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Consumer Knowledge, Perception and Attitudes of Unlabeled Genetically Modified Foods of an Educated Population in the State of Kentucky

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CONSUMER KNOWLEDGE, PERCEPTION AND ATTITUDES OF UNLABELED
GENETICALLY MODIFIED FOODS OF AN EDUCATED POPULATION IN THE
STATE OF KENTUCKY

A Thesis
Presented to
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Western Kentucky University
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In Partial Fulfillment
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Master of Science

By
Aldious A. Waite

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CONSUMER KNOWLEDGE, PERCEPTION AND ATTITUDES OF UNLABELED
GENETICALLY MODIFIED FOODS OF AN EDUACTED POPULATION IN THE
STATE OF KENTUCKY

Date Recommended   *05/01/2017*

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Dean, Graduate School   Date

Dedication

I dedicate this thesis to the faculty and staff of Western Kentucky University and thank

them for taking the time to participate in this research survey. I also dedicate this research

to the WKU community. I am happy to have been privileged to complete my studies

here, my experiences gained here are of great value to me and I will cherish the memories

and friendships going forward.

ACKNOWLEDGMENTS

Thanks to my friends who have supported me, for believing in me and giving me the opportunity to complete a Master of Science Degree in Engineering Technology Management. I also send gratitude to my thesis chair Dr. Khouryieh for his help and guidance to complete my thesis. I thank my committee members Dr. Jackson and Dr. Gray for offering their time and their support. I thank Dr. Doggett for reading my thesis and for giving his guidance. I would also like to thank all those who helped to make this work possible. And most importantly, I thank God for giving me the strength to persevere and bring this work to its completion. I now look to the future with great expectation, understanding that my work is not yet done, that this is only the beginning of a great future, and that with this higher level of education, I am more qualified and delegable to play my part and make honorable contributions to advance the welfare of the whole human race.

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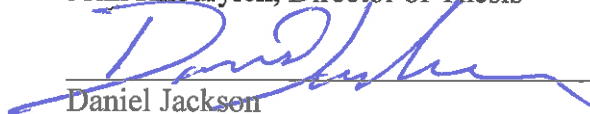
CONSUMER KNOWLEDGE, PERCEPTION AND ATTITUDES OF UNLABELED
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Directed by: Dr. Khouryieh, Dr. Jackson, and Dr. Gray

Department of Architectural and Manufacturing Sciences   Western Kentucky University

Genetically modified (GM) foods technology is a novel idea for improving food and crop production, but the supposed health risk of GM foods, such as possible negative long-term health effects to humans, animals and the environment, have provoked the European Union to create assessment protocols to monitor and regulate the safety of GM foods and crops. This research investigates the perception and attitudes of unlabeled GM foods of the WKU faculty and staff. A survey was administered via WKU Qualtrics, and chi-square tests were performed to see how the benefits and disadvantages of GM foods may affect the purchasing decisions of the educated consumer, and to see if the WKU faculty and staff wants GM foods to be labeled or not. The research confirms that the benefits and disadvantages of GM foods do affect the purchasing decisions of the educated consumer. The survey revealed that about 60% of the WKU faculty and staff buys GM foods, and 40% do not buy GM foods, and approximately 92% of the WKU faculty and staff wants GM foods to have proper labeling and information. The research provides information about how the educated consumer of Kentucky may feel about unlabeled GM foods.

The research also recommends some trade-off benefits of GM foods, including that approximately 35% of the WKU faculty and staff reported that they would buy GM foods if it helps to lower cholesterol and fight diabetes, and 20% say they would buy GM foods if it is cheaper than other foods. Some of the disadvantages of GM foods are that

the pesticide chemicals used in the production methods of GM foods are toxic to humans, animals, and the environment. Approximately 54% of the participants say they would not buy GM foods because they are concerned about how it may affect their long-term health, and about 35% reported that they don't buy GM foods because of improper labeling and information.

Introduction

The underlining difficulties of providing food for the masses is charted in the history of conventional farming methods, such as using the old plough and pickaxe to till the soil for growing crops. The ability to achieve exponential crop growth has been seriously affected by climate changes that have impacted the environment. Plant diseases have caused a series of significant hardships for many nations around the world. Since the 1900's, concerns about the scarcity of food became a well-known fear. There were many harmful threats about a potential food shortage in the near future, threats such as the Irish potato famine, pest problems, climate change, and the growing population led many to believe that destruction of the food supply was close at hand. In 1946, President Harry Truman gave a speech addressing the food crisis in Europe and Asia, urging all Americans to conserve and do what they can to help starving people all over the world (The Food Crisis, 1946). According to the Journal of World Affairs, food prices were at an all-time high in 2008, and food rebellions occurred in countries such as Egypt, Haiti, Cameroon, Indonesia and Bangladesh. However, in the years 2010 and 2011, it appeared that the concern has shifted from food crisis to product price variability and market inadequacy (Kharas, 2011).

The novelties of GM foods and its technology seem to have brought forth the opportunity for change, but there is an awareness that unscrupulous practices of GM food methods could bring forth unwanted consequences to the food chain, cause other unknown disasters to the environment, and threaten public health. According to Tourte (2004), it is necessary to take precautionary steps, to create guidelines, to create judicial

procedures, and to put policies in place to restrict the areas of prohibition and consent for GMO's.

The technology behind genetically modified organisms (GMO) as it relates to plants, gives scientists the ability to look at the relationship between the structure and quality of plant genes from a systematic point-of-view, and gives them the ability to exploit completely the characteristics of plant genes through standard and biochemical approaches. However, in conventional plant breeding, the ability to do this is not readily available, because the genetic makeup of the plant is not easily controllable and makes it very difficult to be assessed (Lindsay, 2002). GM foods technology includes the use of pesticides such as atrazine and chlorpyriphos, which sometimes can be very toxic to human beings and the environment. It also includes the use of harmful insecticidal proteins that are inserted into the plant (Koberstein, 2015).

There is a controversy over GM foods that seems to have been cemented into the media, and the prolonged debate over GM food labels has not yet been privileged with any universal or concrete agreement. The popular question of debate is: Who should be responsible for labeling, the retailer or the manufacturer? These questions demand further research and public attention. Since the discovery of genetic heredity in the 19th century, food scientists, food manufacturers, farmers, biochemists, environmentalists, and other individuals and organizations of the associated sciences have been divided on their opinions on the debate over GM foods and the technology used in its production. According to Koberstein (2015), since 1962 GM food producers have been aggravating scientists who try to support any claim or research that may show that GM foods are

harmful. Anti-GM food supporters argue that it may affect consumer's health, and that it may bring more harm to society than benefits.

According to Tourte (2004), GM foods technology opens infinite possibilities for the diversification of agriculture, and it could be the technology that brings forth much productivity at a lesser cost, and in a much friendlier agricultural environment. Tourte (2004) also reported that the debate over GM foods is divided among three groups of people: the treacherous GM food advocates who wish only to make a quick profit, the activists who refuse to look at the positive sides of GM foods science, and the judicial branch who must take into consideration public interests and information, as well as scientific and technical contributions.

According to the American Sustainable Business Council (2016), 90% of Americans want GM foods to be labeled, and 60 other countries worldwide agree. However, further research needs to be performed to see how this 90% is represented by each state. Labeling GM foods may be good business practice, as it gives the consumer a fair choice to choose between GM foods and non-GM foods, but it might not be a good idea for some American businesses. Labeling may cause some businesses to acquire additional overhead costs, and consumers may not want to buy products that have GM food labels. Perhaps the best way to look at the labeling issue is from a miniature point-of-view - the consumers' opinion of labeling within each state. This research will look at GM foods labeling of an educated group within the state of Kentucky.

Problem Statement

GM foods technology is rapidly increasing with its uses in an array of applications. GM foods technology may advance the economy by improving the production of crops, and enable farmers to grow superior harvests annually. GM foods technology may also help to improve the medical and pharmaceutical curatives. However, because GM foods have become more prominent, there is nothing prophetic about its consequences and how it could affect the perception of the consumer (Tourte, 2004).

The problem is that consumers may be afraid of GM foods because they do not have proper labeling and information and because of the popular beliefs created by media propaganda. Consumers fear that GM foods could affect their health, since the pesticides and chemicals used for GM foods production were not properly tested on humans for long-term effects. The other problem is that the consumer needs to have a fair choice between buying GM foods or not buy GM foods. However, the consumer judgement is distorted, because some GM foods that are available on the market are without proper labeling and information. In addition, no GM foods research has been performed on an educated audience in the state of Kentucky to see how this group feels about unlabeled GM foods.

This research is based on a consumer survey that was performed in the state of Kentucky on an educated group of the Kentuckian population – Western Kentucky University (WKU) faculty and staff. The research will examine the point-of-view of the WKU faculty and staff to get an understanding about how an educated audience feels about unlabeled GM foods in the state of Kentucky.

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Significance of the Research

This research is important because it may encourage consumers to seek more knowledge about GM foods in the state of Kentucky. It will also provide a better understanding of the educated consumers, how they feel about unlabeled GM foods, and their perceptions and attitudes towards unlabeled GM foods. It will also help to determine whether the educated Kentucky consumers want GM foods to be labeled or not.

The research outlines a brief history of GM foods and its purpose in the economy. The research also looks at some of the benefits and weaknesses of unlabeled GM foods, and how they may affect the purchasing decisions of the educated consumer. Although GM foods technology is a complimentary tool that can be used to solve economic and agricultural problems, the issue is that GM foods technology is in a controversial debate because it uses herbicides and pesticides, which is why the consumer may believe that eating GM foods is not safe. This research is also relevant because it seeks to acquire consumer knowledge from an educated audience, which may be useful for the evaluation of consumers' opinion on the issue of unlabeled GM foods. This will help the researcher to understand some reasons why the educated consumer buys GM foods, and why the educated consumer may not want to buy GM foods.

This research may also benefit those who are looking to improve GM foods that would be more valuable to the consumer; they will see some of the possible trade-off benefits, and why the educated consumer may want to buy certain GM foods, and could therefore improve GM foods in this manner.

Purpose of the Research

The purpose of this research is to investigate the knowledge, perception, and attitude of the Western Kentucky University faculty and staff towards unlabeled GM foods in the state of Kentucky, and to determine if the educated population wants GM foods to have proper labeling and information or not.

Research Questions

1. Do the WKU faculty and staff want GM foods to have proper labeling and information or not?

2. Do the WKU faculty and staff believe GM foods are safe or not?

3. Do the WKU faculty and staff purchase GM foods?

4. Do the WKU faculty and staff believe there are trade-offs or benefits of GM foods?

5. Do the faculty and staff of WKU believe there are disadvantages of unlabeled GM foods?

Assumptions

The following are assumptions that were taken into consideration during the conducting of this research:

1. The WKU faculty and staff do not know whether the GM foods available on the market in Kentucky have proper labeling and information.

2. The WKU faculty and staff do not know what are genetically modified foods.

3. The WKU faculty and staff do not know what foods are GM foods.

Limitations

This research was performed on the faculty and staff of Western Kentucky University and the following limitations were identified:

1. The information collected provides a synopsis of the WKU faculty and staff and their knowledge, perception, and attitudes towards unlabeled GM foods in the state of Kentucky, and should only be used for that purpose, and may not be used as inferential statistics that would represent information for the entire state of Kentucky.

2. Not all of the WKU faculty and staff have participated in the survey.

3. Consumer unconscious biases such as age, education, income, and media propaganda and controversy may have influenced consumer response.

4. Not all of the WKU faculty and staff were familiar with GM foods or had proper scientific knowledge about GM foods in the state of Kentucky.

Delimitations

The following were used to set boundaries for the data collection from the population and to control the structure of the research:

1. Consumers were offered the opportunity to enter a drawing for a $50 Visa gift card to encourage their participation.

2. Participants must be at least 18 years or older and must have been a resident in the state of Kentucky for at least 12 months.

3. Participants must have at least elementary education to be able to read and answer the survey questions.

4. Participants must have a legal occupation and does grocery shopping at least once per month.

Definition of Terms

The following definitions were defined to assist the reader with unfamiliar terms:

1. Advisory Committee on Novel Foods and Processes (ACNFP).

2. Advisory Committee on Releases to the Environment (ACRE)

3. The use of herbicides, pesticides, or other chemicals/fertilizers in agricultural farming (Agrochemical).

4. Bovine somatotropin – a growth hormone produced from the bacterium escherichia coli (Bst).

5. A collection of guidelines for food safety practices created for the protection of consumers (Codex).

6. The use of ultraviolet exposure or chemical exposure to reveal the heredity of a gene to access its genetic code (Chemical Mutagenesis).

