Is it Appreciation with Caution? Attitude towards Genetically Modified Foods

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ABSTRACT— *Despite its popularity in some parts of the West, Asia and South America, GM foods on the other hand are popular in very few countries in Africa in terms of its concept of production. Ghana is yet to discover more on its people's attitude towards the consumption GM foods. This study used a purposive sampling method to select 140 respondents in supposedly middle – income communities in Accra; the capital city of Ghana. A Likert scale and a Kendall Coefficient of Concordance were used to determine their level of awareness and appreciation of GM foods respectively; after which a Probit model was used to examine the effect of socioeconomic characteristics on GM foods' appreciation. The study revealed that more than 90% were at least aware of GM foods whiles 70%, appreciative of it. Higher yields came out as the leading benefit of GM foods whiles chemical effect came out as the number one risk factor. It was also discovered that respondents with relatively higher levels of education and income tend to appreciate GM foods. The study therefore recommends more education and debate on the subject of GM foods as well as further studies on the appreciation, adoption and demand for GM foods in Ghana.*

Keywords— GM foods, awareness and appreciation

1. INTRODUCTION

The World Health Organization (WHO) (2005) noted that though the growing of genetically modified (GM) foods have been gaining grounds globally over the years, the total land used for its production in the world is relatively small. James (2004) asserted that there are about 8.25 million farmers producing GM foods in seventeen (17) countries worldwide; of which 90 per cent of these farmers are from developing countries. Though Makoni et al. (2006) is of the view that the United States has the largest share of total land in GM food production, Fukuda-Parr and Orr (2012) noted that Brazil is also a leading producer of genetically modified crops in the world with countries like Argentina, India, Canada and China gradually gaining grounds in its production and consumption.   In Africa, though Fukuda-Parr and Orr (2012) noted that South Africa and Burkina Faso are the only two countries who have formally approved transgenic crops for commercial production, the African Centre for Biosafety (2005) asserted that as many as twenty (24) African countries have Genetically Modified Research and Development capacity centres of which about twenty (20) are actually engaged in some form of research.

Genetic modification (GM) involves the alteration of genetic materials (Ekici and Sancak, 2011). Fukuda – Parr and Orr (2012) is also of the view that crops become genetically modified when a selected individual gene is inserted into another organism to obtain desirable features or traits through the process of genetic modification.

Makoni et al. (2006) asserted that the benefits such as water and energy conservation, friendly bio herbicides and bio insecticides GM crops provide, it stands the chance of meeting some of the greatest agricultural challenges in Africa; which is the problem of food shortage. Nielsen et al. (2001) argues that GM foods are nutritious and of higher quality and Deakin University Australia (2001) also sees GM foods as inexpensive and able to feed the world's ever increasing population. Ekici and Sancak (2011) asserted that genetic modification can be a tool for improving the quality of foods in the world in general. Panse (2011) did not limit the benefits of genetic modification to crops and animals in terms of their resistance to disease and better taste but also stretched its benefits to the environment and society as a whole.Among the environmental and societal benefits Panse (2011) noted were, genetic modification ensured less

required labour hours during crop production, led to natural waste management and encouraged the use of friendly insecticides and herbicides.

In spite of the enormous benefits GM food is perceived to provide, very serious concerns have been raised with respect its safety with regard to the threat and danger it possess to the human and environmental life globally (Ismail et al., 2012). Ismail et al. (2012) noted that producers have ignored the effects of risk on consumers although studies have proven the risk impact of GM. Chen and Li (2007) and Chern and Rickertsen (2002) have argued that the risk concerns of consumers who are not in favour of GM foods are predominantly on the danger it possess to human health. Hoyer and Mcinnis (2009) grouped the risks of genetic modification into six; which were performance, financial, physical/safety, social, psychological and time. Genetic Modification is also believed to deteriorate the nutritional value of food, produce new allergens and increase the risks of cancer in humans among other potential risks (Gizzarelli et al., 2006; Heckmann et al., 2006; Dean and Shepherd, 2007).

