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Assessment of public awareness, attitudes toward and acceptance of genetically modified foods in the city of Kaduna, Kaduna State, Northern Nigeria

*Egbe, N. E.[1], Bukar, A. B.[2] and Adebayo, A. A.[1,3]

[1]Department of Biological Sciences, Nigerian Defence Academy, PMB 2109, Kaduna, Nigeria
[2]Department of Mathematics, Nigerian Defence Academy, PMB 2109, Kaduna
[3]Department of Microbiology, Ekiti State University, PMB 5363, Ado-Ekiti

Abstract

Food is an essential component of daily life, and hence an important topic for many consumers. Genetic modification technology involves the alteration of the genetic machinery of an organism and the application of this technology to food production holds a great promise to overcome global food insufficiency. This study investigates public awareness, knowledge and attitude as well as acceptance of genetically modified foods among consumers in Kaduna City, Northern Nigeria. Questionnaire which was structured to cover three main themes: demographic information, attitudes towards Genetically Modified (GM) foods and knowledge of Genetic technology, was administered to 220 participants. Our findings show that 86% of the respondents in our study are aware of GM foods indicating a high level of awareness; however, the level of knowledge for most of the respondents was rated average. The findings also showed that 70.9% and 81.6% of respondents possessing Bachelors and postgraduate degrees respectively accept that GM technology will improve our standard of living and were more likely to accept GM foods. Awareness, level of education and knowledge of Genetic technology was shown to be important for acceptability of GM foods. In addition most respondents expressed their trust on Scientists and Religious leaders to decide on GM foods and also indicated their source of information on GM foods as the public media, social media and lectures. Therefore it is imperative that those responsible for disseminating scientific knowledge on GM foods and technology at public gatherings or through public media sources be properly educated to enable consumers make informed decision on GM foods.

KEY WORDS: Genetic technology, Public awareness, Attitude, GM Foods, Kaduna.

Corresponding Author: Email: nlegbe@nda.edu.ng, +234(0)9057525954

Introduction

Genetically modified foods are those foods produced from organisms that have had changes introduced into their DNA in order to obtain a desired trait or characteristic, by using the methods of genetic engineering as opposed to traditional breeding. The fear of possible insufficiency in feeding the world's population, attributable to the increasing demand for food products, became less threatening with the introduction of biotechnology into agriculture, which gave birth to the application of genetically modified (GM) technology to produce food (Kagai, 2011; Demon tans Stein, 2013; Tanius and Seng, 2015). The application of this technology is quite promising in reducing production costs, use of pesticides, herbicides and chemical fertilizers; enhancing yields, nutritional value, flavour and shelf life; hence increasing profits of agricultural produce. As a result, GM technology has tremendously attracted increasing interest in the agricultural world over the past 10 years (De

Groote et al., 2009; Kagai, 2011; Lucht, 2015), and has been adopted in several countries in the world (Americas and some Asian countries) except for Europe and most countries in Africa (James, 2013; De Groote et al., 2016). In 2014, genetically modified (GM) crops were grown by 18 million farmers in 28 countries on a total surface of 181.5 million hectares, which correspond to 13% of the world's arable surface. Globally, 82% of the total crop area for soybeans, 68% for cotton, 30% for maize and 25% for oilseed rape were planted with GM varieties in 2014 (James, 2014). This rapid increase makes GM crops the fastest adopted crop technology of the last decades.

Notwithstanding the accrued promises and potential benefits of GM technology, the exception of some countries in adopting the innovation is as a result of persistent controversies surrounding the application of this technology in food production. The debate is largely driven by negative perceptions from consumers about the uncertain effects of GM foods on human health, religious and ethical concerns about taking in foreign gene (Chen and Chen, 2002), concerns on wildlife and environment (Deffor, 2014), and issues on the measures for identification which widely prompted demand for labelling of GM food in many countries in the world (Chen and Chen, 2002). Some debatable issue in many countries are on low awareness and lack of information (Han 1995) while others are cautious of the experts and regulatory bodies of GM foods (Kim, 2012).

Several scientific reviews have been aimed at clearing the doubt of potential consumers, by reporting some benefit of GM foods to human health including reducing exposure to mycotoxins (Miller et al., 2006) and pesticide poisoning (Bennett et al., 2003; Smale et al., 2009), thereby affirming the safety of currently available GM foods for human consumption. Perhaps, except for rare cases of allergenicity, none of these report has preclude any future risk that may be encountered (FAO, 2004; ICSU, 2004). It therefore becomes very crucial to consider the consumer perception of and acceptance towards GM technology and foods.