7. Hybridization or natural selection (Conventional/traditional plant-breeding methods).

8. Department for Environment, Food and Rural Affairs (DERFA).

9. Deoxybonucleic acid - is a type of sugar that link phosphate groups through a series of organic base material: cytosine, adenine, thymine, and guanine. The positioning of these four base materials will determine the variability of the strata. It contains the information for an organism development (DNA).

10. Eosinophilia myalgia syndrome – a flu like illness that causes severe fatigue, rash, shortening of breath, and other flu like symptoms (EMS).

11. Environmental Protection Agency – an organization responsible for monitoring and advising safety procurement and activities for the environment and the public (EPA).

12. Food and Drug Administration – the organization responsible for monitoring, instructing and advising safety standards in the food and drug industry (FDA).

13. Food Standard Agency (FSA).

14. Genetically modified foods are foods that contain ingredients or genetic make-up of organisms that have been artificially or scientifically altered through DNA modification (GM foods/GMO).

15. Immunoglobulin E – a type of protein found only in mammals that are used to fight off diseases (IgE).

16. Plant Protection Act – founded in 1986 by the White House to monitor and regulate science and technology is the United States, it is comprised of the FDA, USDA and the EPA (PPA).

17. A type of amino acid that is essential for protein development and growth (Tryptophan).

18. United States Department of Agriculture – an organization responsible for creating policies and procedures that ensures efficient food and beverage management in agricultural sciences, as well as the safety of the citizens and the environment (USDA).

19. World Health Organization/Food and Agricultural Organization (WHO/FAO).

Review of Literature

There is a pressing need for improved agricultural farming methods to provide food for the growing population; this need must be met without upsetting the system of natural resources. Otherwise, there is the risk of losing the benefits of organic organisms that live and feed off the environment. GM foods technology, along with conventional farming methods, has the potential to bring about this improvement. It has been stated that GM foods technology has led the improvement of crop production and reduced many of the burdens farmers had from using old-fashion farming methods. However, due to the pros and cons of GM foods technology, it has long been scrutinized by GM foods activists in a prolonged debate on whether the benefits of GM foods outweigh its disadvantages (Grover, 2011).

Mutagenesis and radiation are techniques that were being used long ago for plant breeding. These techniques cause plants to yield unpredictable characteristics and the plants would also undergo genetic changes that would have unknown effects just like genetic modification. However, plants created using these methods are sometimes accepted as organic in nature (Halford, 2003). According to Halford (2003), genetic engineering is a process that was developed in the 1970s by scientists who wanted to artificially and scientifically affect the gene or genome of living organisms. GMO, which stands for genetically modified organism, goes by many names, such as genetic engineering, biotechnology, GM foods technology, and recombinant DNA technology. GM foods involves the use of herbicides and pesticides such as Roundup-Ready or glysophate. Roundup Ready was founded by Monsanto in 1974. Roundup-Ready gives famers the ability to protect their plants against weed problems, and helps farmers to have

easier soil turnovers and yield greater harvests. However, the use of herbicides and pesticides such as Roundup-Ready, are toxic to humans and animals.

A Brief History of GM Foods

Gregor Mendel revealed in 1857 that the trait of plants is carried on from generation to generation in pairs; and in 1869 Friedrich Miescher discovered DNA. It was in the late 1970s, when rediscovering Mendel's inheritance characteristics, food scientists realized that cross-breeding could be improved through the modification of the parent DNA or genome of plants. The modification of DNA would allow breeders to reproduce crops that can yield superior harvests. The process was coined genetic engineering or genetic modification and sometimes called GMO. GMO is a process by which a deoxyribonucleic acid (DNA) molecule is transferred from one gene to the next through the process of mutation; the modification of a strain of bacterium or fungi by insertion (Halford, 2003).

It is necessary to control weed problems when doing agricultural farming; and most farmers use chemical herbicides to protect their crops. Organic farming usually does not use herbicide chemicals to grow crops, but it has been reported that organic farmers use herbicides to spray their crops and are ceasing opportunities at niche markets. Organic farming alone may not be able to provide food for the growing masses at an affordable price, at least not without an internationally funded outreach and agreement. Many countries do not have access to the proper environment and resources that are needed to successfully produce exponential crop growth. Some farmers who use chemical herbicides to protect their crops from weed problems face even greater problems when

the weeds become tolerable to the herbicide, causing the farmer to require stronger herbicides, which is not good for the crops or the environment. These stronger herbicides that farmers use to protect their crops are toxic to humans, and require the use of hazardous equipment (Halford, 2003).

Halford (2003) also said that some farmers use glysophate in combination with other herbicides or pesticides to protect their plants against weed and insect problems. One such insecticide is a soil bacterium called Bt (bacillus thuringiensis). Bt produces proteins that are toxic to some insects but non-toxic to mammals. However, there are several forms of Bt proteins that are used to protect different varieties of crops. One such Bt protein is the Cry gene, a Bt protein found in maize which contains a minimum amount of fungal toxins (mycotoxins), these have strong carcinogens which may cause throat cancer, especially for grain-fed animals, and are more problematic in tropical countries because of warm and humid storage conditions of the maize grains. However, there is only a small amount of these chemical toxins in the human food chain.

Glyphosate was developed by Monsanto and sold under many commercial names. Glyphosate is taken in through the foliage of the plant and targets the enzyme's pathway, causing it to cease from producing amino acids (proteins), resulting in the death of the plant. Flavr Savr tomato, which was acquired by Monsanto, was the first GM foods product to hit the market; it was a success on the market from 1996 up until 1999 when it was withdrawn from the market due to anti-GM foods response (Halford, 2003).

The safety of GM foods has been a major issue because there are concerns about GM foods, such that it could cause an increase in the amount of food allergens present in the food chain. However, it is arguable to state that GM foods and plants are no different

from other methods of plant breeding that could introduce allergens into the food chain as well. Nevertheless, the regulatory system is taking precautionary steps to make sure that GM foods do not bring about any new allergens into the food chain (Halford, 2003). However, creating regulatory precautions will not guarantee that new allergens will not transcend into the food chain. Evolution itself is a mystery, and the evolutionary changes that are possible after genetic modification may go on undetected, even whilst the controversial debate of GM foods is frontline news.

GM Foods as a Complementary Tool

There is a wide range of uses for GM foods technology. It is also being used to produce pharmaceutical drugs, synthetic plastic, forestry, marine biology, and several other uses. Farmers who grow GM crops need to be specific in the purpose of use, because no single variety of GM crop is acceptable to be used to fulfill every single purpose. For example, corn produced for bio-fuel should not be grown beside fields that grow corn for human consumption or for animal feed because they will cross-breed. The variety of uses for GM plants may differ depending on the traits of genes, and therefore, they should also be different in their purpose and uses, such as GM crops used for food, or for feeding animals, or GM crops used in food processing for oil or starch qualities (Grumet, Hancock, Maredia, & Weebadde, 2011).

Benefits of GM Foods

Several studies (Caulder, 1998; Grunert, Lahteenmaki, Niellsen, Poulsen, Ueland, & Astrom, 2001) have found that some benefits of GM foods technology are to develop food safety, expand efficiency of nutrition value and taste, decrease pesticide use, and help to satisfy the supply and demand of the world's growing population. According to authors Traill, Jaeger, Yee, Valli, House, Lusk, Moore, & Morrow (2004), it has been perceived that countries who do not accept GM foods or its farming methods may fall behind and experience the yoke of international competitiveness. According to the Food Standards Agency (2003a), consumers may support their local farmers without the correct knowledge and perception of GM foods (as cited in Traill et al., 2004).

GM crops such as cotton, soybeans and corn occupied up to 169 million acres of US land in 2013. Farmers are adopting to GM foods technology because they benefit from the use of time saving methods that GM foods technology offers, such as reduced insecticide uses and less toxic herbicidal uses (Fernandez-Cornejo, Wechsler, Livingston, & Mitchell, 2014).

According to the authors Berg, Baltimore, Brenner, Robin, & Singer (1975), conventional plant breeding methods are limited in their species of interests and therefore limited in the type of genes available that are needed to fulfill specific purposes or uses. In comparison, recombinant DNA technologies' (rDNA) gene source may come from anywhere (e.g., bacteria, other plants, animals, viruses, fungi). Conferring to what was stated on Monsanto's website:

> In fact, seeds with genetically modified traits have been tested more than
> any other crops in the history of agriculture – with no evidence of harm to

humans or animals. In addition, governmental regulatory agencies,

scientific organizations and leading health associations worldwide agree

on the safety of GM crops (Monsanto, 2015, para. 1).

According to Grumet, Hancock, Maredia, & Weebadde (2011), regardless of the

claims that GM foods have been tested on humans and animals and that there is no

evidence of harm, GM foods skeptics express their concerns about the safety of GM

foods; and regulatory procedures were put in place to detect and prevent any potential

hazardous genes from entering the food chain. As stated directly on Monsanto's website:

The safety of GMO crops has been confirmed by numerous third-party

organizations including the American Medical Association, the Society of

Toxicology, the International Life Sciences Institute, the National

Academy of Sciences in the United States, the Royal Society of the United

Kingdom, the World Health Organization, the Institute of Food

Technologists, the French Academy of Sciences, the Food and Agriculture

Organization of the United Nations, the European Food Safety Authority

and the European Union Commission (Monsanto, 2015, para. 12).

As stated by Grover (2012), although consumers benefit greatly from GM foods,

most consumers are unaware of these third-party organizational decisions. Consumers are

usually reluctant to change, especially if that change is undetectable in their diet.

Consumers benefit greatly from GM fruits and vegetables exported from other countries

that can be delayed for ripening, which also helps to reduce spoilage cost for both the

consumer and the seller. Some GM foods are enriched with nutrients to help decrease

malnutrition diseases among poor people. According to Andow and Zwahlen (2006),

some other benefits of GM foods technology are that it helps to meet the need for synthetic raw materials used in industrial trades, such as wood production, bioplastics, starch and therapeutic proteins.

Disadvantages of GM Foods

According to Grover (2012), some of the disadvantages associated with GM foods and its methods are GM-free field crop contamination, pesticides limited to target insects that require farmers to use several other pesticides, unpredictable environmental impacts of disease resistant crops, and toxins produced by herbicides and insecticides that can be harmful to humans and endangered species. Farmers who rely heavily on herbicides and pesticides to grow their crops need to be cautious; they need to take into consideration the environmental and long-term effects of using GM farming methods, because if their decisions are unprincipled, their experimental voyage could harm the food supply. According to the authors Pimentel, Hunter, Lagro, Efroymson, Landers, Mervis, McCarthy, & Boyd (1989):

> Cultivation of herbicide resistant crops has increased the use of broad
> spectrum herbicides like bromoxynil and glyphosate. Bromoxynil is
> absorbed through skin and causes birth defects in laboratory animals, is
> toxic to fish, and may cause cancer in humans…. (as cited in Grover,
> 2012, pp. 34).

According to Kinchy (2012), alfalfa which is a type of grass that is genetically modified to tolerate herbicides, is being used to feed cows. Cows are a major contributor to the dairy diet of most consumers, and most consumers are unaware that genetically modified

alfalfa is being fed to cows. Kinchy (2012) also said that there were high-profile

contamination cases of GM canola from Canada, and the unauthorized use of genetic

material found in traditional varieties of the Mexican maize. Kinchy (2012) stated that:

> In both cases, activists connected to a variety of struggles for social
>
> change, including movement for the environment, global justice, genetic
>
> resources, organic farming, and indigenous rights, have persistently
>
> highlighted the social problematic nature of GE crops (pp. 3).

According to Lim (2014), a list of protein allergens can be found from a

peer reviewed online database (http://www.allergenonline.org/) from the

University of Lincoln Nebraska. The database is operated by a board of

internationally recognized food science experts. The group carried out allergenic

tests on some GM foods, and in their first experiment, they did not find any

allergens coming from GM foods. Lim (2014) reported that only one documented

test of allergenic GM soybean was found, and as a result, the Brazilian GM-soy

nut protein has been kept off the market from consumers. The way they order the

tests is that when a new GM crop is created, new proteins may be created as well;

these new proteins are tested for risk of allergens. The list is continuously under

revision as new projects are carried out on GM foods and new proteins are being

discovered. In one experiment, they have found that consumers with celiac

disease may be allergic to proteins derived from GM wheat (AllergenOnline,

2017).

Lim (2014) said that the tests were carried out mostly on known allergens,

and that there are millions of proteins available in the different types of foods, and

certainly, not all of them have been tested. Different allergic responses to GM

foods are different for individual consumers, and many of these proteins may not

yet be listed in the database, but these proteins are present in non-GM foods as

well.

