# Awareness of and Attitudes towards Biotechnology by Tennessee State University Students with Different Backgrounds and Majors

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**Genetic modification of crops using biotechnology has taken large strides in recent decades with the development of high yielding crop varieties. However, there is ongoing debate among opponents and proponents of the technology regarding its benefits and potential risks. Various studies have shown that lack of knowledge about biotechnology remains the primary reason for anxiety about Genetically Modified Organisms (GMO). This study focuses on assessment of perceptions and attitudes of Tennessee State University (TSU) students towards biotechnology. A face to face survey was administered to obtain data from students in different departments of the university during class times. Statistical methods were used to analyze the data. A statistically significant difference was found between students who had rural background compared to those who came from urban areas. Moreover, statistically significant differences in attitude existed between students enrolled in the social sciences versus those in biological sciences. The results suggest the need for introducing biotechnology issues in relevant college course offerings. Students in the biological sciences had better knowledge and hence less fear of biotechnology. Respondents with backgrounds in agriculture seemed to favor biotechnology products compared to others. The study also looked at the correlation between the students' claim of awareness and their knowledge of biotechnology. Responses from 792 students indicated that awareness plays a key role in forming a positive or negative opinion about biotechnology. Since education plays an important role, the inclusion of biotechnology issues in university curricula would promote the students' perception and understanding of the usefulness of the emerging technology.**

**Keywords:** Genetically modified foods, Awareness and Attitudes, Face to face survey, Tennessee State University.

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## Introduction

Biotechnology has shown great promise over the last couple of decades in the agricultural and food industries. The technology has the potential to change the very nature of humanity [1, 2]. However, limited outreach of important biotechnological research has led to frequent public opposition to its adoption [3, 4]. Increasing public awareness has been reported to tilt opinion towards favoring and adopting biotechnology [5]. Bt corn production has been most acceptable in terms of both usefulness and risk perception.

Public exposure to genetic transformation in plants and animals as well as its application to the environment is needed for the sustenance

of the agricultural industry [6, 7, 8]. College students are the future of the society. Thus biotechnology needs to have an established position that is acceptable among students for a successful future [9]

A variety of previous studies have used surveys to assess students' perceptions, attitudes and knowledge about biotechnology [10, 11, 12]. A farm family background has played an important role in the attitudes of survey respondents regarding biotechnology in the past. Wingenbach et. al. [13] found that almost two out of three college students who responded to the survey have worked on a farm or ranch and 52 percent of their families owned an agriculture production property.

Fritz et.al. [9] assessed levels of awareness and acceptance of biotechnology issues among pre-college students (n = 283), undergraduate students (n = 330), and other adults (n = 166). The percentage of adults who were aware of how biotechnology would affect food, health and the environment was almost three times more than that of the younger respondents. It was concluded that consumer groups were most likely impacted by accurate, unbiased agricultural biotechnology information delivered through the internet and newspapers that originates from reliable, accessible, and science-based sources.

Females have been reported to be less accepting of biotechnology, while individuals identifying themselves as natural scientists were found to be more accepting compared to social scientists [11]. Females majoring in education were found to be the least accepting of biotechnology. Overall, students had limited knowledge of biotechnology and thus more respondents tended to reject biotechnology than embrace it [11]. Respondents ranked knowledge from science classes, experience in science labs and discussions with university professors as the top three factors that formed their beliefs and perceptions about the application of biotechnology [12].

There are several studies on biotechnology pertaining to consumers and producers. In contrast, only a few studies are available involving college students' awareness and attitude towards biotechnology in general and 1890 institutions such as TSU in particular.

## Conceptual Framework

The objective of this study is to asses TSU students' awareness of and attitude towards biotechnology. It is hypothesized that these are related to students' disciplinary areas and characteristics. To the extent that the above hypothesis is not rejected, it can provide a useful input for developing strategies to educate students about biotechnology. The students' educational background was divided into physical, social and biological sciences. Farming background was also considered as a factor affecting their opinions.

