

Original Research Article

Public perception on genetically modified products: a case study of three local government areas in Cross River State, Nigeria

Abstract

Genetically modified products are important asset in modern agriculture with great potential to improve performance and yield of crops and farm animals. This survey was carried out to evaluate the perception of the people of Cross River State, Nigeria on genetically modified products (GMPs). The survey was carried out in four local government areas of Cross River State (Odukpani, Calabar Municipality, Calabar South and Akpabuyo) with 1000 respondents in each local government area giving a total of 4000 respondents. Data obtained from the questionnaire shared to the respondents were carefully collated and presented in simple percentages for ease of understanding. The demographic data showed that there were more males in the study (51.2%) than females (48.80%). Majority of the respondents were aged 25-35 years (46%). Most respondents had tertiary education (65.25%) and were majorly civil servants (27%) and businessmen (22.25%). A greater percentage of the respondents (63.75%) never heard of GMPs prior to this research. Majority of the respondents (63.7%) heard about GMPs from sources other than television (13%), friends (10.25%), newspaper (7.25%) and radio (7.25%). It was grossly observed that most of the respondents had various fears and concerns about GMPs. However, 58.5% agreed that the adoption of biotechnological principles in agriculture will increase productivity. In clear terms, we are still far behind in consumer knowledge of GMPs and there is need for more robust efforts in bringing this great technology to the minds of the consumers.

Keywords: GMPs, GMOs, GMFs, respondents, perception, Cross River State

Introduction

Genetically modified product is most commonly used to refer to plants and animals that are created for human consumption using the latest molecular biology techniques. It usually involves the transfer of genes from one plant to another and in extreme cases, the transfer of animal genes into plants, for example the Bt corn (Saxena and Stotky, 2001). This aspect of biotechnology has over the years generated debates and arguments and a good number of people including the better informed section of the public seem to be confused about the benefits and possible dangers of the use of genetically modified (GM) foods.

It is widely recognized that biotechnology is one of the most innovative technologies developed in the 20th century with even more promising future in the 21st century. Many GM products such as rice with enhanced vitamin A, fruits and vegetables with extended shelf life have already entered the world's food distribution networks. These products have the potential to not only meet our basic need, but also bring a wide range of economic, environmental and health benefits to humanity. Biotechnology advocates emphasize the potential benefits of this great technology to the society through reduction of hunger, malnutrition, cure of diseases promotion of health and general wellbeing. United Nations Development Programme (UNDP, 2001) reported that many

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The abstract should not more than 200 words.

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Please respect Instructions for authors!
References should be numbered consecutively throughout the article, beginning with [1] for the first-cited reference. References should be listed at the end of the paper in the order in which they appear in the text.

References should be cited in the text by numerals in square bracket. For example;

..... Cell cycle arrest and apoptosis induction are targeted in the strategy of cancer therapy [1].

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47 GM crop varieties have shown superiority over conventionally grown crops in terms of yield,
48 pest and disease resistance, nutritional improvement and longer shelf life. With advent of
49 molecular technologies such as Clustered Regularly Interspaced Short Palindromic Repeats
50 (CRISPR), scientist are now snipping genes from microbes, plant, and even animals and
51 inserting them into the genome of desired organism in order to create new traits in plants
52 and animals with numerous economic values to mankind. Chronic hunger and malnutrition pose a
53 persistent threat for hundreds of millions of Africans. Modern biotechnology is therefore seen as
54 a form of emerging technology that can potentially reduce hunger and malnutrition, and is
55 anticipated to play a crucial role in advancing socio-economic development.

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57 The numerous merits associated with biotechnology notwithstanding, public attitude and
58 perception on GM products are divided. Some perceive GM products as reducing labour and
59 production cost, increasing productivity, satisfying nutritional needs, and improving economic
60 and environmental conditions. Others perceive GM foods as hazardous to health, ethically
61 unnatural, and possibly leading to a loss of biodiversity (Hossain *et al.*, 2002). Public perception
62 toward genetically modified (GM) products is crucial in understanding of modern biotechnology
63 and agricultural development. This is because public perception of GM products might influence
64 government regulations, consumer acceptance and farmers adoption of agricultural
65 biotechnology. The divided public perception on agricultural biotechnology has led governments
66 to make effort in supporting a number of studies to gauge the proven benefits and risk of GM
67 technology, facilitating greater involvement of stake holders in GM technology such as farmers,
68 the private sector, scientists, consumers, academia and the media to engage in dialogues for
69 greater acceptance of GM products and promoting the understanding of food safety and
70 environmental impact (Guere and Sun, 2012).

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72 Despite effort made by local and international donor organizations for the adoption of GM
73 technology, the technology continues to face low level of acceptance especially in the
74 underdeveloped and developing worlds. Public interest and concerns over genetically modified
75 organisms (GMOs) have been growing in recent times and are now top on national governments
76 and the world agenda where reducing poverty remains one of the major challenges in the region
77 (United Nations, 1992).

