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Genetically Modified Organisms (GMOs) and the Issue of Safety and *Halal* in Malaysia

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ABSTRACT

To achieve its aim to be a developed nation in 2020, Malaysia has envisaged biotechnology as an important field to be focused as a new engine for economic growth. This is evidenced through the introduction of National Biotechnology Policy 2005 where a special focus will be given to the development of agriculture, and industry. Genetically Modified Organisms (GMOs) is one of the products. Much ado has been said to the development of GMOs and most of consumers are very concern on the safety and the *halalness* of the products. This paper is an attempt to highlight the development of GMOs and some issues that relate to the safety and the *halalness* of the products in Malaysia. To achieve this objective data was collected from both conventional and Islamic sources. This includes policy papers, rules and regulations that relate to the governance of GMOs in Malaysia, and Shariah materials which include classical literatures as well as current fatwas on the issue. The paper concludes that although some mechanisms have been introduced to govern GMOs in Malaysia there is still lacking on the part of the Shariah standards that can be used as a reference in order to govern the practice of GMOs. It is suggested therefore that Shariah standards be developed so as to be incorporated in the existing mechanisms in order to sure that the products are not only safe but also *halal* to consumers.

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INTRODUCTION

Biotechnology is one of the potential sectors being developed in Malaysia. The government has put much effort to ensure that the sector is well developed to provide a better life to the people. This can be seen through the establishment of The National Biotechnology Policy in 2005. One of thrusts that is being focused by the government is to develop the Genetically Modified Organisms (GMOs) for a better life to the people. However, being new the GMOs are not free from criticisms. Consumers still hesitate to take the GMOs products due to the safety and the *halal* status of the products. Thus, to convince the consumers that the products are *halal* and safe to be consumed, it seems that a proper governance and effective enforcement of existing rules and regulations are important. This paper is an attempt to highlight the development of GMOs and some related issues with regard to the safety and the *halalness* of the products in Malaysia.

Historical Development of GMOs:

Biotechnology is a science that combines the biology and technology together used to modify organisms or products of an organism in order to produce better products for the use of the people. This is in line with the definition of the United Nations where biotechnology is known as any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use (Convention on Biological Diversity, 2012). Rastogi (2007) has further elaborated that biotechnology is an application of biological processes to the production of materials to be used especially in medicine and industry. As such, genetic engineering will be the main stream of biotechnology which produces GMOs such as pest resistance crops, increase antioxidants, micronutrients of fruits (Lemaux, 2006) and pharmaceutical products such as vaccine (Houdebine, 2009).

The development of biotechnology has started since 4000 BC when the Egyptians have found alcohol and bakeries production through the process of fermentation (Fiechter and Bayeler, 2000). As the time goes by, the technology becomes more sophisticated where many new discoveries have been made by scientists (Robert,

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1989). Modern biotechnology involves the application of cellular, molecular and genetic processes in the production of goods and services involving high technology tools and machines such as Polymerase Chain Reaction, gene gun, electrophoresis and complex material such as recombinant DNA, cell fusion and engineered protein (Zika *et al.*, 2007) to produce GMOs. Scientists believe that modern biotechnology is becoming the backbone of the field since the field is too wide to be explored (Henk, 2009). At this point, modern biotechnology basically deals with the deoxyribonucleic acid (DNA) of an organism after the discovery of the information regarding the DNA by Watson and Crick in 1953 (Organisation for Economic Co-operation and Development (OECD), 1999; Marzukhi and Umi Kalsom, 2005). Specific tools are used to modify the genetics of organism (Backman, 2001) thus altering the protein to make changes on the characteristics of the organism itself (Keener *et al.*, 2012). The modification that is done through genetic modification processes and it usually does not occur in natural way either by mating or natural recombination process (Lin, 2011).

As far as GMOs is concerned, the main purpose is to improve human life through improving crops, health and industrial sectors (Keener *et al.*, 2012). The scientists however have put some basic guidelines on the development of the GMOs. These include the GMOs should be beneficial to human, do not cause risk to human and environment and to promote justice and fairness to people (Christensen *et al.*, 2002). Latifah and Jamaluddin (2004) have further stipulated that the development of GMOs should not be separated from the social and ethics theories such as rights theory, theories of justice, consequentialism and utilitarianism, precautionary principle, environmental ethics and religion. In other words the development of GMOs should be made in the manner that it gives benefit but not harm to human.

