Konsep keseluruhan di sebalik pengubahsuaian genetik makanan adalah perubahan sifat-sifat gen pada haiwan dan tumbuh-tumbuhan untuk pengeluaran yang lebih besar.

Seterusnya, pembangunan GM dari segi pengeluaran dunia adalah sanagt progresif terutamanya di negara membangun. Perkembangan ini adalah hasil daripada penekanan yang tinggi dikalangan ahli-ahli sains dan pengeluar tanaman di seluruh dunia dengan menggunakan teknik bioteknologi dalam industri makanan. Segala manafaat, walaupu banyak termasuk kemungkinan untuk mencari penyelesaian yang lebih baik dan kerisauan yang semakin meningkat berkenaan masalah kebuluran dunia dengan menghasilkan makanan yang mempunyai kualiti yang tinggi dan lebih lama jangka hayat. Walau bagaimanapun, kontroversi senario bioteknologi pertanian kebanyakannya dianggap sebagai isu berkaitan pengguna. Kekurangan maklumat yang boleh dipercayai mengenai bioteknologi telah menyebabkan kekeliruan orang ramai, terutamanya apabila suara pihak menentang makanan GM meningkatkan penentangan mereka dan memburukkan tindak balas emosi orang ramai. Difahamkan dalam dekad yang lalu kekurangan usaha dan perhatian yang dibayar dalam skop, kategori dan yang paling penting dalam menjelaskan apa yang ada dan tidak makanan GM oleh pakar menyebabkan lebih banyak kekeliruan di kalangan orang ramai dan mereka cenderung untuk menentang makanan GM terhadap produk pengguna.

Hasil daripada isu tersebut, kajian ini dijalankan bertujuan untuk mengenal pasti persepsi pengguna Malaysia terhadap makanan yang diubahsuai secara genetik. Dalam mencapai matlamat ini, satu kaji selidik telah dijalankan di Lembah Klang, Malaysia, di mana 1227 orang responden telah ditemuramah oleh soal selidik berstruktur untuk mengumpul maklumat mengenai persepsi mereka, kesedaran dan pengetahuan ke arah makanan yang diubahsuai secara genetik. Model perspektif Tingkah Laku digunakan dalam kajian ini. Tujuh mata skala Likert dari "Sangat Tidak Setuju" kepada "Sangat Setuju", telah digunakan untuk mengukur persepsi pengguna. Statistik deskriptif, chi-

kuasa dua, analisis faktor dan regresi logistik binari telah digunakan untuk menganalisis data yang diperolehi.

Analisis data menunjukkan bahawa kebanyakan responden menyedari kewujudan makanan GM di Malaysia, walaupun majoriti pengguna tidak membeli makanan dilabel GM atau produk makanan GM. Kajian ini menunjukkan bahawa majoriti pengguna bimbang dengan risiko makanan GM, kesan rawak berkaitan akibat daripada penggunaan makanan GM dan kesan sampingan jangka panjang dari penanaman GM. Di samping itu, kajian ini mengetengahkan kewujudan hubungan antara ciri-ciri sosio-demografi pengguna seperti pendapatan, tahap pendidikan, jantina, bangsa, gaya hidup dan kawasan dengan kesedaran pengguna terhadap makanan GM, kebimbangan mereka terhadap risiko dan manfaat daripada pengambilan makanan GM.

Berdasarkan analisis faktor, enam faktor yang dikenal pasti yang mempunyai pengaruh kepada persepsi pengguna terhadap makanan GM. Faktor-faktor ini termasuk; kebimbangan keselamatan makanan, sejarah pembelajaran pengguna dan kesan masyarakat, kesedaran dan kepercayaan makanan GM, maklumat mengenai makanan GM pengguna, pengguna utilitarian dan pengguna aversif. Selain itu, keputusan daripada logistik binari menunjukkan kehadiran korelasi yang signifikan di antara kebanyakan pengguna 'sosio-demografi pembolehubah terutamanya umur, pendapatan dan tahap pendidikan dengan pembolehubah bersandar adalah kesedaran pengguna dan persepsi terhadap makanan GM.

Berkenaan dengan kesedaran pengguna yang semakin meningkat ke atas keselamatan makanan dan kesihatan makanan terhadap makanan yang diubahsuai secara genetik, ia adalah penting bagi strategi pemasaran yang perlu dibangunkan untuk menghadapi fenomena perubahan oleh badan kerajaan berkaitan atau organisasi masinglain. Walau bagaimanapun, kesedaran pengguna dan pemahaman makanan bioteknologi atau makanan yang dihasilkan melalui teknik bioteknologi adalah sangat penting kepada industri makanan atau pemasar makanan. Tambahan pula, pasaran untuk makanan GM masih merupakan satu konsep baru bagi rakyat Malaysia, banyak usaha yang perlu dilakukan untuk menyebarkan konsep produk makanan yang diubahsuai secara genetik dan pengambilan makanan bioteknologi kepada rakyat Malaysia secara amnya. Oleh itu, pengeluar makanan atau pemasar perlu memahami tingkah laku pengguna dan bagaimana pengaruh ciri-ciri sosio-demografi pengguna Malaysia dalam membuat pembelian.

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Finally, I am delighted to express gratefulness to all those who extended their support, valuable guidance and help in preparing this thesis.

I certify that a Thesis Examination Committee has met on 4 December 2013 to conduct the final examination of Bashir Ibrahim Muse on his thesis entitled "Consumer Perception Towards Genetically Modified Food in The Klang Valley, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Date:

DECLARATION

Declaration by Graduate Student

I hereby confirm that:

- this thesis is my original work
- quotations, illustrations and citations have been duly referenced
- the thesis has not been submitted previously or concurrently for any other degree at any institutions
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia
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- there is no plagiarism or data falsification/fabrication in the thesis and scholarly integrity was upheld as according to Rule 59 in Rules 2003 (Revision 2012-2013). The thesis has undergone plagiarism detection software

Signature:…………………………… Date: 4th December 2013

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Declaration by Members of Supervisory

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision,
- supervision responsibilities as slated in Rule 41 in Rules 2003 (Revision 2012-2013) were adhered to.

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GOLNAZ REZAI, PhD
(Chairman)

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ZAINAL ABIDIN MOHAMED, PhD
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Signature--
JUWAIDAH SHARIFFUDIN, PhD
(Member)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GM Foods	Genetically Modified Foods
GMO	Genetically Modified Organisms
DNA	Deoxyribo Nucleic Acid
CBD	Convention on Biological Diversity
FAO	Food and Agriculture Organization
ISAAA	International Services for the Acquisition of Agri-biotech Application
CAP	Consumer Association Penang
MNRE	Ministry of National Resources and Environment
ACIAR	Australian Centre for International Agriculture Research
MARDI	Malaysian Agricultural Research and Development Institute
BCC	Biotechnology Cooperative Centres
CPD	Cartagena Protocol on Biosafety
ISO	International Standard Organization
INFAD	World Fatwa Management and Research Institute
TRA	Theory of Reasoned Action
BPM	Behavioural Perspective Model
EFA	Exploratory Factor Analysis
KMO	Kaiser-Meyer-Olkin

CHAPTER 1

INTRODUCTION

The introduction chapter is divided into eight sections. The first section discusses the overview of GM foods, followed by Global cultivation and the impact of GM foods in the second section. The third section also discusses food biotechnology industry in Malaysia, while the fourth, fifth and sixth sections discuss the problems, objectives and significance of the study respectively.