Most of the African countries, based on one or other situations associated with their agricultural system, have however been denied the option of rejecting GM foods, as they tend to rely on food aid from many other industrialized countries, which has been reported as a major potential channel of consuming GM foods (De Groote et al., 2004; Kimenju et al., 2005). Agriculture in Nigeria for instance is currently facing several challenges relating to urbanization, industrialization, infrastructural expansion, desertification, among others, leading to soil degradation. The issues of insurgency in the North and militancy in the South-South part of the country has exacerbated the problems. Although Nigeria is by principle not a food aid recipient, but as a result of aforementioned challenges, imports a lot of foods from other countries (Olaniyan et al., 2007). Considering the fact that many foods from countries like US, where Nigeria imports food like soy meal (Watch GM, 2005), have been genetically modified, it is therefore likely that Nigeria has been receiving GM foods without prior information. This is so because effective policy formulation and poor implementation combine to threaten Nigeria's food security (Olaitan, 2017).

Interestingly, after the Nigeria's biosafety bill allowing the use of GM technology was signed into law, which resulted in the establishment of the National Biosafety Management Agency (NBMA) in April 2015, the interest of Nigerian government in commercializing GM foods (Bt Cotton, Bt Maize, Ht Soybean etc.) was publicly announced (Olaitan, 2017). Consequently in May 2016, NBMA granted two permits to Monsanto Agriculture Nigeria Limited for the commercial release/placing on market of GM cotton (Bt Cotton), and the confined field trial of GM maize (Bt Maize) among other GM foods that has been under considerations. It is worth noting that this development will not only regulate the injudicious manner of bringing in GM foods into the country, it will also confine the regulating body to consider farmers' and consumers' perception and acceptance. Hence, the heightened need for strategic risk and awareness communication requested by NBMA as reported by Olaitan (2017).

Taking into account the importance of establishing the levels of consumer's awareness, perception, and acceptance in determining the prospect of GM foods, there is however very few report on the perception of GM foods by Nigerians. The present study therefore surveys the consumers of GM foods in Kaduna State (North-Nigeria) to elicit their awareness, attitude toward and acceptance of GM food and genetic technology.

Materials and Methods

Study Area

The study was conducted at selected

institutions in the city of Kaduna, Kaduna State, North-Western, Nigeria. The city is located on latitude 10° 31' 23" N and longitude 7° 26' 25" E, with total area of 131km^2 (51sq mi) with a population of about 1.3 million. Kaduna serves as trade center and major transportation hub for the surrounding agricultural areas, with its rail and road network.

Major institutions in Kaduna metropolis were selected for the course of this research, which included; Nigerian Defence Academy, Ahmadu Bello University and Kaduna State University. Total of 220 questionnaires were administered to these institutions in the academic year 2017/2018.

Sampling Design

Purposive sampling approach was applied in the selection of respondents among members of staff and students from each of the selected institutions in Kaduna. Owing to the technical nature of this study, some level of education among the respondents was considered, to ease understanding the terminologies, and attendance to the questionnaire. Notwithstanding, few individuals with little or no formal education was also selected as respondents. A total of 220 respondents were randomly selected from the institutions as samples from which required data for this research were obtained.

Data Collection

Qualitative and quantitative data were obtained in this work by using questionnaire to address the objectives of the study. The questionnaire consisted of the demographic profile of respondents, their awareness and readiness to accept GM foods. The respondent's prior knowledge and perception/attitude toward GM food and genetic engineering was also addressed in the questionnaire. Apart from the demographic profile, expected responses for respondents' perception and acceptance were put on a Likert scale of 1-6 ranked as 1 (Yes definitely) to 6 (Don't know) while Likert scale of 1 to 3 ranked as 1 (True) to 3 (Don't know) were used to address respondents' knowledge of genetic engineering. Assessment of awareness of respondents on GM food in Kaduna was done on Yes/No bases.

Data Analysis

The data collected was analyzed using simple descriptive statistics such as frequencies, percentage distribution and tables. The demographic profile of the respondents was analyzed and the results presented as means, maximum, minimum and their standard deviations. This approach was also used in studies of consumer perception of GM foods (Oladele and Akinsorotan, 2007; Kim, 2012). Furthermore inferential statistics like Chi-square test of independence was used to test the relationship between the categorical responses.

Results

Of the 220 questionnaires administered, 180 were correctly completed and retrieved. Table 1 shows the distribution of the knowledge of GM Foods (GMF) against the level of education. This is to find out whether, prior to this survey, the respondents were aware of GMF, according to their level of education. Out of the total number of respondents that had the knowledge of GMF 154 (86%), 28 (18%) hold diploma certificate, 64 (42%) hold graduate degree, 53 (34%) postgraduate and others accounted for the remaining 9 (6%). It was observed that mostly the graduates and those with postgraduate certificate were aware of GMF prior to this survey. Using the Chi-square test of independence, the frequency of each category in the column variables was compared across the categories of the row variables. At 5% significance level, the chi-Square value of 14.367 ($p<0.05$) revealed the responses for the knowledge of GMF is significantly different across the level of education.

Table 1: Distribution of level of education against the knowledge of GM Foods

Educational Level	I have heard of genetically modified food before		Total
	Yes	No	
Sec. Sch. Leaving Cert	5	0	5
Diploma	28	1	29
BSc/BA/DTech/BMech	64	20	84
MSC/PHD	53	5	58
Other	4	0	4
Total	154	26	180

Out of the 154(86%) that responded positively to the knowledge of GMF 63(41%) are females and 91(59%) are males as shown in Table 2. Chi-Square value of 0.029($p<0.05$) which shows that responses of female and male are significantly different in relation to the knowledge of GMF.

Table 2: Distribution of respondents gender against the knowledge of GMF

		Gender of Respondent		Total
		Female	Male	
I have heard of genetically modified food before	Yes	63_a	91_a	154
	No	11_a	15_a	26
Total		74	106	180

Each subscript letter denotes a subset of gender of respondent categories whose column proportions do not differ significantly from each other at the 0.05 significance level.

The distribution of respondents' attitude to GMF against level of education is represented in Figure 1. It shows majority of the respondents, irrespective of their level of education, were prepared to buy GMF if the head of their religious affiliation approves of it and some were prepared to buy GMF if it was cheaper than conventional food.

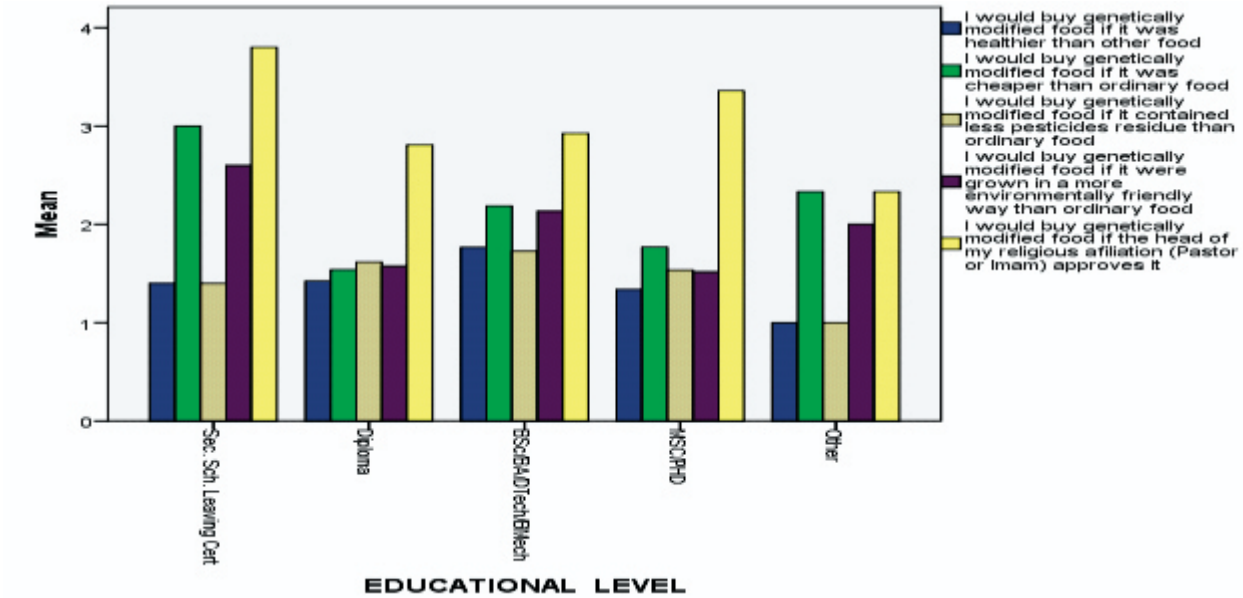

Figure 1: Distribution of respondents' attitude to GM Foods against level of education

Trust plays vital role in consumers' decision to buy GM foods, and as shown in Table 3, respondents in our study will buy GM foods if approved by Scientists in the industries and University Scientists as well as approved by Government regulators. Very few will accept GM Foods if approved by the media or NGOs/Civil Societies.