The Application of GMOs in Agriculture and Health Sectors:

Generally speaking, GMOs is broadly applied in agriculture and food industry. Through GMOs the scientists are able to produce better food, crops and animal to be consumed by man (Hulse, 2004). At this point, Prakash (2011) suggests that GMOs has contributed a lot in improving the life of the people especially in the Africa by improving the agriculture sectors and gives more production to feed the citizens. The GMOs has also contributed to the development of transgenic crops and animals including livestock, poultry and fish and this helps the farmers in term of increasing quality and production of food (United Nations Environment Programme, 2006). Transgenic crops have been used to help farmers to overcome problems of pests and insects without depending on pesticides and insecticides (GRAIN, 2004; Kaskey, 2009) thus reducing bad effects of hazardous chemical materials to humans (Bolognesi and Merlo, 2011). Besides, Genetically Modified (GM) crops have also a better resistance over extreme condition (Keener *et al.*, 2012) and produces higher yield and more nutrients (Lin, 2011; James, 2003). This has been practiced in India and it showed an increase of 80% of cotton whenever the farmers use GM cotton instead of a normal one (Qaim and Zilberman, 2003).

Research in medical has also intensively conducted by scientists to look for chances to improve the sector through modern biotechnology. It was reported that the practice of medicine has been revolutionized through modern biotechnology (Márcio, 1999). Recombinant DNA techniques, monoclonal antibody technology and high technology instrument play very important role to improve the medical field (Hood, 1988). Scientists do apply modified organism in research regarding the development of new pharmaceutical drugs, antibody and gene therapy and also to improve the original ones (Rastogi, 2007).

The Issues of Safety and Halal in GMO Products:

Although GMOs accords with some benefits to human, yet there are some arising issues that worry the people. According to World Health Organization (WHO), these issues include the safety of the products, effects on the environment as well as religious and ethical requirements. Many discussions and debates have been organized around the world to look for the best way of practicing GMOs (Rigaud, 2008).

Controversy over GMOs began to attract people's attention after the issue of the monarch butterfly in New York affected by GM corn (Losey *et al.*, 1999; Hellmich *et al.*, 2001). Although the GM corn was not intended to harm butterflies it has poisoned the larvae of the butterflies thus reduced its population (Hellmich *et al.*, 2001). Since then, GMOs becomes a controversial topic among the people especially in Europe (Briggs, 2001). In another case scenario a soybean product which has been inserted with nut gene has been removed from the market due to some side effects that harmful to consumers who are allergic to nuts (Whitman, 2000; Skerritt, 2004).

Beside safety, the GMO has also brought to the religious issues. This especially concerns with Muslim consumers where their religion requires that all Muslims should take only *halal* or permissible products. There are some reports quoting that some GMO products contain non-permissible elements like pig gene and gene of un-slaughtered animal (Hazzah, 2000; Rahman, 2009). In addition, human hemoglobin, milk containing human coagulation factor and human-pig organ are also used in some of GMO products (Prather *et al.*, 2008). To the Muslims *halal* is a sensitive issue where all products to be consumed should be free from non-permissible or *haram* materials. Therefore the application of GMOs in the food production should follow the strict requirement of the Shariah law (Regenstein, 2003).

Apart from food, cosmetic products are also seen as a dubious thing for allegedly containing biotech products that are not *halal* (Ehsan, 2008). At this point Hunter (2012) stressed that all ingredients derived from GMOs should be *halal* to ensure that the pharmaceutical products are consumable by the Muslims. In addition, the products must also be validated for their safety because some GMO products might be posing some threat of toxicity or pathogenic (Maizirwan, 2009).

The Development of GMOs in Malaysia:

The Malaysian government gives priority to the development of GMO since it has the potential to become a new engine for economic growth to the country (BIOTEK, 2009). Ministry of Science, Technology and Innovation has allocated a lot of funds to improve biotechnology sector through research and development (R&D) projects. The R&D includes the sectors of agriculture, healthcare and industrial biotechnology, where most of the activities involved the development of genetically modified organisms (MOSTI, 2005).