1.1 Overview of Genetically Modified Foods

In 1975, Stanley Cohen and Hebert Bouyer established the foundation of what is known today as recombinant DNA technology. This technique made genetic manipulation a possibility for in vitro handling of genes and, therefore, increasing the likelihood of genetic exchange between living organisms. Roller & Harlander (1998) reported that research on genetically engineered crops began in the 1970's and has continued in a broader context in agricultural crops, through the field testing of genetically modified crops which was first introduced in the U.S. in the 1980's . This technology developed as part of what is currently known as Modern Biotechnology, and was the basis for the enhancement of Genetic Engineering and its applications, which resulted in the growth of a succession of new products in such varied divisions as medicine, agriculture, and mining (Salazar and Montenegro, 2009).

Subsequently, in 1980's, scientists developed recombinant human insulin, which became the first commercial invention of genes cloned in bacteria (Genentech, 2009). Genetic Modification is the practice of changing crops or animals by incorporating genes to ultimately alter the genetic composition of the novel food or food ingredients (Anderson et al., 2005). Genetic engineering creates a more effective production of food. The procedure includes using molecular genetic methods to improve the genetic structure of tissues and organisms by adjusting recombinant DNA (deoxyribonucleic acid) (Macer et al., 1991).

Genetically modified foods are those derived from genetically modified organisms. There are specific changes introduced into the genetically modified DNA of the organisms through genetic engineering techniques. As Uzogara (2000), indicated, Genetically Modified (GM) food refer to the alteration of the genetic makeup of certain foods or crops by insertion of novel genes from other sources or deletion of existing genes, acquiring traits and capabilities that they did not naturally possess. In addition, majority of the genetically modified foods are derived from limited food staples such as soy, canola, corn, dairy, cotton, seed oil and consist only of a small percentage of the total ingredients (Knight et al., 2009).

The Convention on Biological Diversity (CBD) defines biotech/GM foods as "any technological use that practices living organisms or products in order to modify products or processes for specific use". However, from the description above, it can be interpreted that it covers various fields and methods that are currently used in agriculture and in food production, including agronomy, horticulture, animal husbandry, soil microbiology, tissue culture etc. (Behzad, 2011). The process and techniques used for producing GM food is unlike the traditional breeding. They can be explained in three fundamental steps. Firstly, GM food lowers the random nature of classical breeding, secondly GM foods completes the desired results much faster. Thirdly, the process of GM makes it easier and potential to cross the species barrier (Roller & Harlander, 1998).

GM crops have contributed positively to sustainability of food production through lowering production costs, enhancing crop production and increasing profits margin as a result of using inputs more efficiently. For instance, Bacillus thuringiensis (Bt) is able to kill insects by producing alkaline digestive systems through the action of a crystalline protein toxin called cry proteins. Bt transgenic crop is exclusively genetically engineered to resist the European corn borer (ECB), which results in an increased production (Thomas, 1999). Thus, Bt transgenic corn reduces the cost invested in inputs and improve yield. The other essential benefits that GM crops possess include using less chemicals and pesticides, enhanced taste and quality of some foods, increased nutrients, as well as general improvements to resist diseases and pests. Genetically engineered techniques are also useful for the improvement of the animal performance.

1.2 Global Cultivation on Genetic Modified (GM) Foods

Since 1986, the use of modern biotechnology in the agricultural sector has increased tremendously and a number of private companies involved in the genetic development of plants have launched genetic engineering techniques into their programmes, particularly in the USA. For example, Monsanto announced Roundup Ready^{R} soybeans, the first agricultural product to be genetically modified, to offer resistance to the herbicide glyphosate (Salazar and Montenegro, 2009). In 1992, the first genetically modified crop, tobacco, was sold in China, though GM crop commercialization officially began in 1996 (Nap et al., 2003).

Commercialization of biotech/GM crops was initiated in 1995 (Cotton, Company Monsanto; Potato, Company Syngenta), However, prior to 1996, China (GM tobacco) and USA (GM tomato) in particular were the two most famous producers of GM food globally (Redenbaugh et al., 1992).
The status of commercial application among selected Islamic countries using tissue culture, incorporation of molecular markers for breeding programs, commercial production and/or use of biological fertilizers and biological insecticides, research and development of GM crops is shown in Table 1.1. Significant progress concerning this topic has been made in some countries like Iran, Egypt, Malaysia, Indonesia, Pakistan and Bangladesh. The status of agricultural biotechnology

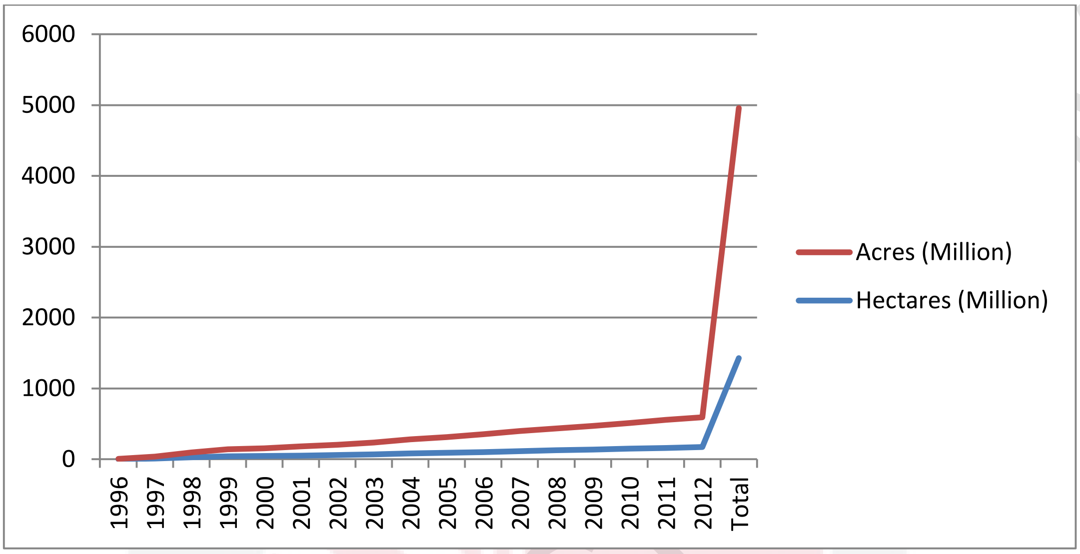
development and its application is quite diverse among the Islamic countries. As the table shows, there are the Islamic countries that enhance and use GM products, some countries are just consumers of biotech crops, while others are in the position to avoid the entrance of GM foods into their nations.