## Materials and Methods

Primary data was collected using a face to face survey of undergraduate students enrolled in ten different departments at TSU. The classes surveyed were randomly selected. Completed individual responses were then collected on spot. The survey focused on three different aspects. The first part focused on assessing the students' knowledge of biotechnology. They were asked about their knowledge and understanding of biotechnology and genetically modified foods. The second aspect was on the students' perception, and thereby the respondents were required to answer questions for assessing whether they look at genetically modified foods positively or negatively. The third part focused on demographics in order to understand the background of respondents with regards to their education and family. Table 1 provides a summary of the characteristics of the respondents.

**Table 1.** Characteristics of the respondents.

| | |
|---|---|
| Average Age (years) | 22 |
| | |
| **College Classification** | |
| Freshman | 17% |
| Sophomore | 21% |
| Junior | 18% |
| Senior | 41% |
| Graduate or Special | 2% |
| | |
| **Type of Degree Enrolled in** | |
| Social Sciences | 52% |
| Physical Sciences | 16% |
| Biological Sciences | 33% |
| | |
| **Race** | |
| African American | 82% |
| Caucasian | 10% |
| Hispanic | 1% |
| Native American | 0% |
| Asian | 2% |
| Other | 6% |

The survey was distributed to 792 students after getting approval from TSU's Institutional Review Board (IRB). Table 1 shows frequency distribution of the type of degree that the students (respondents) were enrolled in. Out of 792 respondents, 409 students (52 percent) were studying social sciences, while another 258 students (32 percent) were enrolled in biological sciences. The rest 125 students (16 percent) were pursuing degrees in physical sciences. Out of the 792 respondents, 41 percent were seniors and only 2 percent were graduate students. The average age was 22 and 82 percent of the respondents were African American as expected for TSU, an 1890 land grant institution.

All 792 responses could not be used in the analyses due to inaccuracies, which included answers such as 'not sure' and incomplete responses. Students were classified according to their grade level (freshman, sophomore, junior, senior, graduate or special). These taxonomies were useful to analyze the students' awareness and attitude regarding biotechnology.

Responses to different survey questions that had similar scale for an issue were grouped together. Both descriptive and statistical methods were used to analyze the data. Statistical tests were used to find the correlations between apprehension regarding biotechnology or GMO crops and respondents' knowledge. Hypothesis testing was performed to find differences between groups who did or did not claim to be knowledgeable about biotechnology and the students' academic background.

Statistical analyses were conducted using non-parametric methods, t-test, F-test and ANOVA. F-test and t-test were used to evaluate the difference between two or more groups. For example, the null hypothesis of 'no difference between students in social sciences and biological sciences' was tested using a t-test, whereas differences among students in the social, biological and physical sciences was tested using F-tests. Similarly, an unpaired t-test was used to see if there was a significant difference in terms of reservation or positive disposition towards GM food between respondents with knowledge and those without knowledge of biotechnology. A non-parametric 'Man Whitney U-test' was performed to confirm the difference between those who had reservations and those who did not about biotechnology and its correlation with the knowledge.

Students in natural and physical sciences were expected to have relatively more awareness about biotechnology than students in the social science disciplines. The survey also covered questions relating to the demographic characteristics of the students such as age, gender, family backgrounds and experience. Likert scale type statements were also included to ensure that respondents provided feedback on different issues.

**Table 2.** Survey responses (percentages) assessing the respondents' true knowledge of biotechnology.

| Survey Question | True | False | Not Sure |
|---|---|---|---|
| The DNA or genes of other organisms such as microorganisms, plants and animals are being mapped, just like the human genome | 70% | 4% | 26% |
| When you eat food, you are also eating DNA or genes | 49% | 24% | 28% |
| There are medicines that are products of biotechnology or genetic engineering currently on the market and being prescribed to patients | 65% | 5% | 30% |
| Some genetically modified crops are on the market and being used by farmer in the U.S. | 78% | 5% | 18% |
| