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# Paradigm on Genetically Modified Foods

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## Abstract

*GM foods (genetically modified foods) are produced by incorporating the desired gene into the genome of the host plant, there by introducing desirable changes in the host using techniques of genetic Engineering. Genetic Engineering is more advantageous compared to selective breeding in bringing about desirable changes in a much faster way. The world population is expected to reach 9 billion people by the year2050, requiring 70% more food than what is produced at present. Food security is needed for growing population which cannot be met by conventional breeding methods because of limited land resources and other environmental conditions. Since GM foods offer superior qualities, give higher yield and can be grown in a wide variety of environmental conditions compared to conventionally grown foods, they are the only way to meet the required food demand. Till now only a small percentage of total agricultural land was being used for the cultivation of GM crops. This is the situation all around the world which should be changed. So the government should take necessary measures to educate the farmers regarding the beneficial characters of GM crops and encourage them to cultivate the same. People around the globe are having many doubts and myths regarding the safety of GM foods. This could be due to lack of proper awareness regarding GM foods and added to this many companies are misleading the public by printing false and misleading labels on their products like - 'GM free foods', 'Safe and GM free' etc. In this context, the current study is undertaken to know the awareness, acceptability and myths' regarding GM foods among Educated and Uneducated communities through a questionnaire supplied to them. The statistical significance of the data obtained was tested by using Fisher-exact test.*

**Keywords**: GM foods, selective breeding, genome, genetic engineering, food security, fisher-exact test.

## Introduction

GM foods are produced from GM crops by incorporating desired gene for enhancing desired traits or to improve nutritional content. The desired traits can be also be enhanced by traditional methods like conventional breeding but these processes are tedious, take more time and sometimes we may not get the desired change. Genetic engineering offers very rapid and accurate production of plants with desired traits[1]. Plant based GM foods are more wide spread like corn, potatoes, soybeans, canola, tomatoes etc compared to animal based GM foods. The first GM food that was produced is tomato, named Flavr Savr, which is produced by incorporating a desired gene that delays the process of ripening[2]. Currently, most of the foods in the supermarkets are containing one or more products from GM foods. GM foods have several advantages over commercially grown foods in a number of ways. The role of GM foods in achieving food security cannot be over ruled. Food security is becoming a major problem around the globe. Around 900 million people in the world are undernourished[3]. Since the population is growing enormously the food demands of the people cannot be met by traditional way of farming. This may be due to reduced land, water resources and adverse climatic and environmental conditions that may in other wards reduce the food production. Development of GM foods divided the educated community in to 2 groups, the proponents and the opponents. Proponents of the GM foods say that GM crops are the only way in achieving food security and are the keys to reduce world hunger[4,5], whereas opponents of GM foods say that this technology causes further risk to food security[6,7]. But speaking really genetic engineering is the only option through which one can enhance the yield, improve the crop quality and can improve the nutritional requirements according to our needs[8,9]. According to ISAAA's report, 25% of the globe that comes to around 170 million hectares was cultivated with plant varieties like Soya bean, Canola, Cotton and Corn. India, Brazil, Argentina, China and South Africa are the five countries those together growing nearly 50% of the world wide cultivated GM crops[10]. But unfortunately agriculture commodity prices were higher compared to productivity gains from GM technology, which can be solved by the commercialization of more GM crops[11]. The main drawback concerned to this is lack of public acceptance[12]. Most of the people around the globe are having many myths regarding production of GM crops with respect to adverse social implications, health and environmental risks. This is mainly due to narrow thinking of politicians under the influence of a few NGO's who are becoming major obstacles for country's agricultural progress. This was clearly evident in the marketing of insecticide resistant Bt Brinjal, India's first GM food.