Table 1.1: The status of commercialization of agricultural biotechnology in selected Islamic Countries

Country	Tissue Culture	Markers	Biological fertilizers and insecticides	Biosafety Protocol Status	R & D Program on GM crops	Field trials of GM crops	Commercial release of GM crops
Iran	Yes	Yes	Yes	Ratified	Yes	Yes	Yes
Egypt	Yes	Yes	Yes	Ratified	Yes	Yes	Yes
Pakistan	Yes	Yes	Yes	Ratified	Yes	Yes	Yes
Burkina Faso	Yes	Yes	Yes	Ratified	Yes	Yes	Yes
Bangladesh	Yes	Yes	Yes	Ratified	Yes	Yes	Soon yes
Malaysia	**Yes**	**Yes**	**Yes**	**Ratified**	**No**	**No**	**No**
Indonesia	Yes	Yes	Yes	Ratified	Yes	Yes	No
Jordan	Yes	Yes	Yes	Ratified	No	No	No
Turkey	Yes	Yes	Yes	Ratified	No	No	No
Libya	Yes	ND	Yes	Ratified	No	No	No
Syria	Yes	Yes	Yes	Accessed	No	No	No
Tunisia	Yes	Yes	Yes	Ratified	No	No	No
Morocco	Yes	Yes	Yes	Signed only	No	No	No
Algeria	Yes	Yes	Yes	Ratified	No	No	No
UAE	Yes	No	Yes	No	No	No	No
Iraq	Yes	Yes	Yes	No	No	No	No
Lebanon	Yes	No	Yes	No	No	No	No
Saudi Arabia	Yes	No	Yes	Accessed	No	No	No

(Source: Behzad, 2011).

The year 2012 marked the anniversary of the 17th consecutive year of the commercial production of GM crops with a record of 100-fold increase in hectarage from 1.7 million hectares in 1996 to 170.3 million hectares (420 million acres) in 2012 of area planted, a sustained increase of 6% or 10.3 million hectares (25million acres) over 2011, thus, making the biotech produced crops the fastest adopted crop technology in the history of the global food production (James, 2012).



(An increase of 6%, 10.3 million hectares (25 million acres) between 2011 and 2012).

Figure 1.1: Global Area of Biotech Crops (1996-2012)
(Source: Clive James, 2012).

Hence, during the 17 years of GM foods, the total number of countries participating in GM food production has increased from only 6 in 1996 to about 28 in 2012. However, out of the 28 biotech crop producing countries, 20 were from developing and only eight were from the industrial nations, as shown in both Table 1.2 and Figure 1. The top nine countries in the list grow more than 2 million hectares, which consist of more than half of the global farmer population. Additionally, about 60% (i.e. 4 billion people), live in the 28 countries planting biotech crops.

The International Services for the Acquisition of Agri-biotech Applications (ISAAA) yearly report on global status of commercialized biotech/GM crops (2012) indicates that for the first time, developing countries have reached a production level of 52% of the global biotech crops in 2012 with the industrial countries at 48%. In 2012, the growth rate for biotech crops was at least three times faster in the developing countries, at 11% or 8.7 million hectares, versus 3% or 1.6 million hectares in the industrial countries. This makes the GM/Biotech crops the fastest adopted crop technology in the history of modern agriculture (Khush, 2012). Table 1.2 shows that China and India were the most developed and dominant GM crop producers in Asia. Out of 170 million hectares in 2012, China (4 Million hectares) and India (10.8 million hectares) planted a combined total area of 14.8 million hectares of mostly Bt cotton. Australia has become the sole Asia-Pacific nation that planted 0.7 million hectares of GM crops in 2012. Australia has succeeded in planting a total area of 2.6 million hectares since commercialization started in 1996 with a focus on Bt cotton and HT canola. Brazil and Argentina were the top GM food producing countries in Latin America. With 170 million global GM food produced in 2012, Brazil (36.6 million hectares) and Argentina (23.9 million hectares), planted a collective total area of 60.5 million hectares.

Table 1.2: Global Area of Biotech Crops in 2012 : by Country (Million Hectares)**

Rank	Country	Area (Million Hectares)	Biotech Crops
1	USA*	69.5	Maize, Soybean, Cotton, Canola,, papaya
2	Brazil*	36.6	Soybean, Maize, Cotton
3	Argentina*	23.9	Soybean, Maize, Cotton
4	Canada*	11.6	Canola, Maize, Soybean, Sugarbeet
5	India*	10.8	Cotton
6	China*	4	Cotton, papaya, poplar, tomato, sweet pepper
7	Paraguay*	3.4	Soybean, Maize, Cotton
8	SouthAfrica*	2.9	Maize, Soybean, Cotton.
9	Pakistan*	2.8	Cotton
10	Uruguay*	1.4	Soybean, Maize.
11	Bolivia*	1	Soybean
12	Philippines*	0.8	Maize
13	Australia*	0.7	Cotton, Soybean
14	Burkina Faso*	0.3	Cotton
15	Myanmar*	0.3	Cotton
16	Mexico*	0.2	Cotton, Soybean
17	Spain*	0.1	Maize
18	Chile*	<0.1	Maize, Soybean, Canola
19	Colombia	<0.1	Cotton
20	Honduras	<0.1	Maize
21	Sudan	<0.1	Cotton
22	Portugal	<0.1	Maize
23	Czech Republic	<0.1	Maize
24	Cuba	<0.1	Maize
25	Egypt	<0.1	Maize
26	Costa Rica	<0.1	Cotton, Soybean
27	Romania	<0.1	Maize

* 18 biotech mega-countries growing 50,000 hectares, or more, of biotech crops

** Rounded off to the nearest hundred thousand

(Source: Clive James, 2012)

Among the four African countries producing the biotech foods, South Africa is the leading nation with 2.9 million hectares planted, followed by Burkina Faso with 0.3 million hectares. This is followed by Sudan and Egypt with both less than 0.1 million hectares of GM foods planted in 2012. The U.S and Canada are the leading GM food producers in Northern America. U.S still holds the leading position for producing GM foods with 69.5 million hectares, and Canada with 11.6 million hectares in the fourth position on the list.

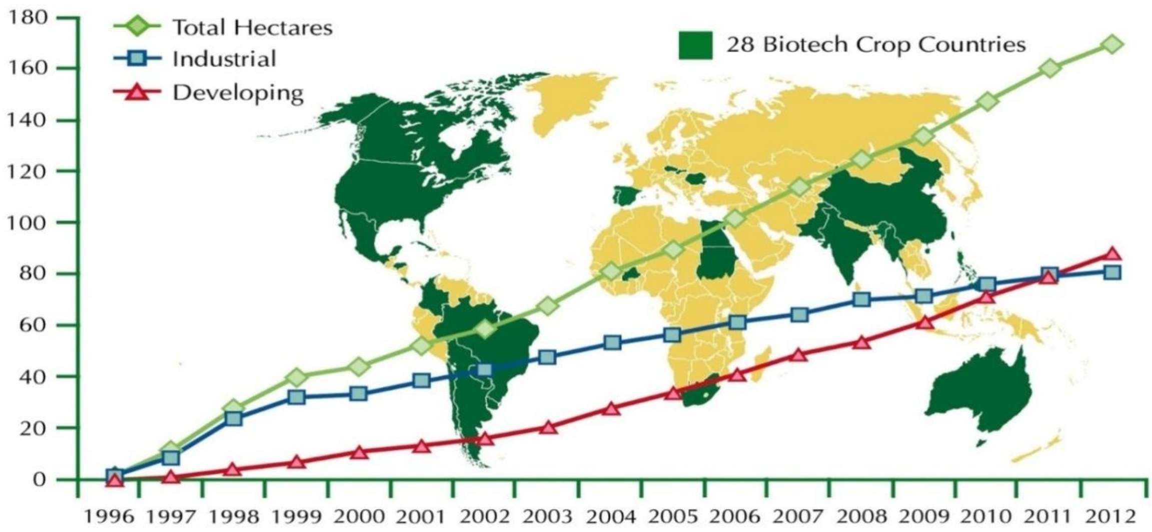


Figure 1.2: Worldwide cultivation areas with genetically modified plants, 1996 - 2012 (millions of hectares).