Considering GMOs as a potential to be developed, Malaysian government has given approval to import GMO products from other countries to be sold in the local market (CAP, 2009). Among these products are the Roundup Ready soya beans, maize MON 810, maize MON 863 and NK 603 (ISAAA, 2011). However, there is some Genetically Modified Food (GMF) that is doubtful of their approval status being sold in the local markets (CAP, 2006). Beside the products that are imported from outside, Malaysia has also developed some GMO products such as recombinant vaccines (Mabic, 2006) and transgenic biodegradable plastic palm oil (Parveez et al., 2000).

The Governance of GMOs in Malaysia:

Taking into account of the risk associated to GMOs, the government has taken an approach where all GMO development should be carried out in a safe manner. As such, to ensure that the practice is safe, in 2007 the government has enforced the Biosafety Act 2007 to regulate all matters that relate to GMOs (Biosafety Act, 2007). This is in line with the initiatives outlined in the National Biotechnology Policy 2005 in which a framework for legislations and regulations need to be developed for the practice of GMOs in the country (MOSTI, 2005). The purpose of Biosafety Act is basically to monitor and regulate the practice of GMOs in Malaysia thus harmless to the consumers as well as the environment.

Apart from Biosafety Act, the government has also enacted some other laws that support the governance of GMOs in Malaysia. These include Plant Quarantine Act 1976 and Protection of New Plant Act 2004. These Acts are enacted to control the activities involving agriculture such as release of new breed resulted from genetic modification process as well as trading (import) of plants from foreign countries. Transgenic plant is one of the categories that highlighted in the Acts. In fact, National policy on biological diversity also emphasizes that any activities involving GMO must follow biosafety guidelines. Besides, the Ministry of Health has introduced new regulations in Food Regulations 1985 to guarantee the safety of food. This is supported by Malaysia Department of Chemistry to identify food containing GMOs' products.

The practice of the GMOs has also attracted the attention from Islamic bodies since the products are subject to *halal* and *haram*. With regard to this, a conference had been conducted by the Fatwa Committee National Council of Islamic Religious Affairs Malaysia on 12th July 1999 to seek resolution about this matter. It was come out with an agreement to allow the use of GMOs' products as long as it follows the procedures set by the committee:

- i. Products, food and drink processed through pig DNA bio-technology is contradictory to Islamic law and it is forbidden;
- ii. Using pig DNA bio-technology in products, food and drink manufacturing does not reach the level of *darura* (necessity) as there is still other alternative which is available;
- iii. This *ijtihad* is based on the *usul fiqh* maxim stating that preventing harm is prioritized than gaining benefit.

The products must also follow the *halal* standards in order to be consumable by Muslim consumers. It is stated in Malaysian standard (MS 1500 2009) that food and drinks containing products and/or by-products of genetically modified organisms (GMOs) or ingredients made by the use of genetic material of animals that are non-*halal* by Shariah law are not *halal*.

Although there are guidelines on the governance of "*halal*" GMO yet the implementation is still vague in order to ensure that the products are safe and *halal*. Until now, there is no comprehensive legislation and policy on GMOs that comply to the Shariah principles (MacKenzie, 2002; CAP, 2009). Presently, the products are not so strictly monitored in terms of originality and status of *halal* and *haram*. An immediate action should be taken by the government to monitor such products especially those imported from foreign countries like US and UK. In addition, although National Food Security Action Plan 2010-2020 does have guidelines to monitor GMO products imported from abroad yet the effectiveness of the implementation is still dubious. Besides that, products' labeling is also not emphasized on GMO products (Sobian, 2009). This will lead to the release of

GMO products into the local market with no adequate information. The introduction of the Biosafety Act 2007 is a good move from the government to regulate the GMOs in the country. The Act however is meant to control GMOs that produced in Malaysia but not from outside. Thus, it seems that the current governance model needs to be improved so that issues that relate to GMO products that plaguing society can be overcome and provide a relief to consumers.