**GM Foods and Food security:** Genetic Engineering has a role to play as we face up to the challenge of global food insecurity. But it is not magic bullet. Food security can be achieved by increasing the productivity. Increased productivity depends on improved seed and better varieties of staple and specific crops which can only be possible through Genetic modification[13]. One can get better yield by making the plants resistant to Insects and viruses. For example, Insect resistant varieties can be produced by incorporating a specific gene from *Bacillus thuringiensis* into the host plant which produces an endo toxin that paralyses the gut of Insects and ultimately kills when they eat the host plants, thus making them resistant to Insects[14]. Introduction of drought tolerant varieties of Maize contributed to significant food security in Africa. Africa, the most vulnerable country that has faced most severe droughts during the last ten years suffered a lot with severe food insecurity. The farmers there rely solely on rainfall for cultivating their crops. But the severe droughts made the crop production very difficult. This problem is solved to certain extent by the introduction of drought tolerant Maize variety[15]. Genetic engineering also enhances the nutritional quality as well as oil production as is seen with GM oilseed rape (canola) [16]. The development of European corn borer resistant maize contributed to significant increase in the production of maize in European countries[17]. Production of GM maize with enhanced vitamin A content helps to fight against vitamin A deficiency in countries where maize is the staple food[18]. Another important achievement with regard to genetic engineering is the development of herbicide resistant varieties. Weeds, which are major obstacles for the growth of crops, can be killed by using the weedicide glyphosate. But at the same time glyphosate affects the normal crop plants also. This problem is solved by the development of glyphosate resistant varieties. The best example for this is soya beans, whose production is significantly enhanced by the development of glyphosate resistant soya beans[19]. Another break through is the production of Genetically Modified Rice with an enhanced vitamin A content[20]. Since rice is a major staple food, and most widely consumed food in India, genetically modified rice with β carotene genes may play an important role in the elimination of deficiency of vitamin A (night blindness, xeroph-thalmia and keratomalacia). By using Genetic engineering it is also possible to produce salt tolerant plants so that one can grow the crops near salty soils which are otherwise not suitable for plant growth[21]. The technology of genetic engineering can also be extended for the production of oral vaccines by incorporating specific antigens into certain varieties of host plants which produce vegetables and fruits with vaccine preparations[22]. Not only vaccines many therapeutic proteins, growth factors, cytokines, antibodies, hormones, recombinant enzymes and human and veterinary vaccines can also be produced by employing Genetic engineering techniques[23].

**Regulations on GM Foods:** GM foods are subjected to strict regulations all around the world. In USA, three agencies like EPA (Environmental Protection Agency), FDA (Food and Drug Administration) and USDA (United States Department of Agriculture) look after the projects that involve GM crops. EPA mainly looks for pesticidal residues in the GM foods and verifies whether the toxin produced by the gene introduced into the host plant is safe for the environment and also ensures that the foreign protein produced by the plant is allergenic or not[24]. FDA mainly looks for the GM foods that are consumed by the animals and human beings. The statement issued by the FDA in 1992 has given relief to GM cultivators. The statement says "that there was no reason to believe that genetically modified foods differ from other foods in any meaningful or uniform way". Under FFDCA (Federal Food, Drug, and Cosmetic Act) GM crops are designated as "Generally regarded as safe". However FDA reserves the right to take serious actions if the introduced gene product into a host crop plants produces foreign proteins that are harmful to mankind and animals. In such cases, pre market approval is mandatory. USDA; in association with its sister concern APHIS (Animal and Plant Health Inspection Services) regulates GM foods under Plant Protection Act. This act regulates GM plants if they were produced by the transfer of genes using *Agrobacterium tumefaciens*. In India GM foods are regulated by the Rules, 1989, which works under Environmental (Protection Act), 1986. The main aim of all these agencies is to ensure safety of GM foods with respect to human health and environmental concerns.

**Labelling of GM Foods:** Labelling enables the consumers to get the information about the products which allows them to select their food on the basis of choice. But at the same time labels on the products should not mislead the public. One of the principles of labelling in the U.S is, labels cannot be misleading. But some manufactures are labelling their products with false and misleading labels like 'safe and GM free', 'GM free foods' etc. Such kind of labels misleads both educated and uneducated communities with respect to the safety of GM foods. So government has to place strict regulations to avoid such type of labelling. Labelling of food products is mandatory in European Union and in other 21 countries[25,26]. Labelling sometimes poses certain problems like, some consumers won't prefer products containing GE products due to wrong notion that in turn may be due to lack of proper awareness regarding GM foods[27]. The mandatory labelling of GM foods was opposed by AMA (American Medical Association) by adopting a statement "there is no scientific justification for special labelling of genetically modified bioengineered foods, as a class, and that voluntary labelling is without value unless it is accompanied by focused consumer education." But most of the people (more than 95% of consumers) support mandatory labelling of GM foods. Some people even argue that one should have a choice related to the type of products they purchase and consume and in fact consumers are having every right to know the information regarding the constituents in their food, especially those products which can cause health problems.[28].