(Source: Clive James, 2012)

According to the worldwide adoption of major biotech crops such as Soybean, Maize, Cotton, and Canola, 81% or 80.7 million hectares of the 100 million soybeans planted globally were of biotech origin (Figure 1.3). This is followed by biotech cotton production which is 81 % of the 30 million hectares of the global cotton. However, out of the 159 million hectares of global maize planted in 2012, 35 % or 55.1 million hectares were biotech maize. In terms of GM foods grown based on traits, herbicide tolerance biotech Canola was the highest and was planted in 9.2 million hectares or 30 % of the 31 million hectares of canola grown globally.

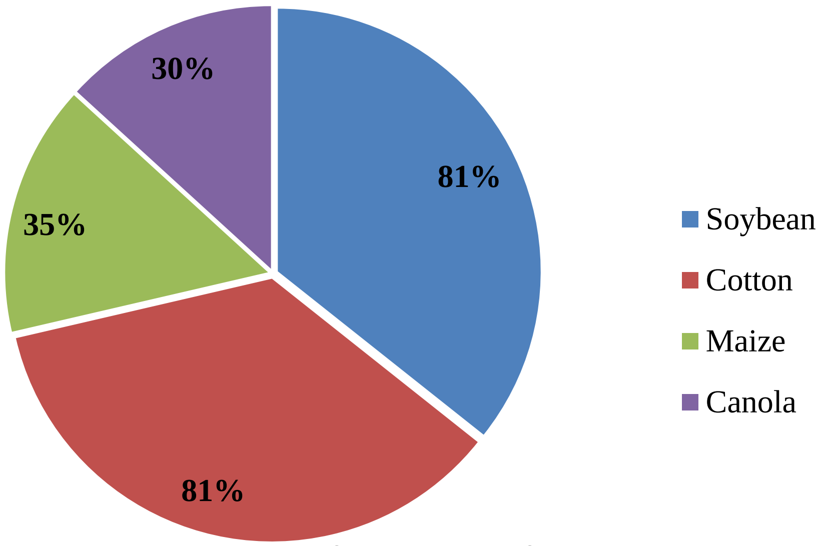


Figure 1.3: Biotech Crop Area as % of Global Area of Principle Crops, 2012 (Million hectares)

(Source: James Clives, 2012)

Table 1.3: Dominant Biotech Crops Planted By The World in 2012

Crop	**Million Hectares**	**% Biotech**
Herbicide tolerant soybean	80.7	47
Stacked traits maize	39.9	23
Bt cotton	18.8	11
Herbicide tolerant canola	9.2	5
Herbicide tolerant maize	7.8	5
Bt maize	7.5	4
Stacked traits cotton	3.7	2
Herbicide tolerant cotton	1.8	1
Herbicide tolerant sugar beet	0.5	<1
Herbicide tolerant alfafa	0.4	<1
Others	<0.1	<1
Total	170.3	100

(Source: International Services for the Acquisition of Agri-biotech Applications, 2012)

1.3 Malaysian Biotechnology Development

Malaysia aims to use biotechnology as a vehicle of economic growth by the year 2020 (Firdaus-Raih et al., 2005; BIOTEK, 2010) with the introduction of the

Malaysian Biotechnology Policy which is divided into three phases - Phase I (2005-2010), Phase II (2010-2015), and Phase III (2016-2020) (MABIC, 2010). The first phase, accomplished in 2010, consists of research and development (R and D), technology development, and promotion of biotechnology programs (BIOTEK, 2010).

During this period, the government took a promotional step by actively introducing biotechnology in the high schools throughout the nation (Firdaus-Raih et al.,2005), established BiotechCorp (Malaysian Biotechnology Corporation) as the primary centre for the development of the biotechnology industry in the country, provided various fiscal and tax incentives to biotechnology companies, granted the BioNexus status (BIOTEK, 2010) and introduced several grants which are ScienceFund, Technofund, Innofund, e-Content and DAGS Roll Out in order to financially support the studies and local projects from research and development to commercialization stage (MOSTI, 2010).

Being an agriculture-based nation, the strength of Biotechnology in Malaysia is in the agricultural biotechnology (green biotechnology) which is foreseen as a potential powerful tool to ensure food security and to boost the country's economy (Latifah et al., 2007). Even though modern biotechnology products developed by Malaysian researchers are not yet planted and commercialized, but the action is almost evident. One of the researches focused on the development of delayed ripening of papaya, which has already been approved by the Genetic Modification Advisory Committee (GMAC) for contained field trials (Latifah et al., 2011). In fact other GM products from other countries are slowly coming into the country. In 2004, the only agricultural product available in the Malaysian market was Glyphosate resistant soybean (Latifah et al., 2007). However, it is no doubt that GM maize has already entered the market since RoundupReady™ maize and YieldGard™ maize (all released by Monsanto) have already been approved for imports into the country (Hoh, 2010).

Espicom (2008) estimates that the Malaysian biopharmaceutical market would be at US$75 million in 2008 and believes it will rise to US$132 million by year 2013. At least twenty six biopharmaceuticals products of modern biotechnology techniques were already registered with the Ministry of Health of Malaysia for use in this country (Latifah et al., 2007). The therapeutic values of the biopharmaceutical products range from different types of insulin for the treatment of diabetes, growth hormones, drugs for the treatment of various kinds of cancers, hepatitis, infertility, autoimmune disorders, organ transplant and infectious diseases (Latifah et al., 2007). The first biopharmaceutical plant was opened in Nilai, Negri Sembilan in June 2006. Fully owned by a local biotechnology firm Inno Biologics Sdn Bhd, which encompasses gene cloning and expression in CHO cells and novel cell expression systems, bioprocess development, and cGMP biopharmaceutical manufacturing (Potera, 2010), the plant will help the country to save up to 30% on biogenerics-based drugs in addition to capitalize the fact that global industry players are now seeking the new markets.

1.4 Malaysia and Food Biotechnology

Modern biotechnology or most commonly referred to as biotechnology is the use of skills to operate organism’s genes for particular practices and generally for industrial reasons. According to the United Nations (2000), at Cartagena Protocol on Biosafety, modern food biotechnology was well-defined as an in-vitro nucleic acid method that includes injection of DNA into organic cells or fusion of cells beyond those currently identified as taxonomic family that changed the natural physiological obstacles and hence are not methods used in traditional breeding or selection.