Font and Gil (2009) noted that perceived risks concerning genetic modification play an important role in terms of consumers' attitude towards GM foods. Mankoni et al. (2006) also opined that the mixed concepts of the GM food worldwide have influenced the attitude towards GM foods globally. Whiles Genetic Modification Organization (GMO) Compass (2006) asserts that the European Union has put in place tight policies with respect to its safety standards and choice, Marden (2003) establishes that the United States in general opposes restrictions on genetically modified foods since there are no scientifically proven hazards. With respect to South America, the continent continues to remain divided in terms of its acceptance. Though countries like Brazil and Argentina are very successful producers of Genetically Modified Crops (GMCs), Bolivia intends eliminating the production of GMCs totally. Mexico on the other hand is experimenting the planting of only GM corn (Marrero, 2010). In the situation of Africa, there are no fixed or specific regulations in terms of GM foods. Though, the law on GM foods ranges from total prohibition to complete acceptance with respect to individual countries, the African Union have adopted a model law for the control of GMCs and has therefore encouraged its member states to formulate laws and policies along its line (Makoni et al., 2006).

In Ghana, some legislation has been made with respect to its regulation, research and implementation. Though genetic modification has the opportunity of boosting crop yield, crop productivity and reducing the effect of pest and insect infestation on crop production, production of GM crops is not popular despite the fact that crops like cassava, tomatoes, garden eggs and cabbage were selected for evaluation for genetic modification. Various strategies have been put in place to lessen the serious problem of security among several African countries of which Ghana is no exception. The use of GM foods to promote food security has been controversial in many countries, with some supporting and the others opposing genetic engineering. Studies conducted in industrialized nations have revealed mixed attitudes and public perceptions on GM food consumption (Makoni et al., 2006). However, little is known about consumers' behavior towards GM crops in terms of its appreciation, awareness of benefits and risks in the individual African countries of which Ghana is included. In addition, the factors which influence the appreciation of GM foods have also not been explored. The study assessed the extent to which GM food is appreciated and the socioeconomic characteristics that influence it. In addition, the study assessed the perceived benefits and risks as in literature by Ghanaians. The knowledge on these themes, will bring to the fore the right policies which need to be taken in the consumption of GM foods and also engender more research in this seemingly new subject called GM.

2. METHODOLOGY

2.1 Study Area

The study was of the view that the concept of genetically modified foods will normally be known in a supposedly 'exposed' area of the country therefore the capital city, Accra, was chosen. Though, Accra is located in the smallest of the ten regions of Ghana (Greater Accra), it is the most cosmopolitan of all the cities in the country. Similar to the general situation in Ghana, it is predominantly dominated by Christians, with Islam being the second most popular religion and the third been traditional. In terms of ethnic groups, the major ones are Gas, Akans and Ewes (Ghana Statistical Service, 2011).

Accra, which falls under the Accra Metropolitan Assembly(AMA), constitutes about 57.1% of the total population of the Greater Accra Region (3,910,000) and is highly characterized by a high level of rural urban migration and a relatively high population growth rate. The city alone constitutes about 9% of the total population of Ghana and also ranks as the most densely populated city in Ghana (Ghana Statistical Service, 2011). Though the Accra Metropolitan Area constitutes more than 100 suburbs, like any other city in the world, it has a mixture of high, middle and low income and also very poor communities. The high and middle income communities include Airport West, East Legon, Cantonments, Trasaco Valley, West Legon, Legon, Airport East, Dzorwulu, South Labone, Sakumono Estates, New Achimota and Nyaniba

Estates. These high and middle income communities also have a relatively higher level of higher education density though the city in general can also boast as having the highest higher education and income density in Ghana (Ghana Statistical Service, 2011).

Its position as the financial and administrative capital has made it the main hub for spreading modernity, new technologies and products in Ghana. The city can boast of more than 5 popular supermarkets and hyper markets with some of their branches in the city. These super and hyper markets may sometimes trade in imported GM foods. Some of these are Accra Mail, Palace Hypermarket, Maxxmart and Koala Shopping Centre.

2.2 Sampling Procedure and Sample Size

Since the concept of genetic modification is not usually familiar to the uneducated which are normally associated with residence at the low income level areas (Maani, 2000), the survey was purposively conducted in places where people were believed to have heard of genetically modified foods. Moving from house to house in these perceived rich areas to conduct the interview was found to be very challenging because residents were very reluctant to give their private information such as income levels in their private residents due to fear of robbery and other factors. In dealing with the privacy challenge, respondents were interviewed at the supermarkets where GM foods are believed to be sold and also where majority of these high and middle income residents normally shop. In addition to these selected places these selected places as well as the University of Ghana, where junior and senior members of the College of Agricultural and Consumers Sciences are believed to have an idea about GM foods were also included. In all four (4) supermarkets (Airport Koala, Osu Koala, 37 Mexx Mart and Accra Mail) were randomly selected in addition to the University of Ghana Campus, making five (5). At each location, twenty (28) respondents were selected with a simple random sampling method. In all, one hundred and forty (140) respondents were interviewed with the use structured questionnaires.

2.3 Method of Analysis

In examining the levels of awareness of GM foods, a Likert Scale in the form; 3 = much, 2 = Average, 1= not at all were presented to the respondents. After the selections were made, the averages of the number of the appearance of the various scales were taken and the scale with the highest was assumed to be the leader in terms of the awareness

With respect to the perception of risks and benefits of GM foods examination, literature was reviewed on both subjects and each top five risks and benefits were presented to respondents to rank from 1 as highest to 5 as lowest. After, the Kendall's coefficient of concordance (W) was used to determine the level of agreement in the ranking. The Kendall's coefficient of concordance was given as:

$$W = \frac{12S}{p^2(n^3 - n) - pT}$$

Where n is the number of benefits or risks, p is the number of respondents, T, ties in the ranks. W is the measure of agreement among several (p) judges who are assessing a given set of n benefits. Where S is a sum of squares statistic over the row sums of ranks, R_i. Where is is expressed in the form:

$$S = \sum_{n=1}^{n}(R_i - \overline{R})^2$$

Where $\bar{R}$ is the mean of R_i values.

Respondents' appreciation of GM foods was assessed with the use of a Likert Scale in the form; 3 = much, 2 = normal and 1= not at all. In probing how socioeconomic characteristics affect the level of appreciation, a Probit analysis was used; where a dummied dependent variable had 1 for 'appreciate' 0 for 'do not appreciate'. With respect to the socioeconomic characteristics which affected the appreciation of GM foods age, eaten before, level of education, gender, income and location and household were used. The Probit model was given in the form:

$$P(y = 1 \mid x) = G(\beta_0 + \beta_1 age + \beta_2 eatenbefore + \beta_3 educationallevel + \beta_4 gender + \beta_5 income + \beta_6 location + \beta_7 householdsize + \varepsilon)$$

G is a function taking on values strictly between zero and one, $0 < G(z) < 1$, for all real numbers. The β_is represent the parameter estimates of the independent variables and ε is the error term of the regression. Age was measured in years and level of education was dummied; where higher education was assigned 1 and lower education was assigned 0. Higher education meant educational background of the respondent was at the tertiary level or above whiles

lower education meant educational background was the below tertiary level. Eaten before was dummied, where 1 was assigned to eaten before and 0 was assigned to not eaten before. With respect to gender, a dummy was used; male were assigned 1 while female were assigned zero. With location, middle income communities and above were assigned 1 whiles and communities below middle income were 0; when it was represented in a form of a dummy. With income, the monthly earnings of respondents were used and household size was measured in count.

3.   RESULTS AND DISCUSSION

3.1   *Socioeconomic Characteristics of Respondents*

From table 1, out of the sample size of 140, the respondents with ages from 20 to 29 years were the largest representing 42% (58) followed by respondents with ages from 30 to 39 years making up 33% (46). Respondents from 40 to 49 years were 16% (23) and those who were 50 years and above were 9% (13). Male respondents were 67.9% (95) whiles female were 32.1% (45). The Educational level was grouped into 4 categories. The largest category of academic qualification was tertiary education which was 67.9% (95), followed by the category with other forms of qualification which was 17.1% (24). Respondents with Secondary, Technical or Vocational education were 10.7% (15) whiles 4.3% (6) had Junior High School (JHS) or middle School education. With respect to marital status, most of the respondents were single making up 54.3% (76) of the sample followed by married who were 42.1% (59), divorced were 2.9% (4) and separated the least with 0.7% (1). On the location of respondents, 56.4% (79) were from predominantly middle and high class communities whiles 43.6% (61) of respondents were also from predominantly low class communities.

Table 1: Socioeconomic characteristics of Respondents

Demographic Variable	Frequency	Percentage	Mean	Standard Deviation
Age				
20-29	58	42	33.29	9.296
30-39	46	33		
40-49	23	16		
50 and above	13	9		
Gender				
Male	95	67.9		
Female	45	32.1		
Level of Education				
JHS/Middle School	6	4.3		
Secondary/Technical/Vocational	15	10.7		
Tertiary	95	67.9		
Non – Formal	0	0		
Others	24	17.1		
Marital Status				
Single	76	54.3		
Married	59	42.1		
Divorced	4	2.9		
Separated	1	0.7		
Location				
Others	61	43.6		
Middle and High Class	79	56.4		

Source: *Field Data, 2012*

3.2 Awareness of GM Foods

On the issue of awareness, it was found out that 97.9% (137) were aware of GM foods whiles 2.1% (3) were not aware and this is indicated in table 2. The awareness could come from the fact that they have been introduced to GM through the internet, foreign media, friends or colleagues. The finding is similar to Ibrahim et al. (2013) where in Klang Valley in Malaysia, almost 90% of the respondents were aware of GM foods; which could be due to the fact both studies were conducted in the capital cities of the two countries where the level of education is usually very high. The result on awareness of this study is different from the findings of Ismail et al. (2012) where in Johor Bahru in southern Malaysia, about half (51.5%) of the respondents were not aware of GM Foods. The reason could be due to the fact that the region may not be too exposed to GM foods because of its location, as compare to Klang Valley, which is located in capital, where the educational level is high. The findings is also different from the findings of Vermeulen et al. (2005) and Li et al. (2002), where consumers in South Africa add Beijing respectively had little knowledge or no knowledge about the GM foods. This is indicated in table 2.

Table 2: Level of awareness of GM Foods

Response	Frequency	Percent
Not at all	3	2.1
Average	99	70.7
Much	38	27.1
Total	**140**	**100**

Source: *Field Data, 2012*

The study probed further to find out whether respondents had eaten GM foods before within or outside Ghana. The result is indicated in table 3. Out of the 140, 57.1% (80) had eaten GM foods before, 11.4% (16) indicated they had not whiles 31.4% (44) noted they were not sure if they had eaten GM foods before.

Table 3:   Eaten GM Foods

Response	Frequency	Percent
Yes	80	57.1
No	16	11.4
Not Sure	44	31.4
Total	**140**	**100.0**

Source: *Field Data, 2012*

In ranking the benefits of GM foods, higher yields was ranked number one with a mean rank of 2.40, shorter time to harvest came out as second with mean rank of 2.83, resistance to diseases and pests was third with a mean rank of 3.08 whiles employment for farmers was fourth with mean rank of 3.30. Lower price of food came out as the fifth with a mean rank of 3.38.   The Kendall's W of 0.063 which was significant at a level of 1.00% indicated that there was a 6.3% agreement among respondents. The first two ranks could be due to the fact that Ghana is not well food secured and these qualities about GM foods could help in that regard. Though Panse (2011) did not rank the benefits of GM foods in their study, they acknowledged that shorter time to yield, employment and higher yields as some of its benefits. Huang et al. (2003) was also of the view that less labour hours and resistance to pest and diseases were some of the benefits of GM foods. This is indicated in table 4.

From table 5, the use of strange chemicals came out as the lead risk for respondents with a mean of 2.32 whiles cancer and unnatural nature of food paired as the second risk rank with a mean of 2.78 each.   Long term effect on environment was ranked as the fourth risk factor whiles the fifth ranked factor was allergens with a mean rank of 3.70. The issue of cancer and use of some chemicals are of a higher concern because cancer is becoming an important subject in the Ghanaian society. Though Woodside et al. (2005) concerning consumers in Australia did not rank the risk factors of GM foods is their findings is similar to the findings of this study since health risk and environmental risks were among the risk factors they discovered. In addition, Panse (2011) also noted human health consequences and allergens are some of the serious risk concerns are believed to be associated with GM foods. Dean and Shepherd (2007) also did not rank their risk but also found out that GM foods causes increased presence of toxins in foods, increased risk of cancer in humans, deteriorates the nutritional food value and produced new allergens.