According to Lim (2014), there was a Caitlin Shetterly who claimed that

GM foods caused her to have allergic reactions. Shetterly reported her problem to

her doctor, and her doctor told her that the allergic reactions may be linked to GM

foods. Shetterly said that after she had stop eating GM foods she was cured of her

allergies. However, during the investigation, allergenic response experts said that

the Shetterly case was just another anti-GM foods activists' response.

GMO Labeling and Food Safety

GM foods labeling is a major issue and a very complex situation, but some

believe that GMO labeling is very simple. According to the authors Goodman, Vieths,

Sampson, Hill, Ebisawa, Taulro, & Van Ree (2008), the benefits of the existing safety

assessment system on GM foods are simple, proficient, and forceful (as cited in Grover,

2011). Regulations for GM foods vary between countries, and between buyer and seller.

The labeling procedures may be different depending on the application or use of the GM

crop. In America, labeling is centered on the final product rather than the actual process

in which the product was created. The FDA requires labeling if the GM foods product

differs extensively in nutritional content, allergenicity, and toxicity (Grumet et al., 2011).

The European Union has taken a more severe approach to the labeling of GMOs, while

the United States has engaged in a more welcoming strategy (Bernauer & Meins, 2003).

Nonetheless, there is a real struggle over the labeling of GM crops, and it raises questions of social concerns over domestic policies and international policies.

According to James (2007), the development of GM foods and crops is steadily rising: over 114 million hectares of GM crops have been created since 2007 (as cited in Romeis, Shelton, and Kennedy, 2008). The authors Lin, Lu, Lin, & Pan (2009) said that since 1996 to 2010, 144 GM crop events were accepted worldwide. Regardless of GM foods success, the safety of GM foods assessment protocol was developed, and must follow the regulations proposed by the Food and Agriculture Organization and World Health Organization (FAO/WHO) and Codex (Grover, 2011).

The Advisory Committee of Novel Foods and Processes (ACNFP) was founded in 1988. The ACNFP is directly responsible for reporting any issues relating to foods and food processes in the UK. The committee includes academic members with knowledge in genetics, immunology, allergenicity, nutrition, microbiology, and food toxins. The committee also include an ethicist and a consumer representative (Halford, 2003).

According to the authors Millstone, Brunner, & Mayer (1999), the goal of the assessment protocol for GM foods and GM crops is to show that GM foods are as safe as their traditional counterparts, and do not carry any new risks that would affect the health of the consumer. However, according to the Codex guidelines and assessment procedures, the unintended effects of GM foods makes it difficult to measure the substantial equivalence that is required to accept GM foods and GM crops to be as safe as their traditional counterparts. GM foods are different in genetic behavior, protein level, metabolite level, and transcript level. Combined efforts are needed to collect and assimilate data procedures; and a comprehensive study of the unintended effects of GM

crops may lead to predictive safety assessments for GM foods in the future (Grover, 2011). However, to achieve this future goal, things may turn out to be very provocative. According to the authors Goodman, Vieths, Sampson, Hill, Ebisawa, Taulro, & Van Ree (2008), "It is important that there is no document proof that any approved GM crop has caused allergic reactions owing to the transgenic protein, or that generation of significant endogenous allergenicity" (as cited in Grover, 2011, pp. 132). A major setback would be the absence of sufficient records and tools to analyze and interpret the safety importance of products with an unknown identity and/or function, which may even lead to the need for further safety studies (Grover, 2011).

Future research is needed to confirm profiling practices. The expansion of publicly available databases of GM foods and GM crops arrangement and strategies is an unconditional requirement that is needed to define the natural variations of complexes contained in and between GM foods and GM crops and plant species (Grover, 2011).

In 2004, Monsanto pursued approval from the Animal and Plant Health Inspection Service (APHIS) for its alfalfa seeds. The APHIS regulatory board approved Monsanto's alfalfa seeds to be commercialized because they resolved that it would not cause any hazardous impact on the environment. However, in 2006, a group of plaintiffs including the National Family Farm Coalition, the Center for Food Safety, the Sierra Club, and two alfalfa seed producers filed a lawsuit against APHIS stating that they violated the US environmental law, in that they failed to provide an environmental impact statement for Roundup-Ready alfalfa. In their report to the court, they asked that the commercialization and cultivation of Roundup-Ready alfalfa be put to a halt until the USDA complete an environmental impact assessment. They also argued that organic dairy farmers expect to

buy non-GMO alfalfa, and farmers are at risk of GMO alfalfa contamination, which also threatens the organic dairy industry (Kinchy, 2012).

Consumers may not have issue with GM foods or GM crops, but the idea of not knowing what the nature of ingredient is that is present in their food, this alone may affect customers' decision toward GM foods. According to Bizzarri (2012), about 38 million tons of soy is imported to Europe each year, of which about 60% is contaminated by GM crops.

Animals fed with genetically modified grains do not have to wear labels if, a) no GMO is found in their DNA, b) they look no different from non-GM fed raised animals, and c) the milk, fish, eggs and meat from GM-fed animals are not different from non-GM raised animals. However, studies have shown that GM food traits can be found in the DNA of animals fed with soy that was sprayed with Round-Up Ready. According to Bizzarri (2012):

> An enzyme, lactic dehydrogenase, was found at significantly raised levels
>
> in the heart, muscle and kidneys of kids fed genetically modified RR
>
> (Round-up Ready) soy. This enzyme leaks from damaged cells and can
>
> indicate inflammatory or other cellular injury (pp. 84).

Bizzarri also said that several attempts were made by PPL Therapeutics to produce milk that would help premature babies develop, but the experiment failed for several reasons, and was later abandoned by the company. The attempts failed because of the high possibility that it could cause allergenic reactions to children. According to Bizzarri (2012):

This is substantially why the attempt by PPL Therapeutics, a bioengineering company from Virginia, failed. The company had invested heavily on Rose, a transgenic heifer expected to produce milk high in alpha-lactoalbumin. The milk, destined for premature babies, ended up causing so many problems that the project was shelved (pp. 84).

Research information, like the PPL Therapeutics experiment, need to be made available to research scientists who are, or may be looking to take, the same direction. The integration of data interpretation, such as the PPL Therapeutics experiment, need to be made publicly available in a designated database where other researchers can get access to the information. In this way, future research can be carried out that may help to advance the successes in the study of GM foods.

GM foods need to be tested on humans to see if there are any hazards to human health. According to the authors Singh, Mehta, Sridhara, Gaur, Singh, Sarma, & Arora (2006), an allergenicity test on genetically modified mustard (brassica juncea) was carried out on 96 patients (rats) with an allergic history of reactions and sensitivity to food allergens; and the results found that six of these rats had skin reactions to genetically modified mustard. Ten of them showed negative IgE (immunoglobulin E) protein control levels as compared to native proteins. The transgene from brassica juncea has been inserted into tobacco, rice, tomato, and arabidopsis products available on the market, but these products have not been tested to validate whether they will have any harmful effects on humans.

According to Smith (1970), despite early concerns associated with the risks of insecticide uses for pest control, the preventative practices of insecticides persisted until a

host of problems became apparent. Some of the problems reported were: occurrence of secondary pests and an increase of target pest populations along with the ruin of useful arthropods; risks to pesticide applicators, wildlife, and consumers; noticeable control failures with consequential development of insecticide resistance; and an overall transformation of the agricultural environment, possibly caused by contamination (as cited in Rabb & Guthrie, n.d.). According to Newsom (1980), synthetic insecticides were introduced in the dawn of the 1940s and 1950s, which supposedly gave farmers worldwide a remarkable control over insect problems associated to crop production (as cited in Romeis, Shelton, & Kennedy, 2008).

Halford (2003) said that it has been reported that consuming GM foods may increase allergenic reactions. A type of protein gene (methionine-rich 2S albumin) nut from Brazil was inserted into soybeans, and was known to cause allergenic problems to species, but the problem was detected and stopped. According to Bizzarri (2012), everyone should know what had happened to chickens that were modified with growth hormones from cows; the chickens grew up very fast (2-3kg within 7 weeks). They were puffed-up with water and flabby with hormones and antibiotics, and they were sold in supermarkets. The chickens were prone to having deformed and malfunctioning limbs, and developed many sicknesses that reduced their life-span. Bizzarri also said that the milk from cows that were genetically modified have less vitamin-concentration, and less proteins and minerals than cows that have not been fed with genetically modified grass. According to Bizzarri (2012), "Bst produces sick cows that produce unhealthy milk and meat that could affect consumer health" (pp. 74).

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The fear of unethical practices of GM foods science continues to worry many consumers. Halford (2003) said that developing countries worry that they may be at risk of having become dependent on GM foods and GM seeds, and GM foods methods, and they could possibly be denied access to them. This may be a real economic issue for developing countries, especially if they are not the ones producing the seeds or exporting the foods; and if they want to produce GM foods and crops, they may have to be licensed and patented under US law, as the USA is the leading producer of GM foods and grains.

GM Foods: Both Problem and Solution

There are many articles and books written about the emerging ideas of plant biodiversity and the technologies used to create plant diversity. GM foods technology is one of the most popular methods used to create biodiversity. According to Ammann (n.d.):

The well-being of earth's ecological balance as well as the prosperity of human society directly depend on the extent and status of biological diversity.… Plant and animal diversity ensures a constant and varied source of food, medicine, and raw material of all sorts for human populations (as cited in Gressel, 2008).

The evolution of GM foods technology has gained dominance over the agricultural market, leaving most farmers who practice the traditional methods of farming in a trail of genetically modified pollen. One of the most effective ways of genetic evolution is the method of cross-pollination (Halford, 2003).

The exponential growth in population leads scientists towards the quest that they are on today. If there ever was to be a scarcity of food, using GM farming methods would be one way in which the food scarcity might be combated. However, food is not scarce right now. According to the authors Stephens and Cowin (2015), 40% of the food produced in the US is thrown away, which is equivalent to $165 billion.

Although genetic engineering is a great discovery that is being used by farmers to diversify and aid in crop production, there is the concern that public health may be at risk due to the treacherous behavior of those who are using genetic engineering methods only for making a quick buck. According to Al-Hayani (2007):

> The biotech industry claims that technology will help alleviate world
> hunger. Some analysts say that the problem is not scarcity of food.
> Physicians and Scientists for Responsible Application of Science and
> Technology (http://www.psrast.org) state that "World hunger is extensive
> in spite of sufficient global food resources. Therefore, increased food
> production is no solution. The problem is that many people are too poor to
> buy readily available food." Another reason why feast turns into famine is
> that most innovations in agricultural biotechnology are profit-driven rather
> than need-driven (pp.157).

Some GMO advocates claim that there is no evidence whatsoever to prove that GM foods pose any health risks, and that labeling GM foods would make the already expensive grocery cart cost even more; this has already been proven in other countries (Brandon, 2014). In 1980, the growing of GMO plants in the United Kingdom became more widespread, and the UK government decided to regulate the field release of GM

plants and animals. In 1990, the Environment Protection Act (EPA) and the Advisory

Committee on Releases to the Environment (ACRE) was created to govern the release

and marketing of GMOs. If a farmer in the UK wanted to release GM crops into the

market, the farmer would have to seek permission through the ACRE, which is in

conjunction with an agreement granted from the Deparment for Environment, Food and

Rural Affairs (DERFA). They would then need to pay a fee of £5000, and wait ninety

days for a decision. In the US, applicants can submit a one-page summary online and

obtain a decision within the next day. GM farmers in the US have an unfair advantage

over UK GM farmers when it comes to the releasing of GM crops into the market.

However, the US has completed over 30,000 field trials of GM plant species from

soybean to walnut; and most of the field trials have caused no problems, so the US

consultant system has made the proposal process less difficult as a result. Although UK

farmers have completed many GM crop experiments that have caused no problems, the

application process for GM field research in the UK have not been weakened (Halford,

2003).

Financial and Economic Aspects of GM Foods

An estimated $83 billion is required to develop agricultural production for most

developing countries (Kharas, 2011). Farming is a very important issue at this moment in

time, but most consumers may not even consider where their food comes from or how it

was grown or manufactured. Farm work is one of the most under-paid positions in the

industry, and food prices are very high. Adopting GMO practices is one of the ways in

which farmers manage to sustain a prolific harvest.