In Layman’s explanation, the systems used for biotechnology include surgical accuracy technology to specifically remove precise strain of alien DNA into another cell to produce new kinds of species with desired characteristic. Biotechnology was recognized as one of the principal tools that can speed up Malaysia’s transformation into a vastly developed nation by 2020 (Latifah et al., 2006). Malaysia was the first Southeast Asian nation to approve a plant biotechnology product for the import of Roundup Ready soybeans in 1997 (Fuller, 2002).

According to Consumer Association Penang CAP (CAP, 2009) and NRE (Ministry of Natural Resources and Environment, 2009), there are already five endorsed transgenic crops in Malaysia. The approved transgenic crops include Roundup Ready soybean, MON 810 maize, MON 863 maize and NK 603 maize for purpose of food, feeding and processing, as well as ice structuring protein derived from a GM yeast, for ice-cream production.

Table 1.4: Approved transgenetic goods and products in Malaysia

Event	Producer	Purpose	Description
Roundup Ready Soybean	Monsanto	Food, feed and Processing (FFP)	An herbicide (Glphosate) tolerant soybean variety of soybean created by transferring modified genes from soil bacterium
NK603 Maize	Monsanto	FFP	Maize tolerant to the herbicide glyphosate produced through the introduction of modified genes from Bacterium Maize designed to resistance attack by the corn borer (insects) by inserting modified bacterium genes.
MON810 Maize	Monsanto	FFP	Maize resistant to corn root worm produced by transferring bacterium genes
MON863 Maize	Monsanto	FFP	ISP produced by manipulating yeast cell (Recombinant Baker's Yeast) used as a processing aid in frozen products to control ice crystal size, shape and growth
Ice-Structuring Protein (ISP) produced in Food	Unilever Malaysia	Ice structuring Protein	In the preparation of ice-cream

(Source: Ministry of Natural Resources and Environment, 2009)

It is noteworthy that the genetic modification of plants in Malaysia has existed since the early 1990's with a huge backing and support from global institutions such as the Australian Centre for International Agriculture Research (ACIAR), International Service for the Acquisition of Agri-biotech Applications (ISAAA) and the Rockefeller Institute. The Initial stage of biotech food research was based on disease resistance capacity and post-harvest quality of domestic crops, however latest studies have moved towards nutritional development. Current efforts include finding a set of molecular markers to classify the weedy and cultivated rice and reducing the interference of production due to harmfulness of weedy rice (Cohen and Paarlberg, 2002).

1.4.1 Status of GM Foods in Malaysia

The biotechnology industry is expanding and offers the market potential for highly attractive products that have economic as well as environmental benefits. Biotechnology is trying to reduce the use of pesticides and increase the farmers' revenues by improving the nutritional quality of food. However, food biotechnology, in general, is relatively new in Malaysia, although food and food ingredients produced by traditional biotechnology such as fermentation technology have brought to market products like soy sauce, yogurt, nata, tempeh, tapai and budu. A number of industries producing sweeteners and food additives based on fermentation have been in existence for decades in this country.

Several genetically modified crops containing traits of value have been produced at the experimental stage although Malaysia has not yet produced a biotechnology crop commercially. At the Malaysian Agricultural Research and Development Institute (MARDI), rice has been successfully modified to resist the tungro virus and papayas manipulated to resist ring-spot virus infection and to have a prolonged shelf life. Other crop plants which have already been approved by the GMAC for contained field trials including pineapples are manipulated to resist "black heart", bananas and papayas for delayed ripening, and chilli for virus resistance (Musalmah, 2006). Though Glyphosate resistant soybean entered Malaysian markets in 2004 (Latifah et al., 2007), it is obvious that GM maize has already entered the markets since YieldGard^{TM} maize, RoundupReady^{TM} maize and YieldGard^{TM} maize (all released by Monsanto) have already been approved for imports into the country (Hoh, 2010).

To streamline biotechnology research, seven Biotechnology Cooperative Centres (BCCs) are established. The BCCs have helped to coordinate biotech research in the various research organizations and improve cooperation and reduce duplication. The seven BCCs are listed here:

i. Molecular Biology Cooperative Centre University Malaya (UM) and University Kebangsaan Malaysia (UKM)
ii. Plant Biotechnology Cooperative Centre Malaysian Agricultural Research and Development Institute (MARDI)

iii. Animal Biotechnology Cooperative Centre Universiti Putra Malaysia (UPM)
iv. Medical Biotechnology Cooperative Centre Universiti Malaysia Sarawak (UNIMAS) and Institute of Medical Research (IMR)
v. Environmental or Industrial Biotechnology SIRIM Cooperative Centre
vi. Biopharmacy Cooperative Centre UniversitiSains Malaysia (USM)
vii. Food Biotechnology Cooperative Centre Universiti Putra Malaysia (UPM) and Malaysian Agricultural Research and Development Institute (MARDI).

Malaysia is also developing genetically engineered oil palm, with a focus on increasing value-added products from the palms, such as high oleate and high stearate oil, nutraceuticals (vitamin A and E), biodiesel and bioplastics. Several animal recombinant vaccines have been produced to assist the development of animal husbandry. Through biotechnology, research is underway in Malaysia to generate cheaper domestic livestock feed to reduce the high costs associated with imported feed.

In Malaysia, the focus of biotechnology work is on the needs of the nation to improve the food production. The economic crisis in the late ’90s has prompted the Government to take a second look at the importance of agriculture especially in food production which can contribute to the national economy. The Government has stressed the need for producing sufficient food for national security and stability. Therefore, the Government is aware of the benefits of genetically modified (GM) crops. At the same time, their impact on consumers as well as producers is recognized.

The Government is aware of food safety and the potential risks of transgenic food crops. At the same time, the government has the responsibility to assure the public of the food safety and the “halalness” of the genetically modified crops and ensure the genetic modified food do not have any adverse effects on human health and environment. Thus, a Genetic Modification Advisory Committee was established under the National Committee on Biodiversity, Science, Technology and the Environment Ministry. The committee’s role is to ensure that risks associated with the use, handling and transfer of Genetically Modified Organisms (GMOs) are identified and safely managed, and to advise the Government on matters relating to the GM technology and its application (Musalmah, 2006).

Malaysia aspires to be a biotechnology hub and this is clearly spelled out in the National Biotechnology Policy that was launched on the 28th April 2005. It is estimated that by 2020, the biotechnology sector would create 280,000 jobs and contribute five per cent to the country’s Gross Domestic Product. Total investment under the National Biotechnology Policy is expected to be around RM30 billion (US$7.9 billion). According to the Ninth Malaysia Plan, a total of RM2.1 billion has been allocated for biotechnology. Out of this, an initial RM300 million has been allocated to Malaysian Biotechnology Corporation to initiate commercialization, technology acquisition, entrepreneur development and for the development of intellectual property framework.