Table 4: Benefits of GM Foods

Benefit	Mean Rank
Higher yields	2.40
Shorter time to harvest	2.83
Resistance to diseases and pests	3.08
Employment for farmers	3.30
Lower price of food	3.38
N	137
Kendall's W	0.063
Chi-Square	34.499
Df	4
Symp. Sig	0.000

Source: *Field Data, 2012*

Table 5: Risks of GM Foods

Risk	Mean Rank
Chemicals Used	2.32
Risk of Cancer	2.78
Unnatural nature of food	2.78
Long term effect on Environment	3.41
Allergens	3.70
N	140
Kendall's W	0 .122
Chi-Square	67.115
Df	4
Asymp. Sig	0 .000

Source: *Field Data, 2012*

3.3 Appreciation of GM Foods

As indicated in Table 6, 26.4 % (37) noted that they do not appreciate GM foods whiles 56.6% (79) noted that they had a normal appreciation of GM foods. Those who much appreciated GM foods were 15.3% (21). The finding on appreciation on this study is in agreement with the findings of Li et al. (2002) where majority of some Chinese consumers are in favour of GM rice and soybean but in contrast with the findings of Honkanen et al. (2004) where consumers do not appreciate GM foods. Wang et al. (2012) also found out that some Chinese consumers do not appreciate GM foods which Woodside et al. (2005) concluded among Australian food manufacturers.

Table 6: Appreciation of GM Foods

Response	Frequency	Percent
Not at all	37	26.4
Normal	79	56.6
Much	21	15.3
No Response	3	15
Total	**140**	**100.0**

Source: *Field Data, 2012*

Out of the six socioeconomic characteristics considered in table 7, educational level and income had significant impact on appreciation of GM foods. Both higher educational and income levels lead to more appreciation for GM foods.

Unlike the study of Li et al. (2002) income and education, were not significant though in China willingness to purchase GM rice and soya bean was the dependent variable of the regression.

Table 7: Appreciation of GM foods with respect to socioeconomic characteristics

Dependent Variable: Appreciation
Method: ML - Binary Probit (Quadratic hill climbing)
Sample (adjusted): 1 137
Included observations: 137 after adjustments
Convergence achieved after 4 iterations
QML (Huber/White) standard errors & covariance

Variable	Coefficient	Std. Error	z - Statistic	Prob.
Age	0.006127	0.012951	0.473083	0.6362
Eaten before	0.386056	0.245439	1.572923	0.1157
Educational level	0.676957**	0.267748	2.528336	0.0115
Gender	-0.388894	0.274494	-1.416766	0.1566
Income	1.25E-05*	7.67E-06	1.627546	0.1036
Householdsize	-0.023226	0.040165	-0.578283	0.5631
C	0.117658	0.640115	0.183807	0.8542

Mean dependent var	0.729927	S.D. dependent var	0.445627
S.E. of regression	0.433401	Akaike info criterion	1.178435
Sum squared resid	24.41868	Schwarz criterion	1.327631
Log likelihood	-73.72282	Hannan-Quinn criter.	1.239065
Restr. log likelihood	-79.91641	Avg. log likelihood	-0.538123
LR statistic (6 df)	12.38717	McFadden R-squared	0.077501
Probability(LR stat)	0.053868		

Obs with Dep = 0	37	Total obs	137
Obs with Dep = 1	100		

Source: *Field Data, 2012*

3.4   *Conclusion and Recommendations*

The findings of the study resulted in the following conclusions; GM foods are fairly known among the educated in Accra. The educated are more likely to appreciate GM foods in Ghana. Higher income earners are more likely to appreciate GM foods in Ghana. This study therefore recommends a similar study should be replicated nationwide. Also, there should be more debate on GM foods with respect to its appreciation or acceptance. In addition, more studies should be conducted on the acceptability of GM foods with respect to issues like type of foods and religion.

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