Table 3: Willingness to accept GM foods if approved by the relevant authorities

	Frequency	Percentage
University Scientist	25	13.9
Scientist in Industry	74	41.1
Government Regulators	56	31.1
Civil Societies and NGOs	10	5.6
News Media (TV/Newspaper)	9	5.0
Total	174	96.7
No Response	6	3.3
Total	180	100.0

The reason for the respondents to approve of GM foods was also surveyed and presented in Table 4. The data obtained shows that 87.2% of respondents will approve of GM foods if they were more tightly regulated and 79.4% will approve of GM foods if they were properly labelled. Interestingly more of the respondents (62.2%) indicated they will approve of GM foods if they were developed indigenously, while 46.1% will approve if they were developed by foreign Biotech companies.

Table 4: Percentage distribution of reasons of respondents to approve of GM foods

S/N	QUESTION	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	DON'T KNOW
1	I approve of GM foods if more tightly regulated	57.2	30.0	2.2	3.3	5.6
2	I approve of GM foods if properly labelled	48.3	31.1	7.2	5.6	6.1
3	I approve of GM foods if developed indigenously	32.8	29.4	6.1	8.9	9.4
4	I approve of GM foods if developed by foreign biotech companies	19.4	26.7	15.6	17.2	9.4
5	I do not approve of GM foods under any circumstances	11.7	8.3	17.2	50.6	7.8

The data presented in Table 5 shows that graduate and postgraduate certificate holders got to know of GM foods from TV/Newspapers, social media and lectures. Others got to know through friends.

Table 5: Distribution of source of information on GM foods against the level of education

			EDUCATION LEVEL OF RESPONDENT				
			Sec. Sch. Leaving Cert	Diploma	BSc/BA/DTech/BMech	MSC/PHD	Other
I heard of genetically modified food/crop from	TV/NEWSPAPER		2	2	14	11	0
			6.9%	6.9%	48.3%	37.9%	0.0%
	FRIEND		0	3	6	2	0
			0.0%	27.3%	54.5%	18.2%	0.0%
	SOCIAL MEDIA		2	2	16	7	2
			6.9%	6.9%	55.2%	24.1%	6.9%
	BOOKS		1	2	6	8	1
			5.6%	11.1%	33.3%	44.4%	5.6%
	LECTURE		0	19	19	24	0
			0.0%	30.6%	30.6%	38.7%	0.0%
	PUBLIC MEETING		0	0	4	3	0
			0.0%	0.0%	57.1%	42.9%	0.0%

Table 6 below shows the response with respect to knowledge of genetics/genetic technology of the respondents. Going by the number of respondents that provided correct answers to the statements, we opine that the respondents have fairly good knowledge of genetics and genetic technology.

Table 6: Similarity in response with respect to knowledge of genetics/genetic technology of the respondents (values in percentages).

S/N	QUESTIONS	TRUE	FALSE	DON'T KNOW
1	All bacteria found in food are harmful	20.6	71.7	6.7
2	Yeasts for brewing beer or making wine consists of living organisms	76.1	8.3	14.4
3	DNA is in every food we eat	48.3	27.2	22.8
4	It is possible to find out in the first few months of pregnancy whether a child will have Down's syndrome.	48.1	17.2	36.1
5	More than half of human genes are identical to those of a chimpanzee	60.6	11.7	27.2
6	Human cells and human genes function differently from those of animals and plants	55.6	31.1	10.6
7	Embryonic stem cells have the potential to develop into normal humans	45.0	23.3	29.4
8	By eating GM fruits, a person's genes may become altered	30.6	46.1	21.7
9	Ordinary tomatoes contain genes while GM ones do not	11.1	55.0	32.2
10	GM animals are always bigger than ordinary animals	61.7	20.0	16.7
11	It is not possible to transfer animal genes into plants	46.1	27.8	23.9

Figure 2 shows the linkage in the responses of the respondents with respect to their knowledge of genetics and genetic technology. The dendrogram shows the similarities in the respondents' knowledge of genetics and genetic technology (variables). It shows three different clusters. The first cluster shows similarities in the response between four variables (all bacteria found in food are harmful - FALSE, yeast for brewing beer or making wine consists of living organisms - TRUE, it is possible to find out in the first few months of pregnancy whether a child will have Down's syndrome – TRUE and more than half of human genes are identical to those of a chimpanzee – TRUE). The second cluster consists of five variables – meaning shows similarities between the following variables; DNA is in every food we eat – TRUE, Embryonic stem cells have the potential to develop into normal humans – TRUE, By eating GM fruits, a person's genes may become altered – FALSE, Ordinary tomatoes contain genes while GM ones do not – FALSE, GM animals are always bigger than ordinary animals – FALSE. The last cluster has only one variable; It is not possible to transfer animal gene into plants – FALSE.

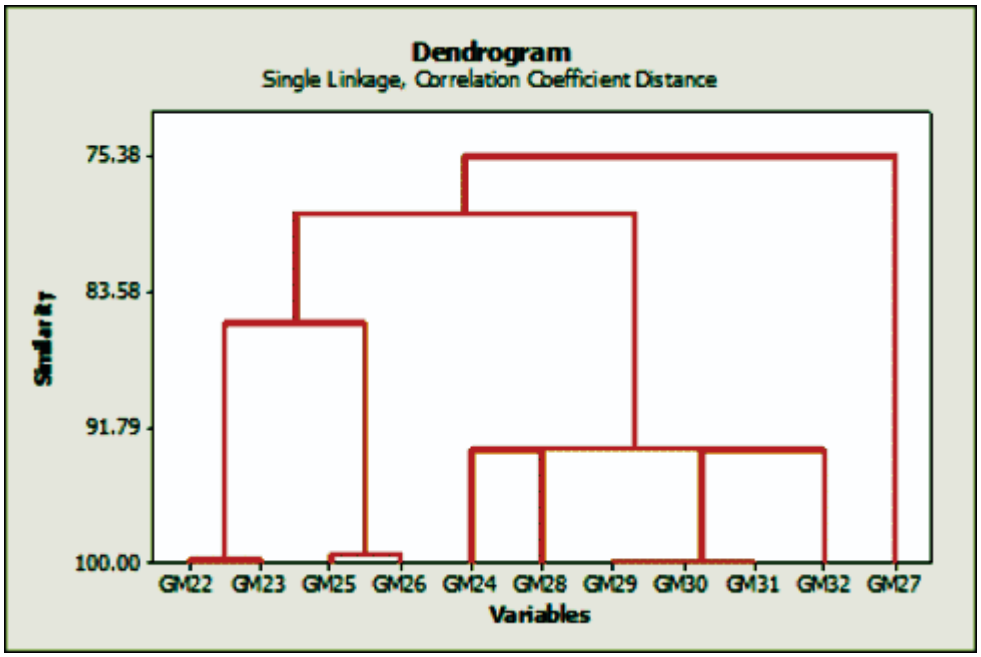

Figure 2: Dendrogram of knowledge of genetics/genetic technology of the respondents

Discussion

Modern biotechnological issues such as GM foods are frequently controversial and especially in cases when they become the subject of public interest, often draw much interest from various categories of people as was observed in this survey.

The study surveyed 58.9% males (106/180) and 41.1% females (74/180). Level of awareness of genetically modified food was high among the respondents, this is no surprise as majority of the respondents had attained some level of formal education ranging from secondary to tertiary. Importantly, this significant level of awareness could also be attributed to the fact that the country recently allowed the field and confined trial of three genetically modified crops (Bt Cotton, Bt Maize, Ht Soybean) (Olaitan, 2017), and the process was widely publicised in the media

Our data also shows that the acceptance or rejection of GM foods tended to reflect on the level of knowledge of the respondents, for instance, the respondents in our survey that had obtained tertiary education believe that GM technology will improve our standard of living in the future. This findings support the statement that education provides an individual with the ability to seek, evaluate and understand information about innovations which can influence their likelihood to accept innovations such as GM foods. This statement also agrees with the findings of Deffor (2014) in a similar survey made in the Greater Accra region of Ghana. Sjoberg (2008) had also reported that experts and scientists view GM technology as good contrary to the view of the public.

Majority of the respondents (both males and females) agree to buy GM crops it they were approved by the relevant authorities such as scientists in industries, government agencies and University scientists but have low trust in civil societies and the media. Trust plays an important role in the assessment of GM food by consumers. Data obtained from the Eurobarometer surveys show that European citizens have high trust in medical doctors, university scientists and consumer organizations and medium or low trust in media and environmental groups, and comparatively low trust in national governments and the biotech industry (Gaskell et al., 2011). Consumers that have only a limited knowledge about new technologies such as genetic engineering often feel unable to make decisions on the benefits and (or) risks of GM crops. They therefore make their own decisions based on the informed decisions made by people they consider trustworthy expert. (Costa-Font et al., 2008; Finucane and Holup, 2005). Willingness to buy GM foods by the respondents was also greatly influenced by religious views. We observed that 43.3% male respondents and 25.4% of female respondents will agree to buy GM foods if approved by the head of their religious organizations. Surprisingly, religious views swayed the opinion of respondents to GM foods more than price and health benefits. In a similar survey carried out in the Philippines by Moon and Balasubramanian (2003), consumer acceptance of GM foods was influenced by ethical and religious views. Furthermore significant impact of religion as was also observed by Deffor (2014)

Economic pressure will sway consumers decision in favour of a product that is cheaper, respondents in this survey indicated that they will buy GM foods if the price was cheaper than the non GM foods. Ali et al., (2016) in his survey of consumer acceptability of GM foods in Pakistan also observed that consumers' acceptance level increases significantly if the GM foods are cheap and provides high nutritious value. In addition Noussair et al., (2004) reported that French consumers were willing to buy GM foods if they were cheaper than non-GM foods.

Distribution of source of information about GM foods against the level of education shows that respondents that hold a graduate and postgraduate certificate got information on GM foods from TV/Newspapers, social media and lectures. A similar observation was also made for Chinese respondents (Frewer et al., 2002). In the work of Pattron (2008) and McCluskey and Swinnen (2004) television was the main source of information for GM foods. A study of US consumers found that scientists, university research groups and medical professionals were some of the most trusted sources of GMO information (Lang and Hallam, 2005). The use of television, Newspapers and public lectures from scientists will be effective means of disseminating information on GM foods in Nigeria.

For the measure of knowledge of genetics/genetic technology, the responses from the respondents show that they possess a fairly good level of knowledge. We observed that 8 of the 11 statements were correctly answered by 45% or more of the respondents, only 3 out of the 11 statements were incorrectly answered judging by 45% or more of the respondents. The fairly good knowledge of GM foods by the respondents could be because they are mostly well educated and as such have easy access to information on topical issues such as genetic technology. This observation is similar to results obtained from among prospective teachers in Slovenia by Sorgot and Ambroz-Dolinsek (2010). However a recent survey of Latvian consumers demonstrated limited understanding of genetics and food, with one-half of the respondents believing that "an ordinary tomato does not contain genes, but a GM tomato does." and more than two-thirds believing that modified genes from GMOs could enter human reproductive cells and be passed to offspring (Aleksejeva, 2014)
The respondents in this survey have a fairly good knowledge of genetics and genetic technology and this could have led to their higher acceptance of GM foods. As seen in Mielby et al., (2013), higher scientific understanding is tied to less negative opinions of GM products and higher acceptance ratings. However the respondents will strongly approve of GM foods if they were tightly regulated and if developed by indigenous firms.

Conclusion

Consumer attitudes about GM food are complex and linked to the consumer's knowledge of the science and public perception. As such considerable effort needs to be directed towards understanding people's attitude towards this gene technology. Based on our findings, we can conclude that the level of awareness of GM foods in our study area is high, however; the level of understanding of GM technology is fair among the respondents. Correlation between knowledge and acceptance shows that the more educated respondents were more inclined to accepting GM foods that the less educated ones. Therefore it is imperative that experts in the field should provide public lectures and other educational formats so the public can develop evidence-based attitudes about GM foods. Trust in religious leaders on the part of the respondents in our study area could also be exploited to help enlighten the public on GM foods and technology. The caveat though is that the religious leaders be properly educated on the technology to avoid misleading the public. Therefore, the education of those responsible for disseminating scientific knowledge at public gatherings or through public media sources is of crucial importance, because their explanations of biotechnology directly inform the public.

References

Aleksejeva, I. (2014). Latvian consumer's knowledge about genetically modified organisms. Management of Organizations: Syst Res. 71:7–16.

Ali, A., Rahut, D. B. and Imitiaz, M. (2016). Acceptability of GM foods among Pakistani consumers GM Crops Food 7(2): 117-124

Bennett, R., Morse, S. and Ismael, Y. (2003). Bt cotton, pesticides, labour and health: A case study of smallholder farmers in the Makhathini Flats, Republic of South Africa. OUTLOOK AGR, 32, 123-128.

Costa-Font, M., Gil, J. M., Traill, W. B. (2008). Consumer acceptance, valuation of and attitudes towards genetically modified food: Review and implications for food policy. Food Policy 33,99–111.

Chen, H. and Chern, W. S. (2002). Consumer Acceptance of Genetically Modified Foods. Paper prepared for presentation at the Annual Meeting of the American Agricultural Economics Association (AAEA), Long Beach, California.

Curtis, K. R., McCluskey, J. J. and Whal, T. I. (2004). Consumer acceptance of genetically modified Food Products in the developing world, AgBioForum. 7 (1&2):70-75

De Groote, H., Gitonga, Z. M., Kimenju, S. C., Keter, F. and Ngigi, O. (2016). But what do Rural Consumers in Africa Think about GM Food? AgBioForum, 19(1): 54-65.

De Groote, H., Bett, C., Okuro, J. O., Odendo, M., Mose, L. and Wekesa, E. (2004). Direct estimation of maize crop losses due to stemborers in Kenya, preliminary results from 2000 and 2001: In Friesen, D. K. and Palmer, A. F. E., eds. Integrated Approaches to Higher Maize Productivity in the New Millennium. Proceedings of the 7th Eastern and Southern Africa Regional Maize Conference, CIMMYT, Mexico, D. F.

De Groote, H., Gunaratna, N. S., Kebebe, E., Lyimo, S., Ouma, J. O., Kyazze, F. B. and Friesen, D. (2009). Indicators of Project Performance and Analysis of Potential Impact. A Survey of Potential Impact of Quality Protein Maize (QPM) on the Nutrition, Health and Well-being of Farm Households and the Impact of the QPMD Project on QPM

Awareness and Adoption in Target Areas in Ethiopia, Kenya, Tanzania and Uganda. Report prepared for the Canadian International Development Agency (CIDA). CIMMYT, Addis Ababa, Ethiopia.

Deffor, E. W. (2014). Consumer Acceptance of Genetically Modified Foods in the Greater Accra Region of Ghana. J Biosafety Health Educ, 2(2): 116-121

Demont, M. and Stein, A. J. (2013). Global value of GM rice: a review of expected agronomic and consumer benefits. New Biotechnol, 30(5): 427-435.

FAO. (2004). The State of Food and Agriculture 2003-04. Agricultural biotechnology. Meeting the needs of the poor? Food and Agriculture Organization of the United Nations, Rome; ftp://ftp.fao.org/docrep/FAO/006/Y5160e/y5160e00.pdf

Finucane, M. L., Holup, J. L. (2005) Psychosocial and cultural factors affecting the perceived risk of genetically modified food: An overview of the literature. Soc Sci Med. 60, 1603–1612.

Frewer, L. J., Miles, S., Marsh, R. (2002). The Media and Genetically Modified Foods: Evidence in Support of Social Amplification of Risk. Risk Anal. 22, 701–711

Gaskell, G., Allansdottir, A., Allum, N., Castro, P., Esmer, Y, Fischler, C., Jackson, J., Kronberger, N., Hampel, J., Mejlgaard, N., Quintanilha, A.,Rammer, A., Revuelta, G., Stares, S., Torgersen, H. and Wager, w. (2011).The 2010 Eurobarometer on the life sciences. Nature Biotechnol. 29, 113–114.

Han, J. H. (1995). Effects of Perception on consumer acceptance of genetically modified (GM) foods. A dissertation submitted to Graduate faculty of the Louisiana State University and Agricultural and Mechanical College in Partial fulfillment of the requirement for degree of Doctor of Philosophy.

ICSU (2004). New Genetics, Food and Agriculture: Scientific Discoveries- Societal Dilemmas. International Council for Science, Paris; http://www.argenbio.org/adc/uploads/pdf/icsu.pdf

James, C. (2013). *Global status of commercialized biotech/GM crops*: (ISAAA Briefs No. 46). Ithaca, NY: International Service for the Acquisition of Agri-Biotech Applications (ISAAA).