78
79 In Africa, very few countries use commercialized GM crops (Karembu *et al.*, 2009) despite the
80 level of hunger and food insecurity in this part of the world. It will be wise that African leaders
81 take steps in the direction that will save the future generation from perceived hunger, poverty and
82 dependency. GM technology is anticipated to produce food crops that will be cheaper and more
83 readily available because of improved yields and more stable production. The adoption of GM
84 crops has been negatively affected by public opinion and anti-GM lobby groups despite the
85 potential for increased food production in developing countries (Nuffield Council on Bioethics,
86 2003). Environmental risks such as gene flow, evolution of resistance in the targeted pest
87 populations, impacts on non-target organisms, and food safety are often raised (Smale and
88 DeGroote, 2003). Several studies have been conducted to assess consumer attitudes and
89 perceptions toward GM crops (Bett *et al.*, 2010; Kimenju and De Groote, 2008; Onyango *et al.*,
90 2006). Results revealed that consumers' perceptions toward the potential benefits and risks of
91 GM crops are still mixed and differ within and across countries. Moreover, consumer attitudes
92 toward GM crops change as consumers are exposed to new information (Smale *et al.*, 2009).

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93 Hence, information has a crucial impact on consumers' references for GM food products. Smale
94 *et al.* (2009) also highlighted the general lack of empirical studies integrating consumers'
95 preferences with farmers' adoption of GM crops in developing countries; that is, the propensity
96 to purchase and the propensity to adopt have rear consideration in a single study. Available
97 scientific knowledge and reviews by national and international science organizations on human
98 health indicate that GM foods are safe and suitable for human consumption (FAO, 2004; ICSU,
99 2004). Despite these assurances, a number of studies show that consumers in developed
100 countries consistently prefer non-GM foods (Costa-Font *et al.*, 2008; Lusk *et al.*, 2005). It
101 becomes imperative to explore the perception of the people of Calabar in Cross River State,
102 Nigeria on genetically modified products. The findings of this study will provide a baseline
103 information to researchers, academia, government and policy makers in the approach to adopt
104 GM products as friendly with great potential to contribute towards mitigating hunger in Nigeria.

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106 Materials and Methods

107 Study area and population

108 This study was carried out in four local government areas in Cross River State namely;
109 Odukpani, Calabar Municipality, Calabar South and Akpabuyo all in Southern Senatorial Zone
110 of Cross River State, Nigeria. Questionnaires were distributed to 1000 respondents in each of the
111 four local government areas giving a total of 4000 participants.

113 Distribution of Questionnaire

114 Questionnaires were distributed to respondents who were mainly civil servant, business
115 men/women and famers. Major information included were age, occupation, educational level
116 knowledge of genetically modified products, length of information, source of information, and
117 general knowledge of genetically modified crops.

119 Statistical analysis

120 Data obtained from the respondents were analyzed using SPSS version 20.0. The results obtained
121 were presented in simple percentages using charts for ease of comparison.

122 Results

123 Demographics of respondents

124 The results presented in Table 1 showe~~d~~ that majority of the respondents were males (51.20%),
125 while the rest (48.80%) were females. The mode age bracket was 25-35 years (46%) for 1840
126 respondents, 36-45 age bracket was 29.25% for 1170 respondents, 46-55 age bracket was 15.5%
127 for 620 respondents and 56 & above was 9.25% for 370 respondents. It was also revealed that
128 48.25% of respondents were single, 34.5% were married, while 17.25% were widows. Also, 27%
129 of the respondents were civil servants, 22.25% were business men and women, 14.5% were
130 farmers, 12.5% were applicants and 23.75% were other occupations not specified in the
131 questionnaire. On educational background of the respondents, 7.75% of respondents stopped at
132 primary education level, 17 % had secondary education, 65.25% had tertiary education, and 10%
133 had no formal education. Thus, most respondents had the benefit of tertiary education.

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Table 1
Demographic analysis of respondents

Gender	Male (%)	Female (%)			
	51.20	48.80			
Age	25-35 years (%)	36-45 years (%)	46-55 years (%)	56- above (%)	
	1840 (46)	1170 (29.25)	620 (15.5)	370 (9.25)	
Marital status	Single (%)	Married (%)	Widows (%)		
	48.25	34.5	17.25		
Occupation	Civil servants (%)	Businessmen/women (%)	Farmers (%)	Applicants (%)	Others (%)
	27	22.25	14.5	12.5	23.75
Education	Primary (%)	Secondary (%)	Tertiary (%)	None (%)	
	7.75	17	65.25	10	

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142 **Knowledge and perceptions of respondents on GMPs**