As the GM foods are relatively new to Malaysian consumers, the National Biotechnology Directorate is stepping up its efforts to implement public awareness programs on biotechnology. The programs include arranging lectures at public forums and schools, preparing and distributing pamphlets about biotechnology, and promoting a better understanding of biotechnology through the media. Thus, this study will attempt to conduct a consumer research to provide insights on how consumers in Malaysia perceive the use of biotechnology to produce foods and how likely consumers are to accepting the various benefits biotechnology derived foods may bring.

1.4.2 National Biotechnology Policy

Malaysia seeks to be a biotechnology hub at the international level and has established a number of national policies to transform biotechnology sector into an engine for economic growth. It is worth mentioning that Malaysia spends RM 13billion yearly on imported food (Ministry of Domestic Trade, Cooperative and Consumerism, 2012). This amount mentioned is growing every year and that makes Malaysia a net food importer. Global catastrophes like flood, earthquakes, and wars have an imminent influence on food prices in Malaysia.

To report food security issues, agricultural research is of preference and several universities and research institutes have ongoing researches ranging from food and commodity crops to vegetable and fruits, using techniques like conventional breeding, marker assisted selection and genetic modification techniques. On the light of the above mentioned development that this sector is promising, the Malaysian government too has placed a high importance on the agriculture biotechnology sector through numerous policies including National Biotechnology Policy, which consists of nine themes and has three phases. In the first phase of the policy which was accomplished in 2010, the Malaysian government carried out a campaign by actively launching biotechnology into the classrooms of high schools throughout the country (Firdaus-Raih et al., 2005), established BiotechCorp (Malaysian Biotechnology Corporation) as the main body for biotechnology industry development in this country. In addition, the government offered different fiscal and tax incentives to biotechnology companies and granted them the Bio Nexus status (BIOTEK, 2010), as well as launching a number of grants which are Science Fund, Technofund, Innofund, e-Content and DAGS Roll Out (MOSTI, 2010). Other policies include National Biomass Strategy (Agensi Inovasi Malaysia, 2012), Economic Transformation Programme (Performance, Management and Delivery Unit, 2012), and the 10-year Malaysian Plan (Economic Planning Unit, 2012). Malaysia National Biotechnology policy is underpinned by nine policy thrusts, including:

Thrust 1: Agriculture Biotechnology Development
The policy will transform and enhance the value creation of the agricultural sector through biotechnology.

Thrust 2: Healthcare Biotechnology Development
The policy on the second thrust is to capitalize on the strengths of biodiversity to commercialize discoveries in natural products as well as position Malaysia in the bio-generis market.

Thrust 3: Industrial Biotechnology Development
The third thrust ensures the developmental opportunities in the application of advanced bio-processing and bio-manufacturing technologies.

Thrust 4: R & D and Technology Acquisition
This thrust is to establish centres of excellence, in existing or new institutions, to bring together multidisciplinary research teams in co-ordinates research and commercialization initiatives. Also, on this stage, it is expected to accelerate technology development via strategic acquisitions.

Thrust 5: Human Capital Development
On this thrust is to build the nation's biotech human resource capability in line with market needs through special schemes, programmes and training.

Thrust 6: Financial Infrastructure Development
The sixth thrust will be able to apply competitive "lab to market" funding and incentives to promote committed participation by academia, the private sector as well as government-linked companies, and also to implement sufficient exit mechanisms for investments in biotech.

Thrust 7: Legislative and Regulatory Framework Development
The thrust will enable to create an enabling environment through continuous reviews of the country's regulatory framework and procedures in line with global standards and best practices. Develop a strong intellectual property protection regime to support R & D and commercialization efforts.

Thrust 8: Strategic Positioning
The thrust is to establish a global marketing strategy to build brand recognition for Malaysian biotech and benchmark progress. This will enable to establish Malaysia as a centre for contract research organizations and contract manufacturing organizations.

Thrust 9: Government Commitment
The last thrust is meant to establish a dedicated and professional implementation agency overseeing the development of Malaysia's biotech industry, under the supervision of the Prime Minister and relevant government ministries.

Currently, the Malaysian National Biotechnology Policy has entered the second phase (2010-2015) (MABIC, 2005) considering that the resource, industry and human power are established adequately to produce biotechnological invention or services that will be able to change from the lab to the market. However, inadequate public knowledge on GM foods has added doubts for policy makers to implement the National Biotechnology Policy that started in 2005 to develop the life value of Malaysians by contributing to the national income and producing more job chances (ISAAA, 2010), as shown in Table 1.7. Thus, by making appropriate marketing decisions the stake holders will be able to follow the guidance of the national policies and ensure services and products that bring net benefits to the Malaysian public. In addition, the course Malaysia takes for GM food products is expected to affect the decisions and approaches in the neighboring nations as well.

Table 1.5: National Biotechnology Policy- The Development Goals (2005-2020)

Development Goals	Phase I (2005-2010) Capacity Building	Phase II (2011-2015) Science to Business	Phase III (2016-2020) Global Business	Progress To-date 2009*
Investment by Government and private sectors				
USD billion	1.7	2.6	4.3	1.3
RM billion	6	9	15	4.5
Total Employment	40,000	80,000	160,000	54,000***
Contribution to GDP (%)	2.5	4	5	2.0***

Sources:

1) National Biotechnology Policy (2005)
2) Biotech Crop
3) Job Street Malaysia

* Estimated for 2009

** Total employment figure covers the life science and biotechnology-related industry

*** Estimated based on revised assumptions

Moreover, the Malaysian government seeing the importance of the biotechnology industry introduced the ninth and tenth Malaysia plan. In the ninth plant, 349 biotech companies, mostly in agriculture, industry and health invested a total of RM 4.5 billion in biotechnology sector. This investment was in a range of activities including genomic science, stem cells, biodiesel and medical devices, and 170 Bionexus companies were registered. Due to the tremendous development of the sector, progress was achieved in research and development (R& D) by biotech companies, with 650 patents granted for biotech-related research in Malaysia.

This is followed by the tenth Malaysian plan, which is in synchrony with the 2nd phase of National biotechnology policy NBP "Science to Business". Within this plan, the biotechnology industry is expected to contribute 2% to GDP, to establish 20 global biotechnology companies and increase in GNI by the year 2020. The tenth Malaysian plan strategies concerning biotechnology sector include establishment of a conductive environment for unleashing economic development, enhancing and holding a first-world talent base and to create selected niche areas alone the global value chain.

1.4.3 Biosafety Act

According to Teng (2008), biosafety is known as a broad term that takes into consideration many aspects of safety especially genetically modified organisms. Due to the growing popularity of genetically modified foods in the 1980s and beginning of 1990s, regulatory laws were adopted on both Asia and Latin America GMO producing countries to regulate biosafety issues and the discharge of GMO's. Currently, there are international organizations and instruments dealing with biosafety issues. These include though not limited to Cartagena Protocol on Biosafety (CBD), codex alimentarius and International Standard organization (ISO). Malaysia ratified the Cartagena Protocol on Biodiversity in 2003, which is the first legally binding international agreement governing transboundary movement of living modified organisms (LMOs). Under the protocol, which came into force on 11 September 2003, helps to ensure the safety handling, transfer and use of LMOs.