## Methodology

**Sources of data:** Primary data is collected by using Questionnaire supplied to the participants of Academic Staff College, 72nd Orientation programme, S.V. University, Tirupathi and this group (consisting of 41 members) was considered as heterogeneous educated community as the participants are from different regions of the Andhra Pradesh state. The same questionnaire is also supplied to uneducated community (common people, 41 members) who are selected randomly and the people belonging to this community were not highly educated but they have very little educational background. Both the communities were given some information regarding the GM foods and the method of production of GM foods prior to giving them the questionnaire. Secondary data is collected from Internet, books and related literature.

**Analysis of Data**: Null and Alternative hypothesis were framed and the data is analyzed by comparing the two individual groups (People belonging to higher education community Vs uneducated community (common people)) by Fisher-exact test.
Null Hypothesis: There is no significant difference between the opinions of both the communities regarding GM foods.
Alternative Hypothesis: There is difference between the opinions of both the communities regarding GM foods.

**Interpretation of data**: The data is interpreted by the findings from Fisher-exact test.

## Results and Discussion

**Results:** Two tailed Fisher-exact test was used for comparing responses of un-paired groups i.e., educated and uneducated population (common people) for question 1 to 4 and for questions 6 to 12. The result is considered to be significant if p-value is less than 0.05 ($p<0.05$) and is not significant if p-value is greater than 0.05 ($p>0.05$). Since the obtained p-values for all the questions 1 to 4 (tables – 1 to 4) and 6 to 12 (tables – 6 to 12) are greater than 0.05, the result is not significant. So we accept the null hypothesis i.e., there no significant difference between the opinions of both the communities regarding GM foods.

Regarding the 5th question, we have used Chi-Square test for comparing the responses of both the communities and the result is not significant as the p-value is greater than 0.05 ($p = 0.3270$) (table - 5). So for this question also we have to accept null hypothesis.

**Discussion:** Both the communities, educated and uneducated (common people) were briefly explained regarding the GM foods and their production prior to providing them with the questionnaire. Coming to higher education community - though most of the participants are aware of i.e., they heard about genetically modified foods as the study was conducted on people working as lecturers in degree colleges and Assistant professors of Universities, most of them doesn't know many of the beneficial characters regarding GM foods such as their improved nutritional quality, their role in food security, ability to grow in marginal soil, their longer shelf life, their resistance towards diseases, Herbicides, Pesticides, Floods, Frost, Droughts etc. Though most of the participants responded that consumption of GM foods is safe but coming to preference most of the respondents preferred conventional foods rather than GM foods. This clearly indicates that they are not having a clear cut idea regarding the safety of GM Foods. Around 30% of the participants are in a wrong notion that consumption of GM Foods leads to genetic disorders thinking that the genes which are introduced in the genetically modified organisms may cause some problems to their systems after consumption. Around 83% of the respondents opined that there should be regulations on the GM foods and even labeling is also necessary on the GM foods.

Coming to Uneducated community (common people) – The people belonging to this community are not higher educated but they have some basic educational background. This community were being explained regarding genetically modified foods prior to providing them with the questionnaire. Most of the participants were unaware of GM Foods and opined that consumption of GM foods is not safe and may cause genetic disorders. Regarding choice of food, most of the respondents preferred conventional foods rather than GM foods. Around 90% of the respondents opined that there should be regulations on the GM foods and even labelling is also necessary on the GM foods.

The findings from both the communities were almost matching. Irrespective of their educational background, both educated and uneducated (common people) communities reacted in the same way regarding the safety and consumption of GM foods. Both the communities opined that there should be regulations on GM foods and labelling is compulsory in order to differentiate the two types of foods.

## Conclusion

From the above findings it is evident that there is no significant difference regarding the awareness of GM foods between the two communities. Both well qualified people and common people are having same opinions regarding the safety of GM foods. So it is the responsibility of the government to take necessary measures to educate the entire population regarding the paradigms on GM foods. Government should also need to take care of those people who misleads the public by false or misleading labelling on foods such as GM free and pure food – GM free etc by framing tight regulations regarding marketing of GM foods. Since the population is growing enormously and the land resources are not sufficient to meet the food requirement of growing population and as well the supply of food by conventional breeding methods is very difficult and also use of Herbicides and Pesticides may cause health problems in

workers, Pollute natural habitats, detrimental to insect biodiversity, may create secondary pests and insect races that are resistant to pesticides etc. So "Genetics is always better than chemicals". Finally to conclude "GM or no GM is a false issue, Sustainability is the real issue". Through science and through ethics we have come to the realization that we are bound by the laws of Nature. We must obey those laws to make agriculture (and civilization) sustainable. Our agricultural practices must reflect our new awareness that many practices threaten sustainability. Food production must be equitable and just, and sustainable, for all the peoples of the Earth and finally it is to say that the preference is not between GM foods and Conventional foods but between sustainable and unsustainable agricultural practices.

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Q1. Are You Aware of Genetically Modified Foods (GM Foods)? – Yes/No

**Table-1**

**Comparison between the opinions of both the communities with respect to Q1**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for Educated community | % of Responses for Uneducated community |
|---|---|---|---|---|
| Yes | 40 | 5 | 97.56 | 12.20 |
| No | 1 | 36 | 2.44 | 87.80 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 1.0000
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q2. Do you think GM Foods have role in achieving food security? Yes/No

**Table-2**

**Comparison between the opinions of both the communities with respect to Q2**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 35 | 4 | 85 | 9.76 |
| No | 6 | 37 | 15 | 90.24 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 1.0000
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q3. Do you think that the consumption of GM Foods leads to Genetic disorders? Yes/No

**Table-3**

**Comparison between the opinions of both the communities with respect to Q3**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 13 | 36 | 31.71 | 87.80 |
| No | 28 | 5 | 68.29 | 12.20 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 1.0000
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q4. Do you think that there is difference between conventionally grown foods and GM Foods in terms of their Nutritive value? Yes/No

**Table-4**

**Comparison between the opinions of both the communities with respect to Q4**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 32 | 5 | 78.05 | 12.20 |
| No | 9 | 36 | 21.95 | 87.80 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 0.0611
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q5. Which food do you choose when both GM Foods and conventional foods are available in the Market? A. Conventional foods B. GM Foods C. Both

**Table-5**
**Comparison between the opinions of both the communities with respect to Q5**

| Opinion of Respondents | Response of Educated community | Response of Uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Conventional Foods (A) | 30 | 35 | 73 | 85.36 |
| GM Foods (B) | 9 | 5 | 22 | 12.20 |
| Both (C) | 2 | 1 | 5 | 2.44 |
| **Total** | 41 | 41 | 100 | 100 |

**Chi Square Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 0.3270.
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q6. Are you aware that GM Foods have longer shelf life? Yes/No

**Table-6**
**Comparison between the opinions of both the communities with respect to Q6**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 30 | 5 | 73 | 12.20 |
| No | 11 | 36 | 27 | 87.80 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 0.2998.
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q7. Do you know that GM crops do not require spraying of Herbicides and Pesticides? Yes/No

**Table-7**
**Comparison between the opinions of both the communities with respect to Q7**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 32 | 4 | 78 | 9.76 |
| No | 9 | 37 | 22 | 90.24 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 1.0000
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q8. Are you aware that GM crops can be grown in all climatic conditions? (Saline conditions, drought conditions, frost conditions) Yes/No

**Table-8**
**Comparison between the opinions of both the communities with respect to Q8**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 25 | 4 | 61 | 9.76 |
| No | 16 | 37 | 39 | 90.24 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 1.0000
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q9. Are you aware that GM crops are resistant towards various diseases? Yes/No

**Table-9**
**Comparison between the opinions of both the communities with respect to Q9**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 28 | 3 | 68.3 | 7.32 |
| No | 13 | 38 | 31.7 | 92.68 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 1.0000
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q10. Do you think that GM foods are safe for consumption? Yes/No

**Table-10**

**Comparison between the opinions of both the communities with respect to Q10**

| Opinion of Respondents | Response of Educated community | Response of Uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 28 | 3 | 68.3 | 7.32 |
| No | 13 | 38 | 31.7 | 92.68 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 0.2317
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q11. Do you think that there should be regulation on GM Foods? Yes/No

**Table-11**

**Comparison between the opinions of both the communities with respect to Q11**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 35 | 38 | 85.37 | 92.68 |
| No | 6 | 3 | 14.63 | 7.32 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 0.0511
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

Q12. Do you think that labelling is necessary for GM Foods? Yes/No

**Table-12**

**Comparison between the opinions of both the communities with respect to Q12**

| Opinion of Respondents | Response of Educated community | Response of uneducated community | % of Responses for educated community | % of Responses for uneducated community |
|---|---|---|---|---|
| Yes | 34 | 38 | 83 | 92.68 |
| No | 7 | 3 | 17 | 7.32 |
| Total | 41 | 41 | 100 | 100 |

**Fisher Exact Test Result based on the above data:** *The p-value obtained by using Fisher Exact test is 0.0703
**Inference**: Since P value > 0.05, the result is not significant. So Null Hypothesis is accepted.