Conclusion:

Production of GMOs seems to benefit human in many aspects of life. However, issues like safety and the *halalness* of the products have raised concerns amongst the consumers when they want to make a decision. The introduction of some regulatory framework in order to govern the GMOs is a good move initiated by the government but an improvement need to be done in order to ensure that the products are safe and *halal* to be consumed. Lacking of *halalan tayyiban* aspects in the current governance should be addressed by the government to protect Muslim consumers from consuming *syubhah* and *haram* elements. Previous studies show that there is an urgent need to develop the Shariah compliance governance of GMOs in Malaysia to ensure that the products are well governed thus protects Muslim consumers from consuming *syubhah* and *haram* things. Incorporation of Shariah elements in the governance of GMOs in Malaysia will provide comprehensive protection towards both to Muslim and non-Muslim consumers. It is suggested however that a further investigation on the regulatory framework is required to improve the governance of GMOs in Malaysia.

REFERENCES

- Al-Jallad, N., 2008. The concepts of al-halal and al-haram in the Arab-Muslim culture: A translational and lexicographical study. University of Jordan. http://elies.rediris.es/Language_Design/LD10/LD_10_02_Nader_Pazeado.pdf.
- Al-Qardhawi, Y., 1995. Halal dan haram dalam Islam. Pustaka Islamiyah Pte Ltd., pp: 15.
- Amin, L., & J.M. Jahi, 2004. Ethical aspects of genetically modified organisms release into the environment. Malaysian Journal of Environmental Management, 5: 99-111.
- Amin, L., N.A.A. Azlan, M.F. Hamdan, A.L. Samian, & M.S. Haron, 2011. Awareness and knowledge on modern biotechnology. African Journal of Biotechnology, 10(58): 12448-12456.
- Amin, L., S.F. Sujak, A.L. Samian, M.S. Haron, M.N. Mohamad, & M.Y. Othman, 2009. Islamic ethics and modern biotechnology. SARI: Jurnal Alam dan Tamadun Melayu, 27(2): 285-296.
- Amin, L., Z.A. Zainol, N.S. Rusly, F. Akpoviri, & N.M. Sidik, 2011. Risk assessment of genetically modified organisms (GMOs). African Journal of Biotechnology, 10(58): 12418-12424.
- Aziz, A.A., & Z.A.M. Hussein, 2009. Impak Bioteknologi ke atas Perlindungan Pengguna: Aspek Undang-undang Berhubung Keselamatan Produk (Biotechnology Impacts on Consumer Protection: Legal Aspects in Relation to Product safety). Jurnal Pengurusan, 29.
- Backman, K., 2001. The advent of genetic engineering. Trends Biochem Sci, 26(4): 268-270.
- Biosafety Act, 2007 (Act 678). Laws of Malaysia.
- BIOTEK, 2009. About us. Retrieved from http://www.biotech.gov.my/index.php?option=com_content&view=article&id=46&Itemid=5.
- Bolognesi, C., F.D. Merlo, 2011. Pesticides: Human Health Effects, In: Editor-in-Chief: Jerome O. Nriagu, Editor(s)-in-Chief, Encyclopedia of Environmental Health, Elsevier, Burlington., pp: 438-453.
- Briggs, H., 2001. The biotech debate: The monarch butterfly. In the BBC News. Retrieved from <http://news.bbc.co.uk/2/hi/science/nature/1298397.stm>.
- Chowdhury, A.Y.T., 2004. The halal and haram in business transactions. Derived from <http://www.iisna.com/business%20transactions%20-%20part1.pdf>.
- Christensen, R., J. Davis, G.M.P. Ochoa, & W. Schmit, 2002. Biotechnology: An Overview. European Investment Bank.
- Consumer Association of Penang (CAP), 2006. Halal haram. Consumer Association of Penang, Malaysia, pp: 145.
- Consumer Association of Penang (CAP), 2009. Revoke and remove approved GM food from our shelves. Retrieved from <http://www.consumer.org.my/index.php/food/safety/136revoke-and-remove-approved-gm-food-from-our-shelves>.
- Convention on Biological Diversity (CBD), 2012. The Cartagena Protocol on Biosafety. Retrieved from <http://bch.cbd.int/protocol/parties/>.
- Convention on Biological Diversity (CBD), 2012. Article 2. Use of Terms. Retrieved from www.cbd.int/convention/articles.shtml?a=cbd-02.
- Ehsan, A.H., 2008. HALAL NUTRACEUTICAL MARKET: ISSUES AND CHALLENGES. In *AFBE 2008 CONFERENCE PAPERS* (p. 573).
- Fiechter, A. and W. Bayeler, 2000. History of biotechnology, 1: 1.