GM foods and crops are now widely produced in many countries. As a matter of fact, GM crop is the most dominant produce in food production and trading market, and it yields higher harvests. In 2009, 43% of the global area of primary crops were GM crops (James, 2010). In 1999, the US soybean and maize industry had some concerns that they may lose market shares in Europe because of the trade tariffs imposed by the European Union (Halford, 2003). In 2009, the global worth of GM crop was 10.5 billion USD, which is 20% of the worldwide crop production market (James, 2010). Clearly, there is significant financial and economic issues associated with GM crops and GM foods production. The trade tariffs imposed by the European Union on GM foods and GM crops coming out of the US could create a financial crisis for many European businesses and an economic crisis for consumers, as well as loss of profit and trade agreements for US GM food producers. According to Halford (2003), "In a recent report, 'Seeds of Doubt,' the Soil Association, a UK organic farming group, claimed the use of GM crops in the US had reduced profitability, reduced yields and raised costs through increased herbicide use (pp. 85).

Environmental and Ethical Aspect of GM foods

Environmental field crop contamination can become a major problem for the food source of the country; and sometimes the use of agrochemicals can be advantageous and yield higher crop varieties for the country. Countries vulnerable to famine such as Zimbabwe, Lesotho, Mozambique, Swaziland, and Malawi have recently accepted GM maize, but was once reluctant to accept help from the USA GM food bid. They were encouraged by anti-GM foods European activists to reject proposals from the United

States. Zambia refused to accept GM food bids from the US even in the face of food

scarcity (Halford, 2003). The European anti-GM foods activists refused to support the

Africans' decision to accept GM food bids from the US because they feared that the

supposed health risks of GM foods would cause a repercussion. The African government

feared that the imported GM seeds would mix with non-GM seeds and jeopardize the

trade agreement they have with Europe.

Perhaps the real problem is not that a food crisis could arise from the unpopularity

of GM food methods, but rather because of the manifestation of collective consciousness

about the fear of GM foods. Consumers fear GM foods because they are not labeled.

According to Harford (2003), the idea that GM foods will "feed the world" is a weight

that no new technology is able to carry on its own, but it is wrong for the well-fed people

of Western Europe to bar GM foods technology when it could be used to improve crop

production and quality. Nevertheless, the supposed health risks and the unknowns of GM

crops and GM foods is a real problem.

The organic farming industry made the attempt to present itself as GM-free, but

was using Bt pesticide to spray its crops and then turned around selling the crops as

organic. It is becoming more difficult for the organic farming industry in America to

produce GM-free crops. And the European organic industry wants to use this to ban GM

crops from the market (Halford, 2003). The conflicts over GM foods and crops are not

just differences about scientific data and possible food threats, they are clashes about

social order and intellectual property rights. Over the past 30 years, there have been

numerous court rulings about whether it should be lawful to patent transgenes (Kinchy,

2012).

In 2011, the Public Patent Foundation (PUBPAT) represented a group of

traditional US and Canadian farmers and seed producers in a law suit against Monsanto.

The complainants did not seek to get any reward, but they asked that Monsanto would not

be allowed to prosecute them for patent infringement if their fields ever became polluted

by Monsanto's patented GM crops. Also, in 2004, there was a patent infringement case in

Canada that ruled in favor of Monsanto. Percy Schmeiser occupied seeds that contained

patented GM material; even though the seeds arrived on the field by accidental means,

Percy lost the case because he knew that the seeds were contaminated. According to

Kinchy (2012):

> The legal dispute did not primarily revolve around questions of seed-
>
> saving rights and the social consequences of patents but rather around
>
> questions of proper research methods and accurate understanding of how
>
> genes affect plant development (pp. 102).

Proper research needs to be performed about GM crops and field contamination;

for the legal debates on patent infringement do have significant social impact, and

do affect public engagement.

Emerging Labeling Laws and Requirements for GM Foods

As GM foods become more widespread, there is the need for a standardized method or systematic approach by which consumers could depend on to help them decipher the GM foods versus non-GM foods code. There are companies that seems to have taken the "non-GMO" labeling approach, while other producers label their products as organic. According to Jeff Harmening, the vice president of General Mills (2016), the battle over GMO labeling remains unresolved, and a national solution for GMO labeling has not been met. Harmening (2016) said that General Mills will begin labeling all products that have GMO ingredients as per the Vermont GMO legislative state law. Harmening (2016) said that General Mills cannot label its products for just one state, as it will only increase costs for the consumer; and other states may soon require other labeling agreements. However, what is needed is a national solution for GMO labeling. The health and safety of GMO products is not a concern, but the consumer needs to know what products contain GMO ingredients (Harmening, 2016). Many of the consumers responded to General Mills' labeling agreement, and they were happy to hear that General Mills would begin to label all products with GMO ingredients. A few consumers also scuffled over the possible rising cost of General Mills products due to the Vermont labeling law requirement. Some of the consumers issued thankful notes to General Mills for deciding to commence labeling for all states. However, the introduction of the S.764 bill will override the Vermont labeling requirements that are currently in progress.

Methodology

This section describes the methods used to collect the data and shape the structure of the research. This section will also describe how the survey was formulated to reach its intended audience.

Research Objective

The objective of the research is to see whether the educated Kentuckian population wants GM foods to have proper labeling and information or not. To achieve this objective, a survey questionnaire was developed and administered to the faculty and staff of Western Kentucky University. This population was selected because the researcher wanted to understand how the educated population feels about unlabeled GM foods in the state of Kentucky. The data collected from the survey provides information on consumer knowledge, perception, and attitudes towards unlabeled GM foods in the state of Kentucky. This research may also provide information about GM food purchases among educated groups of consumers, and it may help to provide an understanding about how the educated consumer feels about the safety of GM foods. It will also provide information about some possible trade-off benefits of GM foods, and will look at some of the disadvantages of unlabeled GM foods.

Survey Development

The survey was limited to residents that have lived in the state of Kentucky for 12 months or more, and they were at least 18 years of age or older. They held legal occupations and were likely to do grocery shopping at least once per month. They also have at least elementary education and could read and answer the survey questions. Some consumers may have rigid attitude towards GM foods, and some consumers may not know what GM foods are; the survey was formulated taking all of this into consideration, and efforts were made to control these limitations as much as possible.

While it may have been necessary to provide the survey correspondents with foreword knowledge about GM foods, preconceived information could have influenced the correspondent's attitude towards GM foods. Therefore, the correspondents were instructed to answer the survey questions to the best of their prevailing knowledge, and they were not given any overview on the subject beforehand. The survey design was a mix of multiple choice questions and some Likert scale statements, which were presented with ratings from 1 through 5: where 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree. The Likert scale statements were necessary to test consumer knowledge and understand their perception towards unlabeled GM foods. The respondents had to select the choices that were closest to their agreement from the statements presented on the Likert scale. In quantifying the results of the survey, choices 1 and 2 were combined as agreeing with the statement presented on the Likert scale, and choices 4 and 5 were combined and stated as disagreeing, and selecting 3 indicated that the correspondent neither agrees or disagrees with the statement.

The tasks of the survey included the writing of an introductory statement. The introductory statement explained what is intended to be accomplished by participating in the survey. The indroductory statement provided the correspondents with the instructions for completing the survey, informed them about the questionnaire format, and told them the minimum amount of time that is expect to complete the survey. The consent and confidentiality statement explains the volunteerism of the participants in the survey. The questionnaire development was directed towards consumer knowledge, perception, and attitudes towards unlabeled GM foods in the state of Kentucky. An experimental survey was first directed to a few faculty from the WKU population and was overseen by the committee chair before the actual survey was admitted. This ensured that the survey constraints were brought to a minimum, and that the survey could meet the intended design.

After the trial survey was carried out and analyzed for improvements, the survey and research design was submitted to the Western Kentucky University's Institutional Review Board for final approval before further action was taken. Western Kentucky University Institutional Review Board accepted the research questionnaire and granted the permission to carry out the data collection. The permission statement asked for the consent of each participant, and outlined their rights of volunteerism. The consent form explained the purpose of the survey, and ensured that the correspondents information would be kept safe.

Participation and Recruitment

        The demographics of the WKU faculty and staff covered several different

counties. A $50 Visa gift card was used to encourage participants. The respondents who

wanted to win the $50 Visa gift card voluntarily entered their email address at the end of

the survey. If correspondents do not wish to participate in the drawing for the $50 Visa

gift card, they did not have to enter their email address, and they were still able to

participate in the survey.

        The survey was created so that the correspondents could attend to one question at

a time. They were not able to move forward to the next question until they have answered

the previous question. The survey questionnaire was sent via WKU email listserve to the

WKU faculty and staff, and the survey was anonymously accessible through Qualtrics

survey platform. The faculty and staff who do not have access to the internet or email

service were unable to participate in the survey. The total number of participants was

216, of which 192 completed 100% of the survey. All responses to the survey questions

were taken into consideration and was used in the analysis for the data reports.

Data Analysis

        The responses collected from the survey was entered into Microsoft Excel

spreadsheet and checked for errors, such as repetitions, and misspelling. The data was

then transferred to Microsoft Word and categorized into three sections: 1) consumer

knowledge towards unlabeled GM foods, 2) consumer perception towards unlabeled GM

foods, and 3) consumer attitude towards unlabeled GM foods. Although the questionnaire

was clear and precise, some correspondents still made some unforeseeable errors, such as entering "USA" as their home county; such responses were considered as unknown.

The finding results are displayed using statistic tables and charts, and the information was expressed by calculating the percentage and frequency of the results in each category. Chi-square evaluations were performed to look at the relationship between variables to see how age, education, and income may have influenced consumer response to the survey questions. The findings were analyzed and used to validate the research questions.

Results and Discussion

The aim of the study was to see how the WKU faculty and staff, an educated audience, would respond to questions about GM foods. The data collected was analyzed and used to answer the research questions about how the WKU faculty and staff feels about unlabeled GM foods.

Consumer Demographics

Table 1 shows that approximately 91% of the participants were residents in the state of Kentucky, of which 63.9% were Warren County residents. The majority of the participants were between ages 30 and 59, approximately 77%. About 9% were less than 30 years old, and 13% were 60 years or older. At least 67% of the WKU participants held postgraduate degrees, 30% held bachelor's degree or some college credit, and less than 1% had less than high school education. Around 43.2% of the WKU faculty and staff make household incomes between $55,000 and $95,000, 23.4% make household incomes greater than $95,000, and 33.3% make household incomes of $54,000 or less.

Table 1

Demographic characteristics of the WKU faculty and staff which describes their age groups, income levels, education, and place of residence.

Characteristics	Description	(%)	Frequency	(N)
Kentucky Resident				(213)
	Yes	(91.08)	194	
	No	(8.92)	19	
Age				(192)
	18-29	(9.38)	18	
	30-39	(27.08)	52	
	40-49	(24.48)	47	
	50-59	(26.04)	50	
	60+	(13.02)	25	
Education				(192)
	Less than High School Diploma	(0.52)	1	
	High School GED	(1.56)	3	
	Assoc. Degree/College Credit	(6.25)	12	
	Bachelor's Degree	(24.48)	47	
	Post Graduate	(67.19)	129	
Household income				(192)
	Less than $25,000	(2.08)	4	
	$25,000 - $35,000	(13.02)	25	
	$35,000 - $45,000	(10.94)	21	
	$45,000 - $55,000	(7.29)	14	
	$55,000 - $75,000	(27.60)	53	
	$75,000 - $95,000	(15.63)	30	
	$95,000 or more	(23.44)	45	
County				(208)
	Allen	(3.37)	7	
	Barren	(1.92)	4	
	Boone	(0.48)	1	
	Butler	(0.96)	2	
	Calloway	(0.48)	1	
	Daviess	(0.48)	1	
	Edmonson	(2.40)	5	
	Franklin	(0.48)	1	
	Graves	(0.48)	1	
	Grayson	(0.48)	1	
	Hardin	(1.44)	3	
	Hart	(0.48)	1	
	Jefferson	(0.48)	1	
	Logan	(1.44)	3	
	Marion	(0.48)	1	
	Mercer	(0.48)	1	
	Pulaski	(0.48)	1	
	Simpson	(0.48)	1	
	Unknown	(18.75)	39	
	Warren	(63.94)	133	

Consumer Awareness and Benefits of GM Foods

Table 2 shows that approximately 96% of the WKU faculty and staff heard about GM foods, 54.6% don't know if they have eaten GM foods, and about 40% of the faculty and staff say they have eaten some form of GM food, such as potato, soybean, corn and tomato. Only 5.6% of the WKU faculty and staff who participated in the survey know for certain that they have not eaten GM foods.

According to Herrera-Estrella(n.d.), many claims have been made stating that consumers have been eating GM foods such as papayas for decades, and no health problems have been linked to GM foods (as cited in Kresge, 2015). Although no health problems have been linked to GM foods and GM crops at the moment; GM foods do not have proper labeling and information, so it would be very difficult to link any health problems to GM foods.