## APPENDIX

Q1. Are You Aware of Genetically Modified Foods (GM Foods)? – Yes/No

**Fisher Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q1**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 1 2.44 2.78 | 35 85.37 97.22 | 36 87.80 |
| **1** | 0 0.00 0.00 | 5 12.20 100.00 | 5 12.20 |
| **Total** | 1 2.44 | 40 97.56 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 1 |
| **Left-sided Pr <= F** | 1.0000 |
| **Right-sided Pr >= F** | 0.8780 |
| | |
| **Table Probability (P)** | 0.8780 |
| **Two-sided Pr <= P** | 1.0000 |

**Sample size – 41**

Q2. Do you think GM Foods have role in achieving food security? Yes/No

**Fisher Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q2**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 6 14.63 16.22 | 31 75.61 83.78 | 37 90.24 |
| **1** | 0 0.00 0.00 | 4 9.76 100.00 | 4 9.76 |
| **Total** | 6 14.63 | 35 85.37 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 6 |
| **Left-sided Pr <= F** | 1.0000 |
| **Right-sided Pr >= F** | 0.5170 |
| | |
| **Table Probability (P)** | 0.5170 |
| **Two-sided Pr <= P** | 1.0000 |

**Sample size – 41**

Q3. Do you think that the consumption of GM Foods leads to Genetic disorders? Yes/No

**Fisher Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q3**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 24 58.54 66.67 | 12 29.27 33.33 | 36 87.80 |
| **1** | 4 9.76 80.00 | 1 2.44 20.00 | 5 12.20 |
| **Total** | 28 68.29 | 13 31.71 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 24 |
| **Left-sided Pr <= F** | 0.4863 |
| **Right-sided Pr >= F** | 0.8689 |
| | |
| **Table Probability (P)** | 0.3552 |
| **Two-sided Pr <= P** | 1.0000 |

**Sample size – 41**

Q4. Do you think that there is difference between conventionally grown foods and GM Foods in terms of their Nutritive value? Yes/No

**Fisher Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q4**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 6 14.63 16.67 | 30 73.17 83.33 | 36 87.80 |
| **1** | 3 7.32 60.00 | 2 4.88 40.00 | 5 12.20 |
| **Total** | 9 21.95 | 32 78.05 | 41 100.00 |

**Fisher's Exact Test Result**

| **Fisher's Exact Test** | |
|---|---|
| **Cell (1,1) Frequency (F)** | 6 |
| **Left-sided Pr <= F** | 0.0611 |
| **Right-sided Pr >= F** | 0.9945 |
| | |
| **Table Probability (P)** | 0.0556 |
| **Two-sided Pr <= P** | 0.0611 |

**Sample size – 41**

Q5. Which food do you choose when both GM Foods and conventional foods are available in the Market? A. Conventional foods B. GM Foods C. Both

**Chi square test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q5**

**FREQ procedure**

| **Table of UN_ED by ED** | | | | |
|---|---|---|---|---|
| **UN_ED** | **ED** | | | |
| **Frequency Percent Row Pct** | **0** | **1** | **2** | **Total** |
| **0** | 2 4.88 40.00 | 2 4.88 40.00 | 1 2.44 20.00 | 5 12.20 |
| **1** | 7 17.07 20.00 | 27 65.85 77.14 | 1 2.44 2.86 | 35 85.37 |
| **2** | 0 0.00 0.00 | 1 2.44 100.00 | 0 0.00 0.00 | 1 2.44 |
| **Total** | 9 21.95 | 30 73.17 | 2 4.88 | 41 100.00 |

**Chi Square Test Result**

| **Statistic** | **DF** | **Value** | **Prob** |
|---|---|---|---|
| **Chi-Square** | 4 | 4.6337 | 0.3270 |
| **Likelihood Ratio Chi-Square** | 4 | 3.9128 | 0.4179 |
| **Mantel-Haenszel Chi-Square** | 1 | 0.0731 | 0.7869 |
| **Phi Coefficient** | | 0.3362 | |
| **Contingency Coefficient** | | 0.3187 | |
| **Cramer's V** | | 0.2377 | |

**Sample size – 41**

Q6. Are you aware that GM Foods have longer shelf life? Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q6**

**FREQ procedure**

| **Table of UN_ED by ED** | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 11 26.83 30.56 | 25 60.98 69.44 | 36 87.80 |
| **1** | 0 0.00 0.00 | 5 12.20 100.00 | 5 12.20 |
| **Total** | 11 26.83 | 30 73.17 | 41 100.00 |