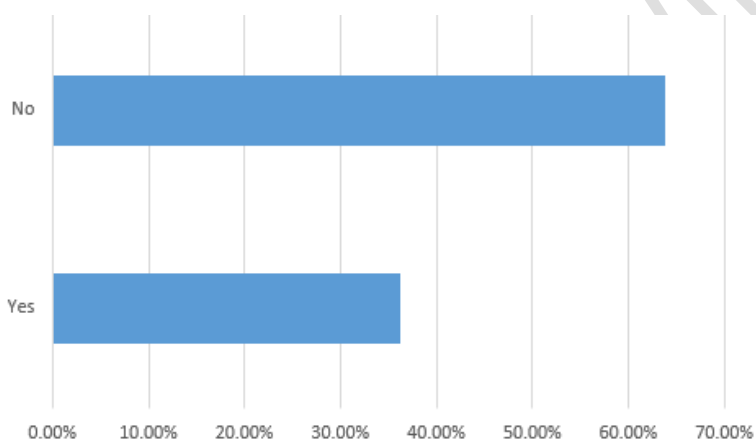
143 In Figure 1, respondents were asked if they have heard of GMPs prior to this study and it was
144 found that 63.75% of the population have not heard of GMPs, while 36.25% of the population
145 have heard of GMPs. On the length of information on GMPs, 60.5% of the respondents were just
146 hearing of GMPs for the first time, 10% heard of GMPs for (1-2) years, 11.5% have heard of
147 GMPs for (3-4) years, 6% have heard of GMPs for (5-6) years, and 12% have heard of GMPs for
148 6 years and above (Figure 2). From Figure 3, it can be observed that the main source of
149 information was from other means of communication (63.75%), followed by the television
150 (13%), friends (10.25%), newspaper (7.25%) and radio (5.75%). From the questionnaire, 8% of
151 the respondents strongly agreed that GMFs will modify their genes, 27.75% agreed, 46.5%
152 disagreed and 17.75% strongly disagreed (Figure 4). In similar fashion, 6.25% of the
153 respondents strongly agreed that GM food is better than conventional food, 22.75% agreed,
154 46.5% disagreed and 17.75% strongly disagreed (Figure 5).

155

156 It was also revealed that 23.4% of the respondents strongly agreed to have fear for GM products,
157 47.41% agreed to fear, 34.12% disagreed while 10.12% strongly disagreed to having any fear for
158 GM products (Figure 6). Results on ethical acceptability of GMFs revealed that, 15.25% of the
159 respondents strongly agreed that GMFs are not ethically acceptable, 34% agreed, 36% disagreed
160 and 14.75% strongly disagreed (Figure 7). From Figure 8, it is found that 35% of the
161 respondents strongly agreed that GMPs can cause health damage, 45.5% agreed, 15.5%
162 disagreed and 4% strongly disagreed. 22% of the respondents strongly agreed that GMPs are
163 unnatural and can lead to chronic disease, 57.5% agreed, 16.5% disagreed and 4% strongly

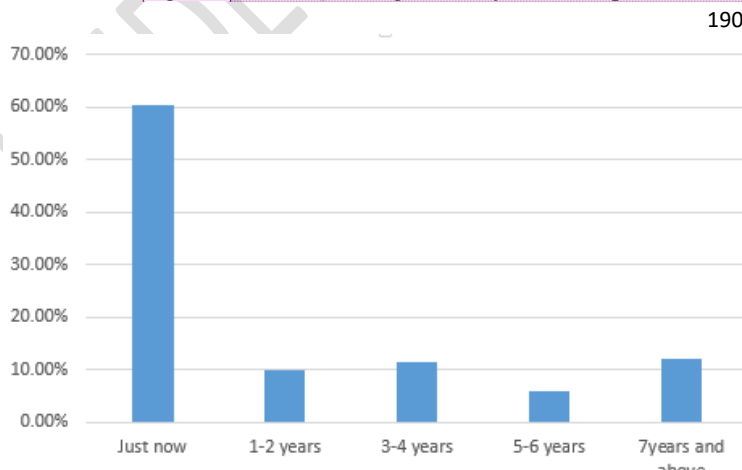
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164 disagreed as shown in **Figure 9**. While, 25.25% of the respondents strongly agreed that GMPs
 165 harm the environment, 49.75% agreed, 21.25% disagreed and 3.75% strongly disagreed (**Figure**
 166 10). Notably, 24% of the respondents strongly agreed that GM technology in food production
 167 will increase productivity, 58.5% agreed, 14.25% disagreed and 3.25% strongly disagreed (**Figure**
 168 11). From the survey, 19% of the respondent strongly agreed that the benefit of GMPs far
 169 outweighs the risk, 43% agreed, 33% disagreed and 5% strongly disagreed as presented in **Figure**
 170 12. From Figure 13, **it can be noted that** 16.75% of the respondents strongly agreed that
 171 GM foods are good for national economy, 57% agreed, 22.25% disagreed and 4% strongly
 172 disagreed. The results in **Figure 14** revealed that 16.75% of the respondent strongly agreed that
 173 GM technology improve yield, pest resistance and drought tolerance, 65.5% agreed, 15.25%
 174 disagreed and 2.5% strongly disagreed. From **Figure 15** it **is was** revealed that, 33% of the
 175 respondent strongly agreed that the government should fund GM research, 45.25% agreed,
 176 18.25% disagreed and 3% disagreed.



189 **Figure 1:** Awareness of genetically modified products (GMPs)

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Figure 2: Perception on the length of Information on GMPs

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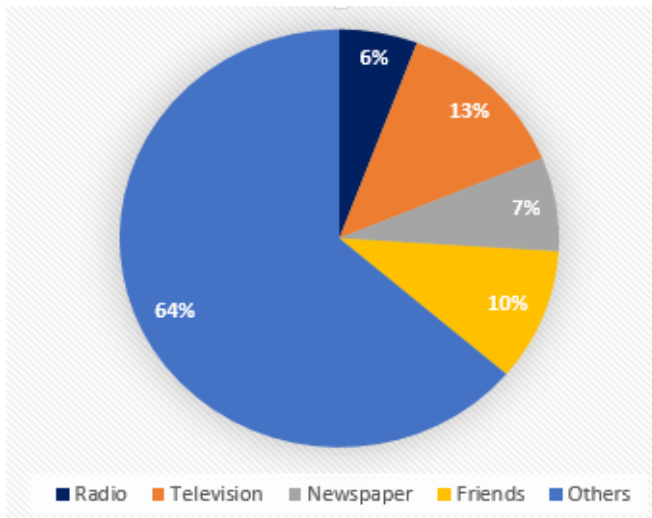
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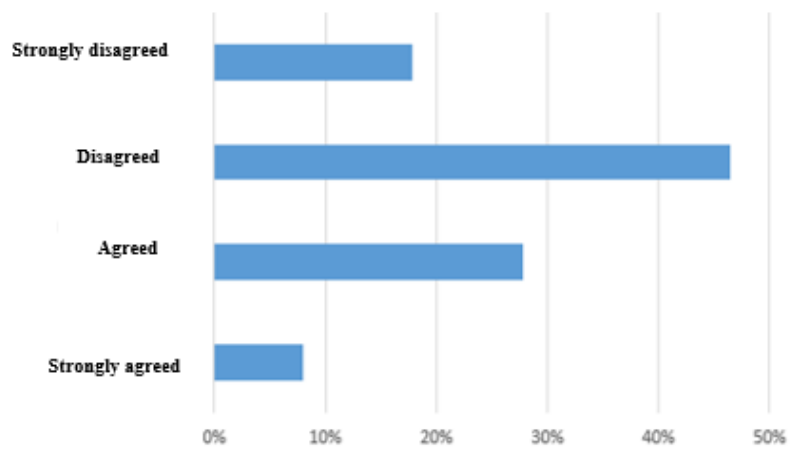
Figure 3: s. Source of information on GMPs

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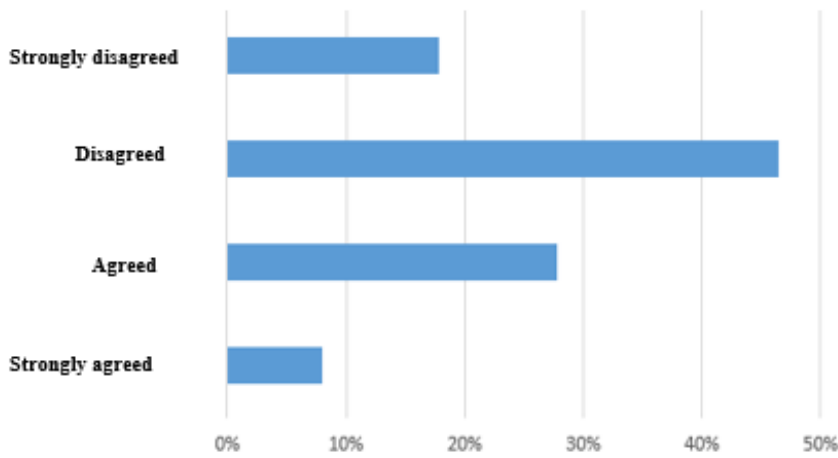


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Figure 4: Perception on GM foods modifying genes

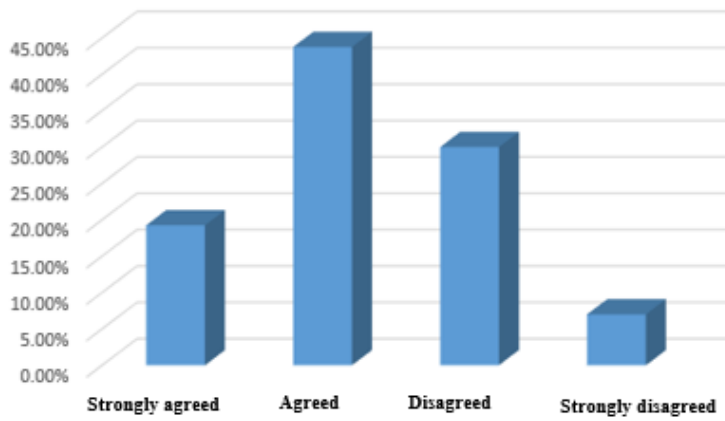
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Figure 5: Perception on comparing GM foods and conventional foods

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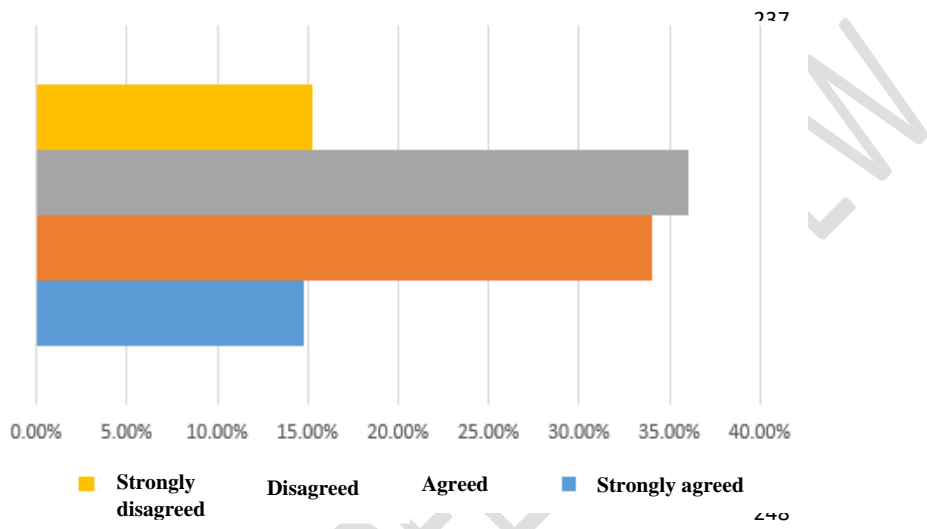


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Figure 6: Perception on fear for GM products

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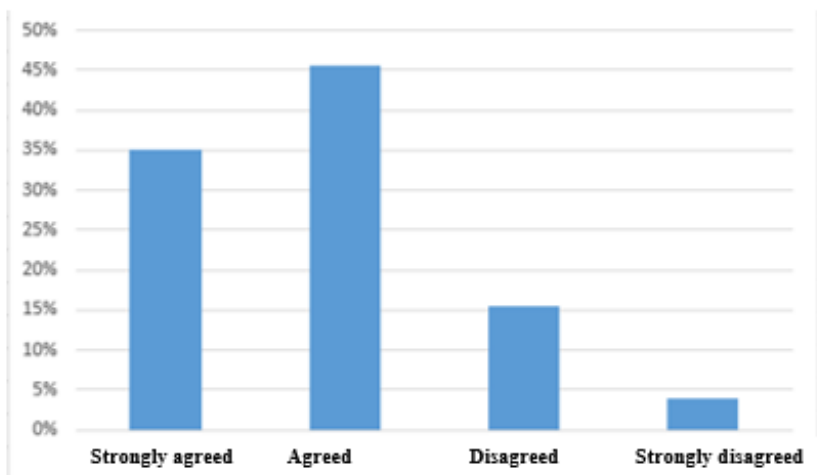
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Figure 7: Perception on ethical acceptability of GMFs

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Figure 8: Perception on GM products causing health damage

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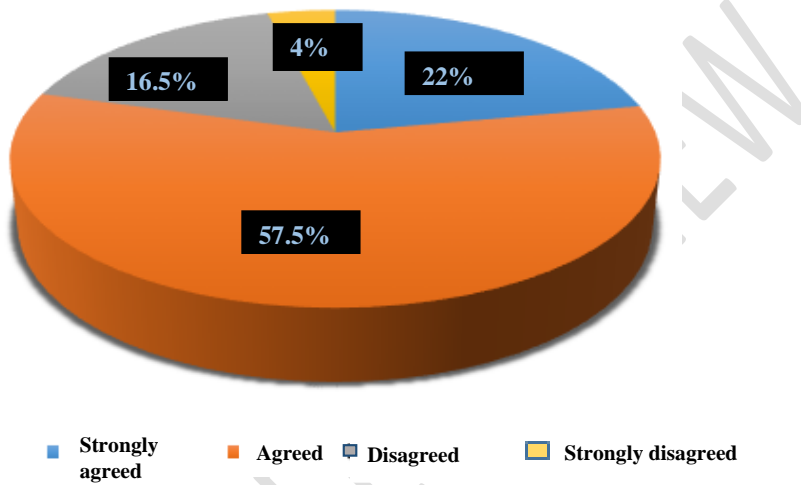
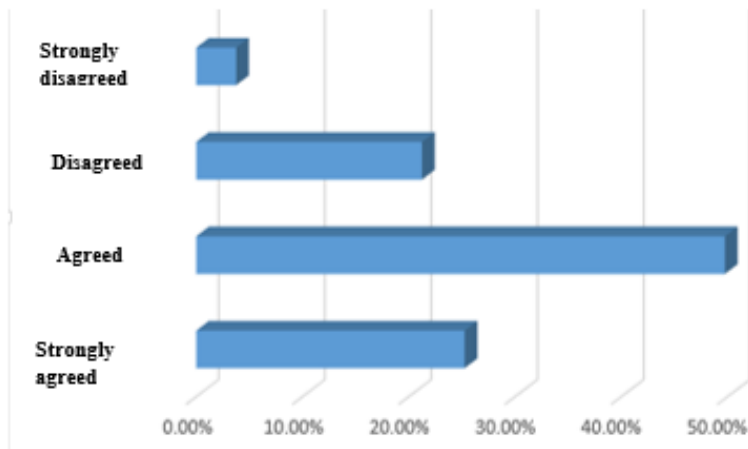


Figure 9: Perception on GM products being unnatural and leads to chronic disease

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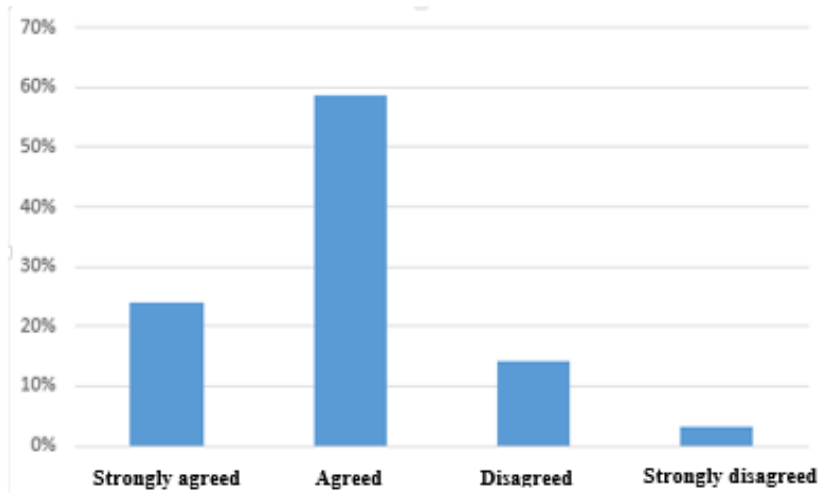


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Figure 10: Perception on GMPs causing harm to the environment

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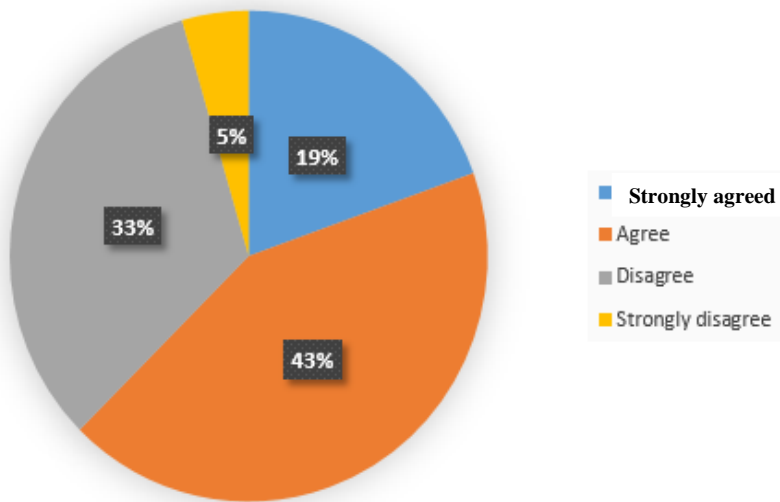


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Figure 11: Perception on increased food production using GM technology

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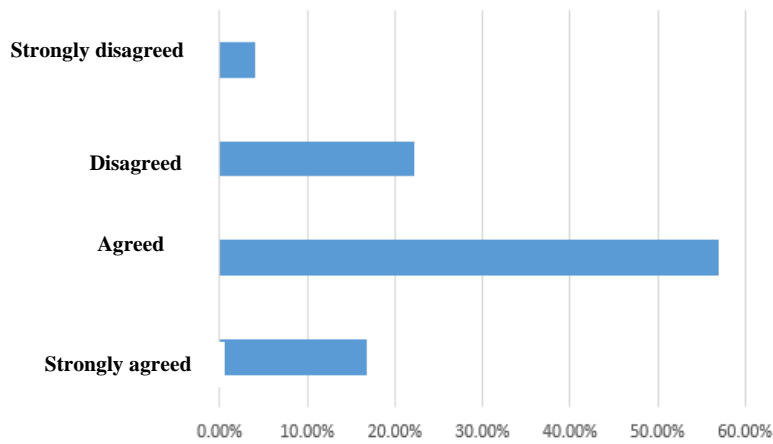
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Figure 12: Perception on the benefits of GMPs