Approximately 52% of the respondents believe that GM foods are safe, while 48% of the WKU faculty and staff don't believe that GM foods are safe. According to results from the Pew Research Center (2015), 37% of US adults say that GM foods are safe, while 57% believe that GM foods are unsafe. Education plays a major role when it comes to the views on safety issues about GM foods. According to Funk & Rainie (2015), approximately 57% of college graduates or post-graduates generally agrees that GM foods are safe, while 38% believes that GM foods are unsafe. Approximately 67% of the WKU faculty and staff who participated in the survey held postgraduate degrees.

Monsanto's Newsroom (2015) said they are committed to developing products that are safe and nourishing, and that seeds with GM traits are often tested more often than any other crops, and that no evidence of harm to humans or animals have been

found; and therefore, governmental agencies worldwide allows the production of GM

foods. However, the consumer may not be aware of this type of information.

Table 2

Consumer awareness of GM foods in the state of Kentucky.

Question	Response	(%)	Frequency	(N)
Have you heard of GM foods?	Yes	(96.15)	200	*(208)*
	No	(3.85)	8	
Do you believe that GM foods are safe?	Yes	(51.94)	107	*(208)*
	No	(48.06)	99	
I have eaten potato, soybean, corn and tomato that were genetically modified.	Yes	(39.8)	78	*(196)*
	No	(5.6)	11	
	I don't know	(54.59)	107	

Table 3 shows that 49.5% of the WKU faculty and staff disagree or strongly disagree (disagree 29.5%, strongly disagree 20%) with the FDA's approval of GM foods, while 22% of the participants neither agree nor disagree with the FDA's approval of GM foods, and 28.5% agree or strongly agree (agree 24%, strongly agree 4.5%) with the FDA's approval of GM foods. Approximately 61.5% of the WKU faculty and staff strongly agree or agree (strongly agree 14%, agree 47.5%) that GM foods help to provide food for the growing population, 18.5% neither agree nor disagree that GM foods help to provide food for the growing population, and 20% disagree or strongly disagree (disagree 9%, strongly disagree 11%) that GM foods help to provide food for the growing population. Table 3 also shows that approximately 42% of the WKU faculty and staff strongly agree or agree (strongly agree 9%, agree 33%) that GM foods may have benefits that could help to improve lives, boost the economy, and help to improve the nation, while 29% of the respondents were unsure that GM foods may help to improve lives, boost the economy, and help to improve the nation.

One of the claims about GM foods is that it can help to fight against vitamin A deficiency; the effort of this claim can be recognized in the Golden Rice project. Approximately 52.5% of the WKU faculty and staff strongly agree or agree (strongly agree 13%, agree 39.5%) that GM foods help to solve important food challenges, and help to fight diseases, such as vitamin A deficiency, while 23% disagree or strongly disagree (disagree 11.5%, strongly disagree 11.5%) that GM foods help to solve important food challenges, and help to fight diseases such as vitamin A deficiency, and 24.5% neither agree nor disagree.

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Whilst GMO technology is widely known for its uses in agricultural farming methods, only 40.5% of the WKU faculty and staff strongly agree or agree (strongly agree 9.5%, agree 31%) that GMO technology help to improve agricultural farming methods, while 34.5% disagree or strongly (disagree 18.5%, strongly disagree 16%) disagree that GMO technology helps to improve agricultural farming methods, and 25% neither agree nor disagree.

The uses of GMO technology have led to increases in agricultural productivity and economic growth, but the debate over GM foods labeling continues to be an issue. The herbicide and pesticide uses in GM crop production is one of the main cause for the debate. According to Lindsay (2002), the successful practices of GM farming methods caused significant improvement in the farming industry, such as rice growths that occurred all over Southeast Asia during 1968 onwards to 1983, and again in 1999. Half of the soybeans grown in the United States were from GM-resistant seeds, and a significant amount of GM canola, soybeans, and maize have seen increased growth in the Western Hemisphere. However, despite all the success, GM foods technology is still at the forefront for discussion; significant efforts are being extended internationally to monitor and implement effective labeling for GM foods. A contributing cause of the debate is that consumers are not aware of the benefits of GM foods technology. However, they are aware of possible disadvantages of GM food practices.

Studies also confirmed that customers' awareness may be influenced by the level of information that is available about GM foods (Steenkamp, 1997; Zhong, Marchant, Ding, & Lu, 2002), but the level of education about scientific knowledge about GM foods also plays a major role in the ability to understand the information that would help in

identifying the risks and benefits of GM foods. According to Verdurme, Gellynck, & Viaene (2001), consumers also weigh the information received based on the source information or association, such as FAO/WHO, or other legal organizations. Consumers who trust these sources may perceive lower risks and higher benefits, and therefore have a higher acceptance level of GM foods (as cited in Chern, Rickertsen, Tsuboi, & Fu, 2002). According to Traill et al. (2004), environmental organizations usually portray a vague image about GM foods, and the information from environmental groups are more likely to perceive GM foods as being something immoral.

Table 3

Consumer awareness of the benefits of GM foods in the state of Kentucky. (N=200).

Statement	Strongly agree N (%)	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)	Strongly disagree N (%)
GM foods are good because the FDA approves that they are safe to eat and I trust the FDA.	*9 (4.5)*	*48 (24)*	*44 (22)*	*59 (29.5)*	*40 (20)*
GM foods are helpful because they help to provide food for the growing population.	*28 (14)*	*95 (47.5)*	*37 (18.5)*	*18 (9)*	*22 (11)*
GMO technology can help to improve our lives, boost the economy, and help to improve us as a nation.	*18 (9)*	*66 (33)*	*58 (29)*	*33 (16.5)*	*25 (12.5)*
GMO technology helps to solve important food challenges and help to fight diseases, such as vitamin A deficiency.	*26 (13)*	*79 (39.5)*	*49 (24.5)*	*23 (11.5)*	*23 (11.5)*
GMO technology is very useful because it helps to improve agricultural farming methods.	*19 (9.5)*	*62 (31)*	*50 (25)*	*37 (18.5)*	*32 (16)*

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree**.**

Table 4 shows that GM foods help to provide food for the growing population, $(X^2 (16) = 28.10, P < 0.03)$ indicates that education may have been an influential factor why the WKU faculty and staff believes that GM foods are helpful, and that they help to provide food for the growing population. Furthermore, $(X^2 (16) = 25.76, P < 0.06)$ indicates a 6% level of significance that education may also be an influential factor why approximately 52.5% of the WKU respondents strongly agree or agree (strongly agree 13%, agree 47.5%) that GMO technology helps to solve important food challenges and help to fight diseases such as vitamin A deficiency.

Table 4

Relationship between level of education of the WKU faculty and staff and their awareness of trade-off benefits of GM foods.

Statement	X^2	*(P-Value)*
GM foods are good because the FDA approves that they are safe to eat and I trust the FDA.	$X^2 (16) = 19.93$	*(0.22)*
GM foods are helpful because they help to provide food for the growing population.	$X^2 (16) = 28.10$	*(0.03) ***
GMO technology can help to improve our lives, boost the economy, and help to improve us as a nation.	$X^2 (16) = 23.16$	*(0.11)*
GMO technology helps to solve important food challenges and help to fight diseases, such as vitamin A deficiency.	$X^2 (16) = 25.76$	*(0.06) **
GMO technology is very useful because it helps to improve agricultural farming methods.	$X^2 (16) = 21.02$	*(0.18)*

Level of significance:
* = P ≤ 0.10
** = P ≤ 0.05
*** = P ≤ 0.01

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree**.**

Table 5 data indicates that at (X^2 (16) =24.37, $P < 0.08$) age may be an influential factor why 61.5% of the WKU faculty and staff agree or strongly agree that providing food for the growing population is a trade-off benefit of GM foods; approximately 77.6% of the WKU faculty and staff were between ages 30 and 59 years old. At (X^2 (16) = 27.73, $P < 0.03$), age may also be the determining factor why 42% of the WKU faculty and staff strongly agree or agree that GMO technology can help to improve lives, boost the economy, and help to improve the nation. There is statistical relationship that age was an influential factor at (X^2 (16) = 23.68, $P < 0.10$), that GMO technology helps to solve important food challenges and help to fight diseases, such as vitamin A deficiency, but the relationship was not significant.

Age was an influential factor at (X^2 (16) =26.94, $P < 0.04$), approximately 40.5% of the WKU faculty and staff strongly agree or agree (strongly agree 9.5%, agree 31%) that GMO technology is very useful because it helps to improve agricultural farming methods, while 34.5% disagree or strongly disagree. There was no statistical significance found in the relationship between the trade-off benefits of GM foods and the WKU faculty and staff household income levels.

Table 5

Relationship between age groups of the WKU faculty and staff and their awareness of trade-off benefits of GM foods.

Statement	X^2	*P-Value*
GM foods are good because the FDA approves that they are safe to eat and I trust the FDA.	$X^2 (16) = 15.28$	*(0.50)*
GM foods are helpful because they help to provide food for the growing population.	$X^2 (16) = 24.37$	*(0.08) **
GMO technology can help to improve our lives, boost the economy, and help to improve us as a nation.	$X^2 (16) = 27.73$	*(0.03) ***
GMO technology helps to solve important food challenges and help to fight diseases, such as vitamin A deficiency.	$X^2 (16) = 23.68$	*(0.10) **
GMO technology is very useful because it helps to improve agricultural farming methods.	$X^2 (16) = 26.94$	*(0.04) ***

Level of significance:	For each of the above statements, respondents indicated whether
* = P ≤ 0.10	they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree,
** = P ≤ 0.05	2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 =
*** = P ≤ 0.01	strongly disagree**.**

Consumer Purchasing Habits and the Trade-off Benefits of GM Foods

Figure 1 shows that approximately 60% of the WKU faculty and staff buys GM foods, and 40% do not buy GM foods. Education or basic scientific knowledge is necessary to realize some of the potential benefits of GM foods, but the major issue is with labeling and information on GM foods, for it is not possible to get the correct information about the GM product if it does not have proper labeling.
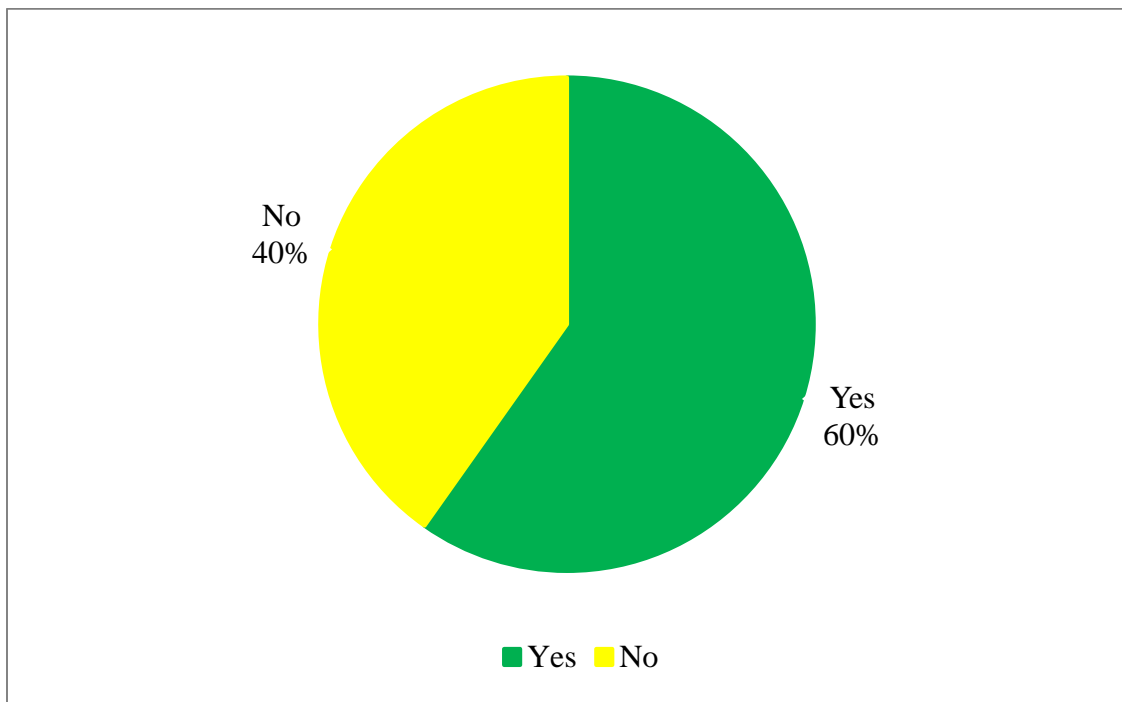
Figure 1. The WKU faculty and staff who buys GM foods. (N=199).

Table 6 indicates that approximately 32.6% of the WKU faculty and staff strongly agree or agree (strongly agree 15.3%, agree 17.3%) that they will not buy GM foods because of the pesticide chemicals used in their production, while 37.7% disagree or strongly disagree (disagree 25.5%, strongly disagree 12.2%) that they don't buy GM foods because of the pesticide chemicals used in their production, and 29.6% neither agree nor disagree. Research by Funk and Rainie (2015), found that people with knowledge in GM foods science are fairly divided about GM foods safety - 47% say that GM foods are unsafe, while 48% say GM foods are safe. Those with less knowledge of GM foods science are more likely to say that GM foods are unsafe - 66% say that GM foods are unsafe and 26% say that GM foods are safe.

According to research by (Frewer, 1999; Hoban, 1998), consumers' acceptance comprises a balancing of risks and benefits, and in the case of GM foods, the concern of consumers may well be extended beyond the potential benefits of traditional food safety, it may also include functional benefits of food, such as better taste and nutritional value, and ecological benefits such as less pesticide use. According to Caulder (1998), consumers may respond more positively towards GM foods that are tastier with longer shelf life. According to Grunert, Lahteenmaki, Niellsen, Poulsen, Ueland, & Astrom (2001), GM foods may also help to appease growing world food demand (as cited in Traill et al., 2004).

Research performed by the Pew Research Center found that 69% of US adults believe that eating foods grown with pesticides would be unsafe, while 28% believes that foods grown with pesticides are safe (Funk & Rainie, 2015). However, there seems to be some other factor that may be influencing consumer skepticism other than the safety

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issue of pesticide chemicals, for while consumers are willing to purchase GM foods, they argue about proper labeling of GM foods.

Table 6 results confirms that approximately 35.2% of the WKU faculty and staff strongly agree or agree (strongly agree 5.1%, agree 30.1%) that they would buy foods that are genetically altered to help lower cholesterol, while 41.8% disagree or strongly disagree (disagree 22.5%, strongly disagree 19.3%), and 23% were unsure whether they would buy genetically altered foods to help lower cholesterol. Approximately 35.2% of the WKU faculty and staff strongly agree or agree (strongly agree 6.1%, agree 29.1%) that they would buy GM foods to help fight diabetes, while 39.4% disagree or strongly disagree (disagree 19.4%, strongly disagree 20%) that they would buy GM foods to help fight diabetes, and 25.5% were undecided.

Research performed by (Alhakami & Slovic, 1994; Lloyd, Hayes, Bell, & Naylor, 2001; Siegrist, 1999) has shown that there is a conflicting relationship between consumers' supposed risks and apparent benefits of GM foods and it has been argued that such negative correlation confirms that consumers may have failed to take into consideration the scale of the risks and benefits. Therefore, consumers who perceive high risks would tend to also perceive lower benefits from GM foods. Nevertheless, it is not unreasonable to argue in favor of both higher benefits and the higher risks. Insect-resistant or herbicide-tolerant GM crops may involve less pesticides and herbicides in their production, which would be good for the environment, while to reduce biodiversity would be bad for the environment (Traill et al., 2004).

Research by Funk and Raine (2015) found that 55% of Americans believe that GM fruits and vegetables are not a good idea. And 37% believe that they are good

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because they help farmers to increase crop yields, and they help to feed more people, and they are good for the environment. However, in comparison to other countries, there is a much greater opposition of GM foods. Aproximately 65% of UK believe that GM foods are a bad idea, Italy 74%, Japan 76%, Germany 81%, and France 89%.

Approximately 46.4% of the WKU faculty and staff strongly agree or agree (strongly agree 25.5%, agree 20.9%) that they will not buy GM foods so long as there are other alternatives, while 30.6% disagree or strongly disagree (disagree 25%, strongly disagree 5.6%), and 22.9% of the WKU faculty and staff were undecided. Also, approximately 19.8% of the WKU faculty and staff strongly agree or agree (strongly agree 3%, agree 16.8%) that they buy GM foods because they are cheaper than the alternatives, while 42.8% disagree or strongly disagree (disagree 27%, strongly disagree 15.8%), and 37.2% neither agree nor disagree that they would buy GM foods if they were cheaper than the alternatives.

Table 6

Consumer purchasing habits and the trade-off benefits of GM foods. (N=196).

Statement	Strongly agree N (%)	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)	Strongly disagree N (%)
I would buy foods that are genetically altered to help lower my cholesterol.	*10 (5.10)*	*59 (30.10)*	*45 (22.96)*	*44 (22.45)*	*38 (19.39)*
I would buy foods that are genetically altered to help fight diabetes.	*12 (6.12)*	*57 (29.08)*	*50 (25.51)*	*38 (19.39)*	*39 (19.90)*
I will not buy GM foods so long as there are other alternatives.	*50 (25.51)*	*41 (20.92)*	*45 (22.96)*	*49 (25)*	*11 (5.61)*
I don't buy GM foods because of the pesticide chemicals that are used in their production.	*30 (15.31)*	*34 (17.35)*	*58 (29.59)*	*50 (25.51)*	*24 (12.24)*
I buy GM foods because they are cheaper than the alternatives.	*6 (3.06)*	*33 (16.84)*	*73 (37.24)*	*53 (27.04)*	*31 (15.82)*

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

The results in Table 7 shows that there was no statistical relationship found between the WKU faculty and staff purchasing habits of the possible trade-off benefits of GM foods and their levels of household income. Chi-square evaluation shows that there was some relationship at (X^2 (24) = 33.33, ($P < 0.10$) but the relationship was not significant. Table 7 also shows that there was no statistical significance observed between the WKU faculty and staff purchasing habits of GM foods and their levels of education.

Table 7

Relationship between household income and the purchasing habits and trade-off benefits of GM foods of the WKU faculty and staff.

Statement	X^2	*P-Value*
I would buy foods that are genetically altered to help lower my cholesterol.	X^2 (24) =33.33	*(0.10) **
I would buy foods that are genetically altered to help fight diabetes.	X^2 (24) =31.73	*(0.13)*
I will not buy GM foods so long as there are other alternatives.	X^2 (24) =22.48	*(0.55)*
I don't buy GM foods because of the pesticide chemicals that are used in their production.	X^2 (24) =27.06	*(0.30)*
I buy GM foods because they are cheaper than the alternatives.	X^2 (24) =13.86	*(0.95)*

Level of significance:
* = P ≤ 0.10
** = P ≤ 0.05
*** = P ≤ 0.01

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

Consumer Perception of GM Foods and their Concerns about Unlabeled GM Foods

Table 8 shows that 14.3% of the WKU faculty and staff strongly agree or agree (strongly agree 2.5%, agree 11.8%) that GM foods could have ingredients that they may be allergic to, while 56.8% of the WKU faculty and staff disagree or strongly disagree (disagree 30.2%, strongly disagree 26.6%), and 28.7% were not sure. According to Branum and Lukas (2008), the Center for Disease Control (CDC) have reported in their nationally represented data findings that allergic response to foods have seen an increase over the last decade within the United States. According to Lim (2014), allergenicity seems to be one of the main concerns of GM foods, and an estimated 70% of foods found in the United States contain GM ingredients.

Table 8 indicates that approximately 38.4% of the WKU faculty and staff strongly agree or agree (strongly agree 14.3%, agree 24.1%) that they don't trust GM foods because GM foods do not have proper labeling and information, while 26.1% disagree or strongly disagree (disagree 17.4%, strongly disagree 8.7%), and 35.3% neither agree nor disagree.

According to Kresge (2015), foods that are genetically modified cause many consumers to worry about their long-term health. Approximately 54.3% of the WKU faculty and staff strongly agree or agree (strongly agree 24.6%, agree 29.7%) that GM foods are a health concern because they are not tested for long term effects, while 22% disagree or strongly disagree (disagree 16.4%, strongly disagree 5.6%), and 23.6% neither agree nor disagree.

According to Miguel (2015), GM crops threaten the purity of organic produce and only until certain regions are declared GM free, the agricultural system of GM and non-

GM crops will remain a problem, and GM crops will ascend at the expense of non-GM

agricultural production methods (as cited in Randall, 2015). However, it would be very

challenging to create a system where you have non-GM regions and GM regions co-

existing, because pollination is a process that happens broadly and very naturally between

fields, and there are many ways by which pollen from GM-crops can travel to fields that

are non-GM.

Table 8 also indicates that 20% of the WKU faculty and staff disagree or strongly

disagree (disagree 15.9%, strongly disagree 4.1%) that GM crops are a major concern

because they contaminate and infiltrate the gene of non-GM crops, while 45.6% strongly

agree or agree (strongly agree 24.1%, agree 21.5%), and 34.3% of the WKU faculty and

staff neither agree nor disagree that GM crops infiltrate and contamination the gene of

non-GM crops.

Table 8

Consumer perception of GM foods and their concerns about unlabeled GM foods.
(N=195).

Statement	Strongly agree N (%)	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)	Strongly disagree N (%)
I am allergic to certain ingredients but I am not sure if they are present in GM foods.	*5 (2.56)*	*23 (11.79)*	*56 (28.72)*	*59 (30.26)*	*52 (26.67)*
GM foods do not have proper labeling and information, so I don't trust them.	*28 (14.36)*	*47 (24.10)*	*69 (35.38)*	*34 (17.44)*	*17 (8.72)*
GM foods are a health concern because they are not tested for long-term effects.	*48 (24.62)*	*58 (29.74)*	*46 (23.59)*	*32 (16.41)*	*11 (5.64)*
GM crops are a major concern because they contaminate and infiltrate the gene of non-GM crops.	*47 (24.10)*	*42 (21.54)*	*67 (34.36)*	*31 (15.90)*	*8 (4.10)*

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

Table 9 shows that at $(X^2 (16) = 25.18, P < 0.07)$ there is a 7% significance that age may be an influential factor in response to the statement that GM foods may contain ingredients that consumers may be allergic to.

Table 9

Relationship between age groups and the WKU faculty and staff perception of GM foods.

Statement	X^2	P-Value
I am allergic to certain ingredients but I am not sure if they are present in GM foods.	$X^2 (16) = 25.18$	*(0.07) **
GM foods do not have proper labeling and information, so I don't trust them.	$X^2 (16) = 17.14$	*(0.38)*
GM foods are a health concern because they are not tested for long-term effects.	$X^2 (16) = 11.54$	*(0.78)*
GM crops are a major concern because they contaminate and infiltrate the gene of non-GM crops.	$X^2 (16) = 18.93$	*(0.27)*

Level of significance:
* = P ≤ 0.10
** = P ≤ 0.05
*** = P ≤ 0.01

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

Table 10 shows that at (X^2 (16) = 41.19, $P < 0.02$) household income may be an influential factor in why approximately 54.3% of the WKU faculty and staff strongly agree or agree (strongly agree 24.6%, agree 29.7%) that GM foods are a health concern because they are not tested for long term effects. Table 10 also shows that at (X^2 (16) = 38.61, $P < 0.03$) there was a 3% possibility that household income was an influential factor when the WKU faculty and staff responded to this statement that GM crops are a major concern because they contaminate and infiltrate the gene of non-GM crops.

Table 10

Relationship between WKU faculty and staff income levels and their perception of GM foods.

Statement	X^2	*P-Value*
I am allergic to certain ingredients but I am not sure if they are present in GM foods.	$X^2 (16) = 20.49$	*(0.67)*
GM foods do not have proper labeling and information, so I don't trust them.	$X^2 (16) = 20.49$	*(0.67)*
GM foods are a health concern because they are not tested for long-term effects.	$X^2 (16) = 41.19$	*(0.02) ***
GM crops are a major concern because they contaminate and infiltrate the gene of non-GM crops.	$X^2 (16) = 38.61$	*(0.03) ***

Level of significance: ** = P ≤ 0.10* *** = P ≤ 0.05* **** = P ≤ 0.01*	For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

Consumers Attitude Towards Enforcing Labels for GM Foods

Figure 2 shows that an estimated 92% of the WKU faculty and staff who participated in the survey say they want GM foods to have proper labeling and information, while 8% say that GM foods should not get proper labeling and information. Proper labeling is important because it lets the consumer know whether the product has been genetically altered or not. Proper labeling may include information such as describing the nature of the ingredients present in GM foods, such as the types of proteins or genetic background. According to Langer (2016), with the widespread concern of food safety, the consumer is more likely to avoid foods with GM food labels.

Within the near future, there are possibilities that some GM foods may be required to have proper labeling or product identification, which will enable the consumer to find additional information about the product, such as its genetic information. In July of 2016, S.764 bill, now Public Law No: 114-216, was passed through the Senate House, which required the USDA to create new guidelines for monitoring GM foods (Congress.gov, 2016). This new bill will override the Vermont legislation enacted two years prior. The Vermont bill was taking effect as companies such as General Mills, Kraft, Campbell's Soup and Pepsi started to label some of their products that contains GMO ingredients. However, the bill will allow GM manufacturers and producers to write labels in plain text, digital barcode, or symbolic labels. The Vermont Food Fight Fund supporters argued that the new bill will delay GMO labeling for two more years. They also argued that it is weaker, because it will allow companies to determine how they want to disclose genetic engineered product information (Gallagher, 2016).
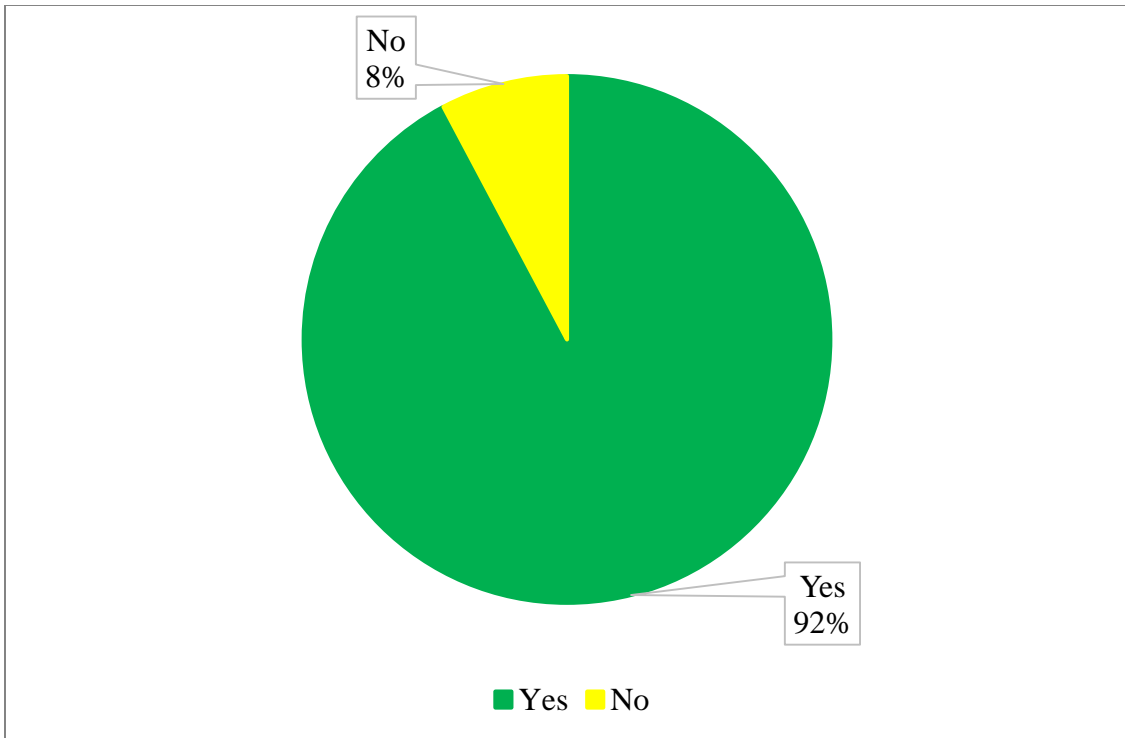
Figure 2. Consumer attitude towards enforcing labels for GM foods. (N=193).

Table 11 shows that approximately 62.9% of the WKU faculty and staff strongly agree or agree (strongly agree 33.8%, agree 29.1%) that GM foods should be labeled because they may have long-term health effects, while 14.5% disagree or strongly disagree (disagree 11.9%, strongly disagree 2.6%), and 22.4% neither agree nor disagree. Approximately 86.9% of the WKU faculty and staff strongly agree or agree (strongly agree 52.6%, agree 34.3%) that GM foods should get proper labeling even though they were approved by the FDA, while 8.2% of the WKU faculty and staff disagree or strongly disagree (disagree 6.2%, strongly disagree 2%), and 4.7% neither agree nor disagree.

According to Traill et al. (2004), some legal organizations create a dull picture about GM foods technology practices, and trusting in the information from legal sources may not be a good alternative. Whether the WKU faculty and staff who participated in the survey trust the FDA's decision on GM foods or not, based on the data from the survey, they seem to be very firm with their decision that they want GM foods to be labeled. Approximately 80.6% of the WKU faculty and staff disagree or strongly disagree (disagree 34.3%, strongly disagree 46.3%) that GM foods should not be labeled because labeling GM foods could cause a manufacturing shutdown that may trigger a food crisis in the nation, while 4.6% strongly agree or agree, and 14.5% neither agree nor disagree.

Table 11 also shows that approximately 89% of the WKU faculty and staff strongly agree or agree (strongly agree 55.7%, agree 33.3%) that GM foods should be labeled because the consumer has a right to know how the product was made, while 4.1% disagree or strongly disagree, and 6.7% neither agree nor disagree. Approximately 8.8% of the WKU faculty and staff strongly agree or agree (strongly agree 3.6 %, agree 5.2%)

that GM foods should not be labeled because they are safe otherwise the FDA would not put them on the market, while 74.4% of the WKU faculty and staff disagree or strongly disagree (disagree 32.8%, strongly disagree 41.6%), and 16.6% neither agree nor disagree. There was no correlation indicating that age, education, or income may have been an influence for the responses demonstrated in Table 11 results.

Table 11

Consumer attitude towards enforcing labels for GM foods. (N=192).

Statement	Strongly agree N (%)	Agree N (%)	Neither agree nor disagree N (%)	Disagree N (%)	Strongly disagree N (%)
GM foods should be labeled because they may have long-term health effects.	*65 (33.85)*	*56 (29.17)*	*43 (22.40)*	*23 (11.98)*	*5 (2.60)*
GM foods should be labeled because the consumer has a right to know how the product was made.	*107 (55.73)*	*64 (33.33)*	*13 (6.77)*	*6 (3.13)*	*2 (1.04)*
GM foods should not be labeled because they are safe, otherwise the FDA would not put them on the market.	*7 (3.65)*	*10 (5.21)*	*32 (16.67)*	*63 (32.81)*	*80 (41.67)*
I believe that GM foods should be labeled even though they are approved by the FDA.	*101 (52.60)*	*66 (34.38)*	*9 (4.69)*	*12 (6.25)*	*4 (2.08)*
GM foods should not be labeled because labeling may cause a manufacturing shutdown which could trigger a food crisis in the nation.	*3 (1.56)*	*6 (3.13)*	*28 (14.58)*	*66 (34.38)*	*89 (46.35)*

For each of the above statements, respondents indicated whether they agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

Conclusion and Recommendation for Future Study

Conclusion

Research Question #1: Do the WKU faculty and staff want GM foods to have proper labeling and information or not?

Yes, 92% of the WKU faculty and staff wants GM foods to have proper labeling and information. As compared to other studies that explored this area on consumer response to GM food labels, 92% is significantly high. Research performed by Chern, Rickertsen, Tsuboi, & Fu, (2002) found that the United States ranks a low 49% in wanting GM foods to get proper labeling and information, while other countries such as Norway rank 84%, Japan 60%, and Taiwan 79%.

Research Question #2: Do the WKU faculty and staff believe GM foods are safe?

Yes, at least 52% of the WKU faculty and staff who participated in the survey believes that GM foods are safe, while 42% believes that GM foods are not safe.

Research Question #3: Do the WKU faculty and staff purchase GM foods?

Yes, approximately 60% of the WKU faculty and staff say they have purchased some form of GM foods, and 40% say they don't buy GM foods. Also, 39.8% say they have eaten genetically modified potatos, soybeans, corn and tomatoes, while 54.5% say they don't know if they have eaten GM foods, as most genetically modified foods do not have proper labeling and information.

Research Question #4: Do the WKU faculty and staff believe there are trade-off benefits of GM foods?

       Yes, the results confirmed that consumers may be more likely to purchase GM foods with possible trade-off benefits. Some trade-off benefits identified in this study were, approximately 42% of the WKU faculty and staff who participated in the survey said they would buy GM foods that are cheaper than alternative foods; and about 40% agreed that they would buy GM foods if they had additional benefits that would help to fight illnesses such as diabetes and high cholesterol. Also, 61% of the respondents agreed that GM foods help to provide food for the growing population, and 52% agreed that GM foods help to fight against vitamin A deficiency.

Research Question #5: Do the faculty and staff of WKU believe there are disadvantages of unlabeled GM foods?

       Yes, approximately 89% of the respondents agrees that GM foods should be labeled because the consumer has a right to know. About 14% fear allergic reactions from GM foods. Approximately 87% agrees that GM foods should be labeled even though the FDA say they are safe. Approximately 40% would not buy GM foods because they do not have proper labeling and information. While an estimated 54% believes that GM foods may have long-term health effects, and 92% said they want GM foods to be labeled.

Recommendation for Future Study

This study was limited to the WKU population; therefore, future research needs to be performed for the entire state of Kentucky. Future research is recommended to explore new ways to introduce quality benefits into GM foods such as possible trade-off benefits of GM foods that would help cancer patients, help fight diabetes, and help lower cholesterol. Future research needs to be performed to look closely at how the disadvantages of unlabeled GM foods may affect consumer purchasing decisions.

While there are some great benefits behind GM foods technology, scientists should not be too hasty in disregarding the old farming methods of food production and agriculture. It is important and necessary to invent novel ideas for the future that would make food production easier and faster, but public health regarding food safety should be of the utmost importance. According to Pew Research Center (2015), approximately 67% of Americans believe that scientists who study GM foods do not have a good understanding about GM food safety and its long-term effects on the health of consumers; while 28% believes that scientists do have enough knowledge and understanding about GM foods and its effect on human health.

Future research needs to be performed to look at how GM foods labeling may affect companies that do not want GM foods to be labeled. Future research needs to be performed to look at how GM foods labeling may impact companies that do want GM foods to be labeled.

According to Grover (2011), the science behind GM foods will play a significant role in helping scientists to understand and analyze the genome of plants and will give them the tools to improve the development of plants. It is better to use GM foods

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technology as an additional tool and not use it as the means to replace conventional methods. Furthermore, research carried out in this field must be transparent and open to public opinion; any detectable or foreseeable knowledge of risks must be taken seriously (Tourte, 2004).

Geographic location and climate change are two of the most critical environmental problems that affect the changes of plant genes and affects the ability to produce continuous harvests. A process needs to be developed by which plant genes can continuously reproduce and be harvested each year without the interruption that is caused by geographic location or climate change. The solution then is not to try and change the seasons or the structure of plant genes, but to reproduce the environment in which the plant can be grown without weather interference.

Appendix A: Percentage response of the WKU faculty and staff and their participating counties.

County	Frequency	(%)
Allen	7	(3.37)
Barren	4	(1.92)
Boone	1	(0.48)
Butler	2	(0.96)
Calloway	1	(0.48)
Daviess	1	(0.48)
Edmonson	5	(2.40)
Franklin	1	(0.48)
Graves	1	(0.48)
Grayson	1	(0.48)
Hardin	3	(1.44)
Hart	1	(0.48)
Jefferson	1	(0.48)
Logan	3	(1.44)
Marion	1	(0.48)
Mercer	1	(0.48)
Pulaski	1	(0.48)
Simpson	1	(0.48)
Unknown	39	(18.75)
Warren	133	(63.94)