- GRAIN., 2004. GM cotton set to invade West Africa: Time to act! Retrieved from <http://www.grain.org/briefings/?id=184>.
- Halal Malaysia, 2011. Takrifan halal. <http://www.halal.gov.my/v3/index.php/ms/mengenai-pensijilan-halal/takrifan-halal>.
- Hamka., 1983. Tafsir Al-Azhar, Juzu' 6. Singapura. Pustaka Nasional Pte Ltd., pp: 1617-1620.
- Hamka., 1983. Tafsir Al-Azhar, Juzu' 7. Singapura. Pustaka Nasional Pte Ltd., pp: 1852-1855.
- Hasan, A., A. Fazullah, A.Z. Abidin, & B. Abdul Jalil, 2011, June. Halal Studies In Universities: A Way Forward To Manage Halal Business. In *International Journal Of Arts And Sciences Conference (Ijas2011) Austria*. pp: 1-9.
- Hashim, P., 2009. Alternative ingredients for halal cosmetic and personal care products. 3rd IMT GT International symposium on halal science and management. , pp: 134.
- Hazzah, K., 2000. Are GMO's Halal?. Retrieved from <http://www.agbioworld.org/biotech-info/religion/halal.html>.
- Hellmich, R.L., B.D. Siegfried, M.K. Sears, D.E. Stanley-Horn, H.R. Mattila, T. Spencer, K.G. Bidne, M.J. Daniels and L.C. Lewis, 2001. Monarch larvae sensitivity to *Bacillus thuringiensis* purified proteins and pollen. *Proc. Natl. Acad. Sci. USA.*, 98:11925-11930.
- Henk, v.d.B., 2009. Philosophy of Biotechnology. In M. Anthonie (Ed.), *Philosophy of Technology and Engineering Sciences* (pp. 1301-1340). Amsterdam: North-Holland.
- Hood, L., 1988. Biotechnology and Medicine of the Future. *JAMA*, 259(12): 1837-1844.
- Houdebine, L.-M., 2009. Production of pharmaceutical proteins by transgenic animals. *Comparative immunology, microbiology and infectious diseases*, 32: 107-121.
- Hulse, J.H., 2004. Biotechnologies: Past history, present state and future prospects. *Trends in Food Science & Technology*, 15: 3-18.
- Hunter, M., 2012. The emerging Halal cosmetic.
- ICTSD, 2009. Malaysian biosafety act enters into force. Retrieved from <http://ictsd.org/i/news/biores/65569/>.
- International Service for the Acquisition of Agri-biotech Applications (ISAAA), 2006. Labelling. Retrieved from <http://www.isaaa.org/kc/Publications/html/articles/Labeling/malaysia.htm>.
- International Service for the Acquisition of Agri-biotech Applications (ISAAA), 2011. Approved GM events in Malaysia | GM approvals in Malaysia. Retrieved from <http://www.isaaa.org/gmapprovaldatabase/country/default.asp?CountryID=120&GMApprovalsin=Malaysia>.
- Ismail, S.M., 2008. Makanan ubahsuai genetik (GM Food) : Satu analisis hukum. Universiti Malaya.
- James, C., 2003. Global review of commercialized transgenic crops. *Current science*, 84 (3).
- Kaskey, J., 2009. Monsanto, dow chemical win approval for modified corn (Update3). Retrieved from <http://www.bloomberg.com/news/>.
- Keener, K., T. Hoban, and R. Balasubramanian, 2012. Biotechnology and its application. Department of food science. The North Carolina Cooperative Extension Service. North Carolina State University. Retrieved from <http://www.ces.ncsu.edu/depts/foodsci/ext/pubs/bioapp.html>.
- Kuiper, H.A., G.A. Kleter, H.P.J.M. Noteborn, E.J. Kok, 2002. Substantial equivalence – An appropriate paradigm for the safety assessment of genetically modified foods? *Toxicology*, 181-182: 427-431.
- Latif, M.A., 2006. 'Current Issues on Halal Food'. Retrieved from <http://agroindustry.files.wordpress.com/2009/11/current-issues-in-halal-food.pdf>.
- Lemaux, P.G., 2006. Introduction to genetic modification. *Agricultural biotechnology in California series*, 8178.
- Lin, D., 2011. Arguments For and against genetically modified organisms: GMOs from an animal rights and vegan perspective. Retrieved from http://animalrights.about.com/od/animalsusedforfood/a/Arguments-For-And-Against-Genetically-Modified-Organisms_2.htm.
- Losey, J.E., L.S. Rayor and M.E. Carter, 1999. Transgenic pollen harms monarch larvae. *Nature*, pp: 399.
- MacKenzie, V., 2002. GM foods : Will their fate be decided in Asia. Report for ASrIA, the Association for Sustainable and Responsible Investment in Asia with support from Cazenove Asia, pp: 16.
- Maizirwan, M., 2009. Halal issues in pharmaceutical products: urgent need to have modern and efficient production of pharmaceuticals and biopharmaceuticals. *Halal Pages 2009/2010*, 56-63.
- Malaysian Biotechnology Information Centre (MABIC), 2006. Biotechnology in Malaysia. Retrieved from <http://www.bic.org.my/?action=localscenario&do=biotechnology>.
- Márcio, A.F. Belem, 1999. Application of biotechnology in the product development of nutraceuticals in Canada. *Trends in Food Science & Technology*, 10(3): 101-106.
- Marzukhi, H. and A.B. Umi Kalsom, 2005. Pengenalan kepada bioteknologi pemakanan dan pertanian. In Syaikh Mohd Saifuddeen, S. M. S., Wan Roslili, A. M. and Azrina, S. (Eds), *Sempadan bioteknologi menurut Islam*. Institut Kefahaman Islam Malaysia (IKIM). Pp: 21-31.