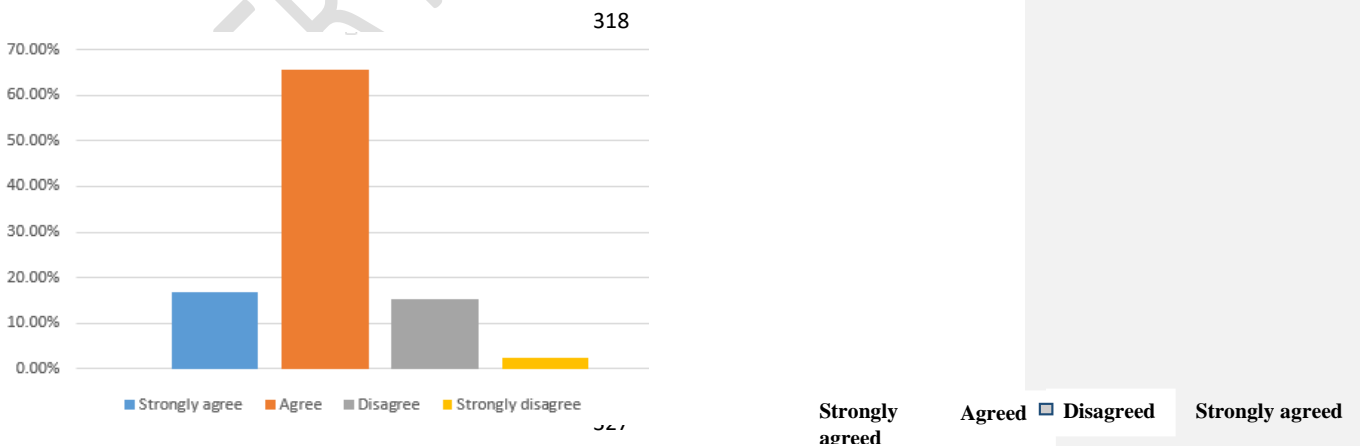
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Figure 13: Perception on GM foods on national economy



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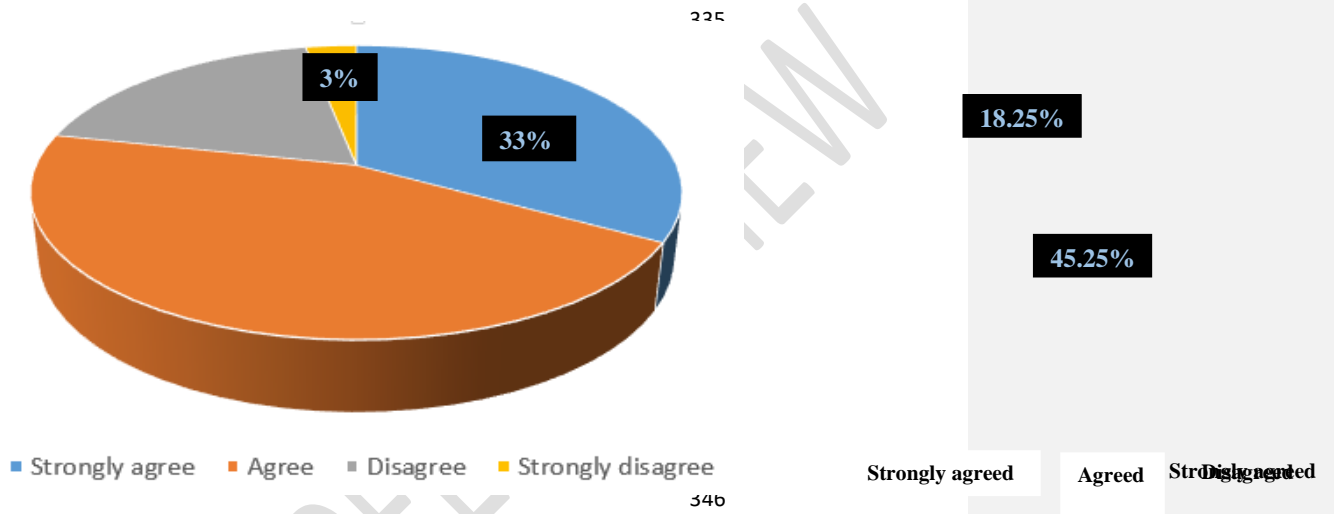
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Figure 14: Perception on GM technology to improve yield, pest resistance and drought tolerance

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Figure 15: Perception of government funding Gm research

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350 **Discussion**

351 GM products have been in the food system for decades and are becoming even more present, yet
352 consumer knowledge and awareness are not improving especially in the developing world which
353 includes Cross River State in Nigeria. Majority of the respondents who participated in the study
354 were males. Mucci and Hough (2004) studied consumer perception and purchase intentions for
355 GM foods in Argentina and found out that GM food was more acceptable by male consumers
356 than ~~by~~ females. Christoph *et al.* (2008) examined consumer attitudinal clusters based on
357 acceptability of genetic modification in Germany and found that GM supporters tended to be
358 older and were more often male than female. Similar studies done in the United States found that
359 women are less supportive of GM crops and foods than their male counterparts (Hossain *et al.*,
360 2002). Females, especially from developing countries, are generally less knowledgeable, less
361 interested, and less supportive of science and technology than males (Anunda *et al.*, 2010). These
362 reports corroborate the submissions of the findings of our study.