Appendix B: The level of education of the WKU faculty and staff who participated in the GM foods survey
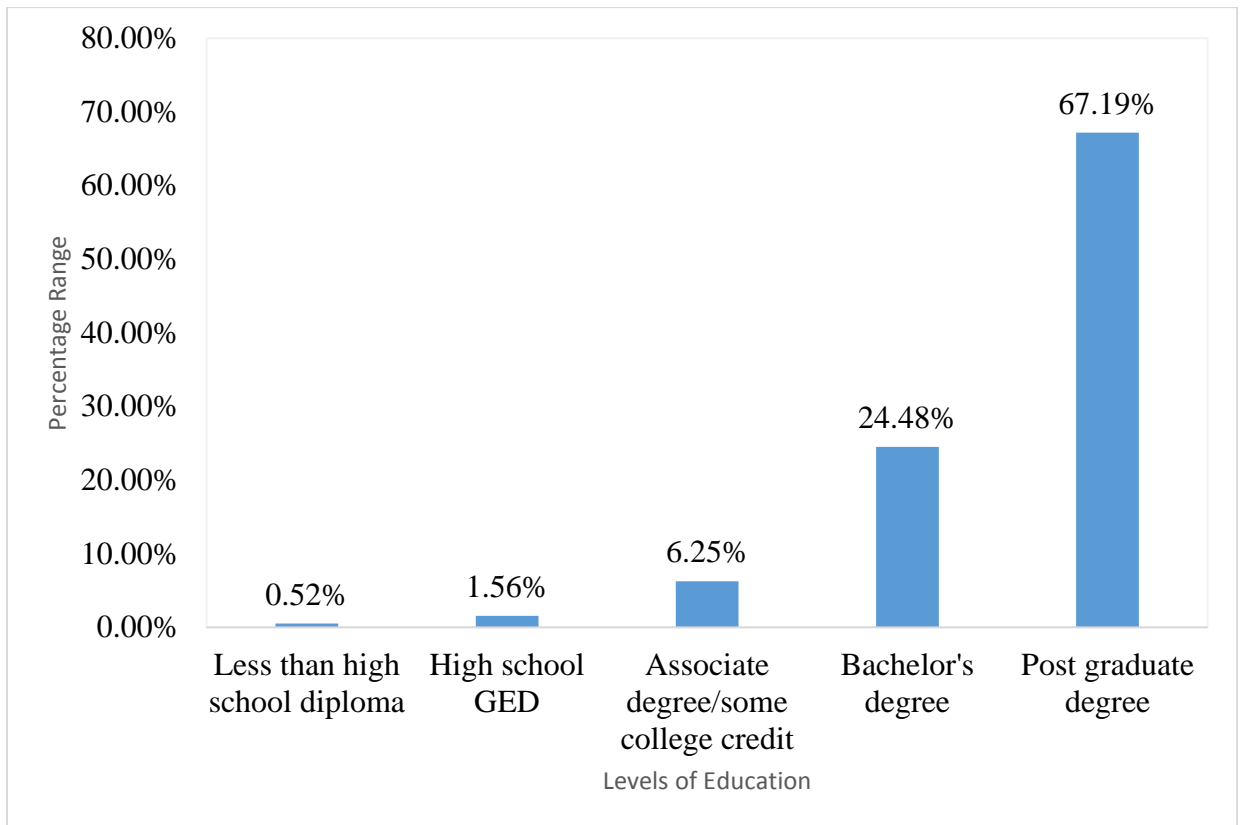
Appendix C: The levels of income of the WKU faculty and staff who participated in the GM foods survey.

A bar chart titled with axes "Percentage Range" (y-axis) and "Levels of Income" (x-axis).

Levels of Income	Percentage
Less than $25,000	2.1%
$25,000 - $35,000	13.0%
$35,000 - $45,000	10.9%
$45,000 - $55,000	7.3%
$55,000 - $75,000	27.6%
$75,000 - $95,000	15.6%
$95,000 or more	23.4%
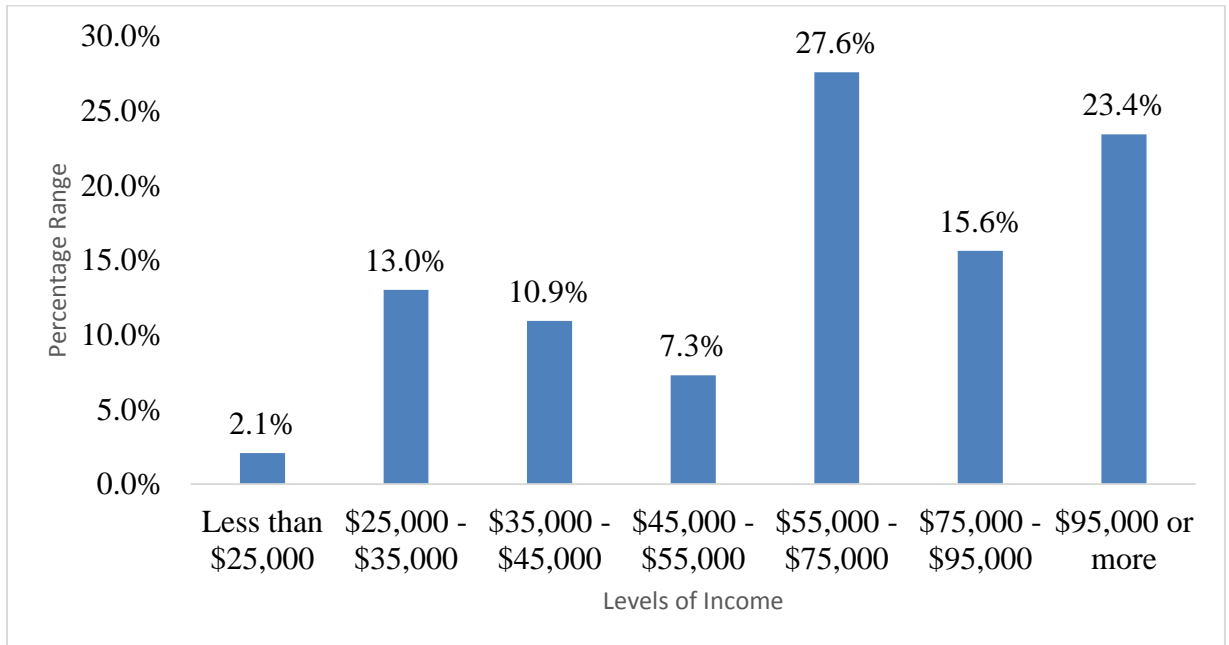
Appendix D: Chi-square evaluation of whether age, or household income affects consumers' decision to buy GM foods.

		Do you buy genetically modified foods?		
		Yes	No	Total
What is your age?	18 - 29	13	5	18
	30 - 39	37	15	52
	40 - 49	30	17	47
	50 - 59	19	31	50
	60 +	16	9	25
	Total	115	77	192
What is your household income?	Less than $25,000	2	2	4
	$25,000 - $35,000	12	13	25
	$35,000 - $45,000	12	9	21
	$45,000 - $55,000	10	4	14
	$55,000 - $75,000	30	23	53
	$75,000 - $95,000	17	13	30
	$95,000 or more	32	13	45
	Total	115	77	192

Add Stub

		Do you buy genetically modified foods?
What is your age?	Chi Square	14.34
	Degrees of Freedom	4
	p-value	0.01

		Do you buy genetically modified foods?
What is your household income?	Chi Square	5.20*
	Degrees of Freedom	6
	p-value	0.52

Appendix E: Likert scale statements used in the survey analysis.

For each one of the following statement about genetically modified foods, please indicate whether you agree or disagree on a scale of 1 to 5, where: 1 = strongly agree, 2 = agree, 3 = neither agree nor disagree, 4 = disagree, and 5 = strongly disagree.

Statement	Strongly agree (%)	N	Agree (%)	N	Neither agree nor disagree (%)	N	Disagree (%)	N	Strongly disagree (%)	N	Total
I would buy foods that are genetically altered to help lower my cholesterol.	5.10%	10	30.10%	59	22.96%	45	22.45%	44	19.39%	38	196
I would buy foods that are genetically altered to help fight diabetes.	6.12%	12	29.08%	57	25.51%	50	19.39%	38	19.90%	39	196
I will not buy genetically modified foods so long as there are other alternatives.	25.51%	50	20.92%	41	22.96%	45	25.00%	49	5.61%	11	196
I don't buy genetically modified foods because of the pesticide chemicals that are used in their production.	15.31%	30	17.35%	34	29.59%	58	25.51%	50	12.24%	24	196
I buy genetically modified foods because they are cheaper than the alternatives.	3.06%	6	16.84%	33	37.24%	73	27.04%	53	15.82%	31	196

Appendix F: Consent Form with Institutional Review Board Approval.

INFORMED CONSENT DOCUMENT

Title: Consumer knowledge, perception and attitudes of unlabeled genetically modified foods and genetically modified crops in the state of Kentucky.

Investigator: Aldious A. Waite. Graduate student of the Architectural Manufacturing Sciences Department at WKU. Phone: 270-421-0688. Email: aldious.waite915@topper.wku.edu

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your agreement to participate in this project.
You must be 18 years old or older to participate in this research study.

The investigator will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have. You should keep a copy of this form for your records.

1. **Nature and Purpose of the Project:** I am conducting a survey on consumer knowledge, perception and attitudes of unlabeled genetically modified foods and genetically modified crops in the state of Kentucky.

2. **Explanation of Procedures:** The researcher will give you a short questionnaire about genetically modified foods for you to fill out. Please answer the questions to the best of your knowledge. The questionnaire consists of 18 questions and will take about 7 - 10 minutes of your time.

3. **Discomfort and Risks:** There are no known risks associated with this study. No harm will result upon your participation in this study, and all response will be confidential.

4. **Benefits:** As a reward for your participation, at the end of the survey, you may enter your email address for a chance to win a $50 visa gift card. Your participation may be used to encourage further research on the subject matter.

5. **Confidentiality:** All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reported individually). All questionnaires will be concealed, and no one other than the primary investigator and assistant researchers listed below will have access to them.

6. **Refusal/Withdrawal:** Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

Your continued cooperation with the following research implies your consent.

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Paul Mooney, Human Protections Administrator
TELEPHONE: (270) 745-2129

WKU IRB# 16-400
Approval - 5/2/2016
End Date - 5/2/2017
Expedited
Original - 4/5/2016

Appendix G: The GM foods questionnaire

1. Are you currently a resident of Kentucky?

   ⦿ Yes   ○ No

2. Have you been a resident of Kentucky for at least 12 months or more?

   ⦿ Yes   ○ No

3. What is your home county?

4. Have you heard of genetically modified foods, or (GMO's)?

   ○ Yes   ○ No

5. The FDA approves of GM foods; do you trust the FDA?

   ○ Yes   ○ No

6. I have eaten potato, soybean, corn and tomato that were genetically modified.

   ○ Yes   ○ No   ○ I don't know

7. I am allergic to certain ingredients but I am not sure if they are present in GM foods.

   ○ Yes   ○ No

8. Do you buy GM foods?

   ○ Yes   ○ No

9. For each one of the following statement about GM foods, please indicate whether you agree or disagree on a scale of 1 to 5, where: 1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, and 5 = strongly agree.

	Strongly Agree	Agree	Neither	Agree	Strongly Agree
GM foods are good because the FDA approves that they are safe to eat and I trust the FDA.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods are helpful because they help to provide food for the growing population.	○ 1	○ 2	○ 3	○ 4	○ 5
GMO technology can help to improve our lives, boost the economy, and help to improve us as a nation.	○ 1	○ 2	○ 3	○ 4	○ 5

GMO technology helps to solve important food challenges and help to fight diseases, such as vitamin A deficiency.	○ 1	○ 2	○ 3	○ 4	○ 5
GMO technology is very useful because it helps to improve agricultural farming methods.	○ 1	○ 2	○ 3	○ 4	○ 5
I buy GM foods because they are cheaper than the alternatives.	○ 1	○ 2	○ 3	○ 4	○ 5
I would buy foods that are genetically altered to help lower my cholesterol.	○ 1	○ 2	○ 3	○ 4	○ 5
I would buy foods that are genetically altered to help fight diabetes.	○ 1	○ 2	○ 3	○ 4	○ 5
I will not buy GM foods so long as there are other alternatives.	○ 1	○ 2	○ 3	○ 4	○ 5
I don't buy GM foods because of the pesticide chemicals that are used in their production.	○ 1	○ 2	○ 3	○ 4	○ 5
I don't buy GM because I think they have high cholesterol and fat content.	○ 1	○ 2	○ 3	○ 4	○ 5

GM foods do not have proper labeling and information, so I don't trust them.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods are a health concern because they are not tested for long-term effects.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods crops are a major concern because they contaminate and infiltrate the gene of non-GM crops.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods should be labeled because they may have long-term health effects.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods should be labeled because the consumer has a right to know how the product was made.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods should not be labeled because they are safe, otherwise the FDA would not put them on the market.	○ 1	○ 2	○ 3	○ 4	○ 5
I believe that GM foods should be labeled even though they are approved by the FDA.	○ 1	○ 2	○ 3	○ 4	○ 5
GM foods should not be labeled because labeling may cause a manufacturing shutdown which could trigger a food crisis in the nation.	○ 1	○ 2	○ 3	○ 4	○ 5

10. What is your age?

  ○ 18 - 29

○ 30 - 39

○ 40 - 49

○ 50 - 59

○ 60 +

11. What is your highest level of education?

○ Less than high school deploma

○ High school GED

○ Associate degree/some college credit

○ Bachelor's degree

○ Post graduate degree

12. What is your household income?

○ Less than $25,000

○ $25,000 - $35,000

○ $35,000 - $45,000

○ $45,000 - $55,000

○ $55,000 - $75,000

○ $75,000 - $95,000

○ $95,000 or more

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