Ministry of International Trade and Industry (MITI). Halal Hub. http://www.miti.gov.my/cms/content.jsp?id=com.tms.cms.section.Section_8ab65e4b-7f000010-72f772f7-ce3196c6.

Ministry of International Trade and Industry (MITI). Halal Hub. Retrieved from http://www.miti.gov.my/cms/content.jsp?id=com.tms.cms.section.Section_8ab65e4b-7f000010-72f772f7-ce3196c6.

Mohamad, M.H., 2009. Tuntutan halalan toyyiban boleh memperkasakan ekonomi ummah. Institute of Islamic Understanding Malaysia (IKIM). <http://www.ikim.gov.my/index.php/en/utusan-malaysia/7883-tuntutan-halalan-toyyiban-boleh-memperkasakan-ekonomi-ummah>.

MOSTI, 2005. Biotechnology for wealth creation and social well being : The way forward. Ministry of Technology and Innovation (MOSTI), Malaysia.

MS 1500: 2009. Halal food - Production, preparation, handling and storage - General guidelines (Second revision). Department of Standards Malaysia.

MS 2424:2012. Halal pharmaceuticals - General Guidelines. Department of Standards Malaysia.

National Council of Fatwa Islamic Affairs Malaysia (JAKIM) 1999. Biotechnology in Food & Drink. Retrieved from <http://www.e-fatwa.gov.my/fatwa-kebangsaan/bioteknologi-dalam-makanan-minuman>.

National Council of Fatwa Islamic Affairs Malaysia (JAKIM) 2011. Eating Genetically Modified Food Law (Genetic Modified Food). Retrieved from <http://www.e-fatwa.gov.my/fatwa-kebangsaan/hukum-memakan-makanan-terubahsuai-genetik-genetic-modified-food>.

Netto, 2007. Malaysia to enforce labeling of GM foods. In the news about GM issues of gm- free Ireland. Retrieved from <http://www.gmfreireland.org/news/2007/apr.php>.

Nor, A.H.M., M.N. Mohamad and Z. Nasohah, 2002. Falsafah perundangan Islam. Mahzum Book Services. Selangor., pp: 17-44.