A potential side effect that may result from the adoption of new technologies is always a major concern to the consumers'. Concerns associated with the enhancement of crop plants can be divided into two broad groups: biosafety and bioethics, including the religious concerns. Biosafety fears include the concerns linked with the potential negative impact of modern biotechnology over its potential adverse effects on biological diversity.

In Malaysia, the Biosafety Act was enacted by parliament in 2007, and came into force in December 1, 2009, on which section 61 requires the identification and labeling of living modified organisms (LMOs) and their products, including genetically modified (GM) food. The Act regulates the release, importation, exportation and the ingredients of living modified organisms and the release of the products of such organisms, with the objective of protecting human, plant and animal health, the environment and biological diversity. In Malaysia, the Biosafety Act comprises of 7 parts that each part gives the accurate information to the respective activities. Part 1 familiarizes the Act including citation and commencement, non-application, interpretation as well as the cost affecting the activities that will be executed. In part 2, the formation of an institutional biosafety committee is further explained and the endorsement for future release and importation of living modified organisms will be explained in part 3. This is then followed by the information relating on authorization of certificate of validation, and finally in part 4 and 5. The process for petition and miscellaneous are further discussed in part 6 and7. A study conducted by Rusly et al., (2011), concluded that the great demand to establish biosafety education in Malaysia, and that biosafety aspect such as food, health, agriculture, and environmental safety issues have to be added to enable the curriculum will go beyond biotechnology applications.

1.4.4 Halal Status of GM Foods

The concept of "Halal" is considered central from the perspective of science and religion that covers concerns such as cleanliness, ethical values and food safety, not only in the Islamic world but also in other societies. Basically, "Halal" means "permitted" and opposite to "Haram" which means forbidden. In other words, they represent what is known as permissible and legitimate or not based on the instructions from God. From the perspective of the Holy Quran, everything is permissible or Halal unless it is clearly determined to be Haram. Genetic engineering is considered as a tool for production of food, medicine and industrial products and services for human welfare. Since the arrival of genetic engineering products such as GM foods in the Muslim markets, there has been a growing opposition from some Muslim consumers concerning the safety as well as their conformity with sharia.

According to International Workshop for Islamic Scholars on Agribiotechnolgy; Shariah compliances held on Penang indicates that Halal issues in genetic engineering, on foods derived from modern biotechnology, can be categorized as:

1- Products derived from transferring genes from Halal origins into Halal recipients; e.g. products of transferring genes from wheat to rice where all the elements used during genetic engineering process are considered "Halal".
2- Products derived from transferring genes from Haram origin into a Halal recipient; e.g. products of transferring genes from pig, or other Haram animal, or Halal animal not properly slaughtered into a Halal entity such as rice or wheat.
3- Products derived from transferring genes into Haram recipients; e.g. the product of transferring gene from rice into any Haram animal, such as pig.
4- Products with mixed Halal and Haram origins.

Based on the above points, food products derived from modern biotechnology are "Halal" and there is no objection in the use of derived food products and they are permissible and could be labelled as "Halal". On the other hand, the developments in food technology and biotechnology are also important to Muslims in Malaysia. Muslims are currently open to more different ingredients and processed foods that may be of questionable halal status. This case puts extra emphasis on the halal issue. Moreover, permissibility of the products (foods, drinks and medicines) are not the only worries among Muslims in this country. They are similarly having concerns on the safety and nutritious contents of the food consumed.

Most interestingly, almost all Islamic countries import directly or indirectly and consume large quantities of biotech crops from major biotech crop producing countries such as USA, Argentina, Brazil and Canada. Table 1.8 indicates some of the Islamic nations and the source of their imported oil seed, edible oil and maize. Most of the Islamic countries import a key part of their edible vegetable oil and animal feed (maize).

Table 1.6: Source of vegetable oil, oil seed and Maize imported by selected Islamic Countries

Country	Oil and Oil Seeds	Cereal
Iran	Argentina, Brazil, second hand	
Egypt	USA, Argentina, Canada, Brazil	
Turkey	Argentina, USA, Brazil	
Saudi Arabia	Brazil, USA, Second hand	USA, Argentina
Syria	Argentina	
Jordan	USA and Second hand	USA, Argentina, Brazil
Sudan	Second hand	USA (Corn) and Second hand
Oman	Argentina, UAE, USA, Saudi Arabia, Brazil	USA, Argentina, Brazil
Algeria	Argentina, USA, Brazil	Canada, Argentina, USA, Brazil
Malaysia*	Indonesia, Argentina	Vietnam, Australia, Brazil

* Malaysia is a net vegetable oil (Palm oil) exporter, but still imports CPO to be refined to PPO from Indonesia
(Source: Behzad, 2011)

According to the Population and Housing Census 2010 figures, nearly 61.3% of the 28.3 million population of Malaysia practice Islam (Department of Statistic, 2010). The figures strongly back the reason as to why the acceptability of foods, drinks or medicines is so crucial to the Malaysian Muslim community. Therefore, it is of great importance to clarify the relation between biotechnology-based products such as foods, drinks and medications with the halal characteristics, and related issues on biotechnology and Islam, especially those concerning the fatwa on biotechnology-based products (consumable products) in Malaysia.

Fatwa or an Islamic ruling is defined as a scholarly opinion on a matter of Islamic law to provide guidance to other scholars, judges and citizens on how delicate issues of Islamic law should be understood, interpreted or applied. The issuance of Fatwa in Malaysia is carried out by the government institution named the National Fatwa Committee, formed in 1970, under the National Council for the Malaysian Islamic Affairs. The Fatwa Committee is recognized by JAKIM and is appointed by the Council of Rulers, on which issuing Fatwa is assisted by World Fatwa Management and Research Institute (INFAD).

In Malaysia, there is only one fatwa that is closely associated to biotechnology and consumable products. The fatwa was issued in Special Conference of the National Fatwa Committee in Malaysian on July, 12, 1999. The fatwa rules that:

1- Goods, foods and drinks which are made through the process of the pork's DNA biotechnology contravened with the *syara'* is prohibited.
2- Using the pork's DNA biotechnology in the goods, foods and drinks industries that did not yet reached the level of *dharurat* (emergency) as there are many other alternatives.
3- This *ijtihad* is based on the Islamic jurisprudence as regards: "preventing harm takes precedence over gaining or attaining benefits".

1.4.4.1 GM food Labelling in Malaysia

GM food labelling system should be adopted in order to effectively handle the detection of GM food in Malaysia. An appropriate yet cost effective method must be used to regulate the GMO contents of a food product which are within or above the mandated threshold level (Kaur et al., 2010). An analytic technique known as real-time polymerase chain reaction (PCR) which first amplifies specific DNA sequence of food sample and then requires the specific transgenetic DNA sequence at the amplified sequence were introduced to determine the strain and the quantity of GMO present in an food sample (Abdullah et al., 2006).

Similar techniques were employed and explained by Kaur et al. (2010) to detect GM maize in processed feeds commercialized in Malaysia. Out of 103 processed feed samples, 27 of it were tested positive of GM material while for 20 maize samples, 13 were tested positive for GM material. According to quantification of GM levels in the samples, processed feed samples has decreased levels compared to raw maize due to processing possibly contributed to fragmentation of some DNA sequence. Concentrations of MON810, NK603 and GA21 were discovered in both feeds and maize in Malaysia.