James, C. (2014). Global Status of Commercialized Biotech/GM Crops: ISAAA Brief. ISAAA:Ithaca, NY, USA,.

Jegede, A. S. (2007). What Led to the Nigerian Boycott of the Polio Vaccination Campaign? PLoS Med. 4(3): e73

Kagai, K. K. (2011). Assessment of Public Perception, Awareness and Knowledge on Genetically Engineered Food Crops and their Products in Trans-Nzoia County, Kenya. J Dev Sust Agricult, 6: 164-180.

Kim, R. B. (2012). Consumer Attitude of Risk and Benefits towards Genetically Modified (GM) foods in South Korea: Implications for food policy. Engineering Economics- INZ-EKON 22(2): 189-199.

Kimenju, S. C., Groote, H. D., Karugla, J., Mbogoh, S. and Poland, D. (2005). Consumer awareness and attitudes toward GM foods in Kenya. Afr J Biotechnol, 4: 1066-1075.

Lang, J. T., Hallman, W. K. (2005).Who does the public trust? The case of genetically modified foods in the United States. Risk Anal. ;25:1241–52.

Lucht, J. M. (2015). Public acceptance of plant biotechnology and GM crop; Review. Viruses, **7**: 4254-4281

McCluskey, J. J. and Swinnen, J. F. M, (2004). Political economy of the media and consumer Perceptions of biotechnology. Am J Agricult Econ., 86: 1230-1237.

Mielby, H., Sandoe, P., Lassen, J. (2013). The role of scientific knowledge in shaping public attitudes to GM technologies. Public Underst Sci. 22:155–68
.
Miller, H. A., Conko, G. and Kershen, D. L. (2006): Why spurning food biotech has become a liability. Nature Biotechnol, 24(9): 1075-1077.

Moon, W. Balasubramanian, S. K. (2002). Public perceptions and willingness-to-pay a premium for non-GM foods in the US and UK. AgBioForum. 4, 221–231.

Noussair, C., Robin, S. and Ruffieux, B. (2004). Do consumers really refuse to buy genetically modified food? Economics Journal 114: 102-120.
Oladele, O. I. and Akinsorotan, O. A. (2007). The attitude towards Genetically Modified Organisms (GMOs) and their effect on health and environment in Southwestern Nigeria: Scientist perceptions. JCEA, 8(1): 91-98.

Olaiton, P. (2017). Assessments of commodity and trade issues made by USDA staff and not necessarily statements of official U.S. government policy. *Global Agricultural Information Network (GAIN)* Report; USDA Foreign Agricultural Service, https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20Annual_Lagos_Nigeria_12-18-2017.pdf

Olaniyan, S. A., Bakare, A. A. and Morenikeji, O. A. (2007). Genetically Modified Foods in Nigeria: A Long-Lasting Solution to Hunger? Biol., 29(67): 191-202.

Pattron, D. D. (2008). A Survey of Genetically Modified Foods Consumed, Health Implications and Recommendations for Public Health Food Safety in Trinidad. Int J Food Safety 7:4-14

Sjoberg, L., (2008). Genetically modified food in the eyes of the public and experts. Risk Manag.., 10: 168-193.

Smale, M., Zambrano, P., Gruere, G., Falck-Zepeda, J., Matuschke, I., Horna, D., Nagarajan, L., Yerramareddy, I. and Jones, H. (2009). Measuring the economic Impacts of Transgenic Crops in Developing Agriculture during the First Decade. Approaches, Findings and Future Directions (Food Policy Review 10 IFPRI), Washington DC. International Food Policy Research Institute (IFPRI).

Sorgot, A. and Ambroz-Dolinsek, J. (2010). Knowlege of, Attitudes Toward, and Acceptance of Genetically Modified Organisms Among Prospective Teachers of Biology, Home Economics, and Grade School in Slovenia. Biochem Mol Biol Edu. 38 (3):141–150

Tanius, E. and Seng, S. W. (2015). Consumers awareness towards genetically modified (GM) foods. IJBEL, 6(2): 17-26.

Watch G. M., (2005). *Conned with corn*. http://allafrica.com/stories/200504250259.html
UNICEF. (2004). Traditional chiefs from Niger and Nigeria join together to fight polio. Retrieved from http://www.unicef.org/infobycountry/niger_20533.html?q