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364 Respondents with younger age have higher knowledge of GMFs compared to older age. This
365 shows that old people are not fully aware of GMPs. This may be as a result of their educational
366 background or not having the opportunity to be educated. It is imperative to purport that the
367 move to advocate GMFs is more promising with the younger age brackets ~~that who~~ may have
368 more capacity to broadcast the technology through the new emerging platforms. Most of these
369 younger people are single and are free to engage in the activities that will promote wider
370 coverage of GMFs such as consumer education. More participants were in active service which
371 suggests that their level of education must have influenced their knowledge of the GMF. There is
372 a great concern over the low percentage of farmers (14.5%) that participated in this study who in
373 most cases reported that they have no idea about GMFs. This calls for more translation of the
374 science behind GMF to farmers and proper sensitization on the benefits of GM crops to fully
375 engage them in advocating GM products. From the survey, it was clear that the level of
376 education has a positive relationship with the knowledge of participants on GM products as most
377 of the participants reported to have had tertiary education. Department stores, where items are
378 labelled and price-tagged, seem to belong to the learned, who can read and write. Often, to shop
379 with pre-written list of needs. Therefore, one expects them to be knowledgeable of GMFs (Eneh
380 *et al.*, 2016).

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382 Surveys show that 63.75% of the residence in Cross River State that were captured in the
383 questionnaire were unaware of GMOs or do not fully understand GM products, their traits and
384 they themselves are dissatisfied with their self-rated knowledge, indicating a desire and a need
385 for wide spread consumer education. The low level of awareness of GMPs in Cross River State
386 is a call on the government within and outside as well as biotechnology companies to create
387 platforms to disseminate information to the people of Cross River State and Nigerians by
388 extension. In recent time, the government of Nigeria has recently approved Bt cotton as its first
389 genetically modified crop in 2018 as a pest-resistance variety of cotton, a step to revitalization of
390 its textile industry and boosting economic development (Isaac, 2018). In 2019, National
391 Biosafety Management Agency in Nigeria approved a genetically engineered cowpea variety
392 (pod borer resistant) for utilization by Nigerian farmers (Adebowale, 2019). Pod borer insect,
393 *Maruca vitrata* can reduce yield by 80% in cowpea and the cultivation of the resistance variety is
394 a promising approach to yield improvement with the potential to boosting Nigerian economy and
395 contributing to food security. Despite this approaches by the Nigerian government in adopting

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396 | GM crops, ~~its her~~ citizens are still lacking the awareness of the advances, the basic science
397 behind GM crops and the benefits inherent in their utilization. This is evidence in the results of
398 the survey obtained in this study which revealed that 60.5% of the respondents were just hearing
399 of GMPs for the first time, 10% know of GMPs for 1-2 years, 11.5% for 3-4 years, 6% for 5-6
400 years, and 12% for 7 years and above. It was revealed that among the respondents who have
401 heard about GMP, greater percentage sourced information from means other than television,
402 newspapers, radio and friends. It is therefore recommended that efforts taken on consumer
403 education and sensitization programmes for the general public should be further increased.
404

405 The low level of awareness and lack of public engagement in biotechnology and genetically
406 modified food is a key premise in acceptability of GMPs over the conventional foods where most
407 of the respondents agreed that conventional food is better than GM food. The public need to be
408 properly guided with special emphasis on the safety of GM food after consumption and should
409 be made to understand that GM crops have been tested through robust trails to be
410 environmentally friendly before their approval and subsequent release. Subjectively, the benefits
411 associated with GM crops as advanced ways to fighting food insecurity far outweighs any
412 perceived controversial demerits. It will be a very unwise decision if this promising science is
413 stamped through the nonchalant and recalcitrant views of the public towards its acceptability.
414 Therefore and most importantly, the government and biotechnology agencies have a very critical
415 role to play in creating a wide coverage of public enlightenment on the benefits of GMPs in
416 Cross River State and Nigeria as a whole.
417

418 **Conclusion**

419 Explicitly, the knowledge of the respondents on genetically modified product was quite low and
420 by implication, this maybe the general knowledge status of other Nigerians on GMPs. It is
421 therefore very urgent that the respective advocates of GMPs doubled their effort in consumer
422 education and more public enlightenment on the many benefits inherent in the use GMPs.
423

424 | **Competing interest:** Authors have declared that no competing interest exists.

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Comment [H41]: The authors should ensure that every reference cited in the text is also present in the reference list (and vice versa). References should be numbered consecutively throughout the article, beginning with [1] for the first-cited reference. References should be listed at the end of the paper in the order in which they appear in the text.
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Ramesh CK, Rehman A, Prabhakar BT, Vijay Avin BR, Aditya Rao SJ. Antioxidant potential in sprouts vs. seeds of *Vigna radiata* and *Macrotyloma uniflorum*. *Journal of Applied Pharmaceutical Science*. 2011; 1(3):99-103.

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