The concentration of MON810 in raw maize and feeds were 34.8-69.8% and 0.3-48.2%. Concentrations of NK603 in maize and feeds are documented in the range of 5.4-31.2% and 2.7-20.9% while 4.7-17.2% and 7.5-8.7% of GA21 are spotted in both maize and feed samples. Only one feed sample had MON863 content of 16.1%. It is mentioned that if Malaysia is to emulate the EU, Japan and Korea Republic to label GM food products, all the detected 27 feed samples and 13 maize samples bought from local animal feed outlets must be labelled as the labelling threshold for EU, Japan and Korea Republic or 0.9, 5 and 3% respectively (Kaur et al., 2010). If the result from the studies is extrapolated to the real market situation in Malaysia, nearly 10 to 45 percent of the local soy and corn based foods possibly contain GM material without any labelling or any other relevant consumer information attached. Summary of the GM detection research carried out is presented in Table 1.7.

Table 1.7: Selected Foods and Feed Products Detected for GM Ingredients in Malaysia

Products	Purpose	No. of Samples	Positive result (GM)	Ratio (%)	Detected GM material	Levels (%)
Soybean	Food	20	9	45	EPSPS,RR	N/A
Soy flour	Food	5	0	0		N/A
Tofu	Food	37	8	21.62	EPSPS,RR	N/A
Fucuk	Food	10	0	0		N/A
Tempe	Food	8	1	12.5	EPSPS,RR	N/A
Soy sauce	Food	5	0	0		N/A
Maize	Feeds	103	27	26.21	MON810,NK603,GA21	4.7-69.8
Feeds	Feeds	20	13	65	MON810,NK603,GA21,MON863	0.3-48.2

(Source: Adapted from Kaur et al. and Abdullah et al. 2010)

1.5 Problem Statement

As applications of biotechnology in food products become more frequent, consumers deal with new possibilities, difficulties, and risks/benefits associated with GM foods. Some consumers, however, view biotechnology techniques as a dangerous process. Approval of GM foods is associated with the consumers' risk/benefit values about GM foods. When customers understand its advantages for themselves and the community, they will be more willing to buy GM foods, compared to consumers who understand few of the advantages.

However, if consumers understand GM foods as a threat to environment, they would be less willing to purchase them. Contextually, consumers' risk/benefit values of GM foods are required to play an important part in identifying their buying behaviour toward GM foods. GM food productions have become phenomenal in the world, especially in the developing countries; and as a result, gene technology in food production becomes more prevalent. Notwithstanding, the concept of GM food is still very new to Malaysian people, and the market for GM foods is still at the introductory stage in Malaysia.

Food safety is increasingly essential for consumers purchase decision making. It is evident that knowledge about GM food industry aid consumers to make informed decisions about the safety of the foods they eat. It is also argued that, in order to enhance public understanding towards this technological innovation, information discussing process must be effectively made. Deficiency of knowledge will only slow down the development of the biotechnology industry and may result in misunderstandings of its use. Consumers nowadays are more conscious about the health aspects of new food products and are having greater interest in maintaining a healthy lifestyle and diet.

Labelling of GM foods is very crucial for the GM food manufactures, as to which is consumer demand especially health conscious consumers, religious, ethical or moral concern consumers. From consumer's perspective, mandatory labelling for GM foods is essential so that consumers can choose whether or not they want to consume or use GM foods. Labelling will also serve to inform the consumers about the GM food content, and would also serve to warn those who have health concerns. Given the advantages of labelling of GM foods and the government emphasis on the biotechnology industry, it is still doubtful if consumers are willing to pay a premium price for GM foods.

As a result of this awareness, consumers are embracing the results of food claims, which have a direct effect on their purchasing of foods, and in particular GM foods. In addition, different views exist on GM food consumption among consumers, and the variety of choices available in the market has made the issue of GM food an interest to consumers' food purchasing concern. It must not be forgotten that, Malaysia is a developing country in the middle of implementing its National Biotechnology Policy.

Many previous studies have shown a positive correlation between consumers' perceptions and GM food consumption. This means they perceived GM food as a route towards healthier food with higher efficiency, environmentally friendly quality and benefits for the farmers. On the other hand, those who criticize GM foods consider it as a serious threat to health and environment in the long run, due to genes manipulation. However, there is a need to determine the extent to which Malaysian consumers are actually aware of GM foods and also the underlying advantages which come with this concept.

GM foods are at the introductory stage in Malaysia and unlike other food products, GM food present distinctive characteristics. Nevertheless it is curtail to find how Malaysian consumers perceive these products. Despite scientific uncertainties of GM foods, it is crucial to understand the extent to which the Malaysian consumers are aware of these products and how their perceptions affect them in accepting or rejecting the GM foods as part of their daily diet. Therefore this study will try to answer questions regarding the consumers' characteristics and demographic factors and their perception and awareness of GM food products in Malaysia.

1.6 Objectives of the Study

The general objective of this study is to determine Malaysian Consumers' perception towards genetically modified foods.

The specific objectives are:

1) To identify the dimension of consumer perception towards GM food.
2) To determine the relationship between consumer socio-demography and consumer perception and awareness towards GM food.

1.7 Significance of the Study

The launch of biotechnology for agricultural production is considered to be major benchmarks, and it's usage for the production in food and agriculture has improved greatly during the past decade. The overall use of genetic modification on agricultural crops is regarded as one of the most crucial, yet controversial developments in science and technology.

GM food ensures sustainable food production for the fast growing world population, thus creating market opportunities for farmers and food processors to produce and market. An increasingly consumer who are more concern on food safety, food quality, labelling, nutrition and value-added enhanced qualities also creates opportunities for agricultural biotechnology expansion.

The study will broadly explore the awareness, perceptions and acceptance of market players regarding genetic modified foods. This will provide valuable information for the market players who are involved in the food industry to promote genetically modified foods in the local market. Consumers are concerned about the food products from the biotech industry, and how they give importance on the side effects they cause. It is also important to the biotech industry as there is a growing concern among consumers which shows the importance of food safety, environmentally friendly products and health food products from the biotech industry.

The study will also shed light on the need to increase knowledge on genetically modified foods among the consumers and identify the factors influencing consumer's perceptions. The overall result of this study will be used to improve the awareness, perception of Malaysian consumers towards food biotechnology, since the attitude of the consumers for the safety of the food supply and food labelling is less towards the genetically modified foods.

1.8 Organization of the Thesis

The thesis is composed of five chapters. Chapter one highlights the background of the study and the problem formulation. Chapter two discusses a review of literature on the previous studies and discussions on the consumer's awareness, perceptions and acceptance of genetically modified foods. Chapter three explains the methodology and tools of analysis for this study. In this chapter, each variable and determinants are theoretically discussed and sample procedures and the data collection process is explained. Chapter four displays the analysis and results of the study. Finally, chapter five explains the findings of this study and includes related recommendations, limitations and conclusion.

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