Organisation for Economic Co-operation and Development (OECD), 1999. Policy Brief: Modern biotechnology and OECD.

Parveez, G.K.A., M.M. Masri, A. Zainal, N.A. Majid, A.M.M. Yunus, H.H. Fadilah, O. Rasid And S.C. Cheah, 2000. Transgenic oil palm: production and projection. *Biochemical Society Transactions*, 28: 6.

Prakash, C.S., 2011. Benefits of biotechnology for developing countries. Retrieved from <http://www.agbioworld.org/biotech-info/topics/dev-world/benefits.html>.

Prather, R.S., M. Shen, and Y. Dai, 2008. Genetically modified pigs for medicine and agriculture. *Biotechnology and Genetic Engineering Reviews*, 25: 245-266.

Qaim, M. and D. Zilberman, 2003. Yield effects of genetically modified crops in developing countries. *Science*, 299: 900.

Rahman, L.A., 2001. 'Halal Products Consumerism, Technology and Procedures'. Melaka: Percetakan Surya Sdn Bhd.

Rahman, L.A., 2009. Isu halal tiada penghujung. Alambaca Sdn. Bhd. Malaysia., pp: 68-78.

Rastogi, S.C., 2007. *Biotechnology Principles and Application*. Alpha Science International Ltd. U.K.

Regenstein, J.M., M.M. Chaudry, & C.E. Regenstein, 2003. Kosher and halal in the biotechnology era. *APPLIED BIOTECHNOLOGY FOOD SCIENCE AND POLICY*, 1: 95-108.

Rigaud, N., 2008. Biotechnology: Ethical and social debates. In the OECD International Futures Project on "The Bioeconomy to 2030: Designing a Policy Agenda".

Robert, B., 1989. Janus-faced biotechnology: an historical perspective. *Trends in Biotechnology*, 7(9): 230-233.

Safian, M.Y.H., 2005. Islam and biotechnology: With special reference to genetically modified foods. *Science and Religion: Global Perspectives*.

Salleh, S.M.S.M.S., 2006. 'Aspects of Food Safety from the Islamic Perspective'. In Shaikh Mohd, S.M.S & Sobian, A. (Ed.). *Food and Technological Progress an Islamic Perspective*. (pp. 143-157). Kuala Lumpur: MPH.

Shaari, J.A.M. & N.S.M. Ariffin, 2010. Dimension of Halal Purchase Intention: A Preliminary Study. *International Review of Business Research Papers*, Volume 6. Number 4.

Skerritt, J.H., 2004. GMOs and Society. In *Proceedings of the 4th International Crop Science Congress*.

Sobian, A., 2009. Pengguna wajib tahu makanan ubah suai genetik. Institut Kefahaman Islam Malaysia (IKIM). Retrieved from <http://e-kiosk.ikim.gov.my/downloadarticle.asp?id=46>.

Sujak, S.F., L. Amin, A.L. Samian, M.S. Haron, M.N. Mohamad, & M.Y.H. Othman, 2011. Kod etika Islam untuk bioteknologi moden. *SARI: Jurnal Alam dan Tamadun Melayu*, 29(2): 167-198.

United Nations Environment Programme, 2006. *Africa environment outlook 2: Our environment, our wealth*. United Nations Environment Programme.

Whitman, D.B., 2000. *Genetically Modified Foods: Harmful or Helpful? Cambridge Scientific Abstracts—Genetically Modified Foods—Hot Topic Series*.

World Health Organization (WHO), 20 questions on genetically modified (gm) foods. Retrieved from <http://www.who.int/foodsafety/publications/biotech/20questions/en/>.

Yunus, A.M., W.M.Y.W. Chik and M. Mohamad, 2010. The concept of halalan tayyiba and its application in products marketing : A case study at Sabasun hyperruncit Kuala Terengganu, Malaysia. *International Journal of Business and Social Science 1: 3*.

Zika, E., I. Papetryfon, O. Wolf, M. Gomez-Barbero, A.J. Stein and A.-K. Bock, 2007. Consequences, Opportunities and Challenges of Modern Biotechnology for Europe. Office for Official Publications of the European Communities.