**Fisher's Exact Test Result**

| **Fisher's Exact Test** | |
|---|---|
| **Cell (1,1) Frequency (F)** | 11 |
| **Left-sided Pr <= F** | 1.0000 |
| **Right-sided Pr >= F** | 0.1902 |
| | |
| **Table Probability (P)** | 0.1902 |
| **Two-sided Pr <= P** | 0.2998 |

**Sample size – 41**

Q7. Do you know that GM crops do not require spraying of Herbicides and Pesticides? Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q7**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 8 19.51 21.62 | 29 70.73 78.38 | 37 90.24 |
| **1** | 1 2.44 25.00 | 3 7.32 75.00 | 4 9.76 |
| **Total** | 9 21.95 | 32 78.05 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 8 |
| **Left-sided Pr <= F** | 0.6449 |
| **Right-sided Pr >= F** | 0.7959 |
| | |
| **Table Probability (P)** | 0.4408 |
| **Two-sided Pr <= P** | 1.0000 |

**Sample size – 41**

Q8. Are you aware that GM crops can be grown in all climatic conditions? (Saline conditions, drought conditions, frost conditions) Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q8**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 15 36.59 40.54 | 22 53.66 59.46 | 37 90.24 |
| **1** | 1 2.44 25.00 | 3 7.32 75.00 | 4 9.76 |
| **Total** | 16 39.02 | 25 60.98 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 15 |
| **Left-sided Pr <= F** | 0.8751 |
| **Right-sided Pr >= F** | 0.4883 |
| | |
| **Table Probability (P)** | 0.3634 |
| **Two-sided Pr <= P** | 1.0000 |

**Sample size – 41**

Q9. Are you aware that GM crops are resistant towards various diseases? Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q9**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 12 29.27 31.58 | 26 63.41 68.42 | 38 92.68 |
| **1** | 1 2.44 33.33 | 2 4.88 66.67 | 3 7.32 |
| **Total** | 13 31.71 | 28 68.29 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 12 |
| **Left-sided Pr <= F** | 0.6927 |
| **Right-sided Pr >= F** | 0.7683 |
| | |
| **Table Probability (P)** | 0.4610 |
| **Two-sided Pr <= P** | 1.0000 |

**Sample size – 41**

Q10. Do you think that GM foods are safe for consumption? Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q10**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 11 26.83 28.95 | 27 65.85 71.05 | 38 92.68 |
| **1** | 2 4.88 66.67 | 1 2.44 33.33 | 3 7.32 |
| **Total** | 13 31.71 | 28 68.29 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 11 |
| **Left-sided Pr <= F** | 0.2317 |
| **Right-sided Pr >= F** | 0.9732 |
| | |
| **Table Probability (P)** | 0.2049 |
| **Two-sided Pr <= P** | 0.2317 |

**Sample size – 41**

Q11. Do you think that there should be regulation on GM Foods? Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q11**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 2 4.88 66.67 | 1 2.44 33.33 | 3 7.32 |
| **1** | 4 9.76 10.53 | 34 82.93 89.47 | 38 92.68 |
| **Total** | 6 14.63 | 35 85.37 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 2 |
| **Left-sided Pr <= F** | 0.9981 |
| **Right-sided Pr >= F** | 0.0511 |
| | |
| **Table Probability (P)** | 0.0492 |
| **Two-sided Pr <= P** | 0.0511 |

**Sample size – 41**

Q12. Do you think that labelling is necessary for GM Foods? Yes/No

**Fisher's Exact test result for comparing the responses of Educated (ED) and Uneducated (UN_ED) population for Q12**

**FREQ procedure**

| Table of UN_ED by ED | | | |
|---|---|---|---|
| **UN_ED** | **ED** | | |
| **Frequency Percent Row Pct** | **0** | **1** | **Total** |
| **0** | 2 4.88 66.67 | 1 2.44 33.33 | 3 7.32 |
| **1** | 5 12.20 13.16 | 33 80.49 86.84 | 38 92.68 |
| **Total** | 7 17.07 | 34 82.93 | 41 100.00 |

**Fisher's Exact Test Result**

| Fisher's Exact Test | |
|---|---|
| **Cell (1,1) Frequency (F)** | 2 |
| **Left-sided Pr <= F** | 0.9967 |
| **Right-sided Pr >= F** | 0.0703 |
| | |
| **Table Probability (P)** | 0.0670 |
| **Two-sided Pr <= P** | 0.0703 |

**Sample size – 41**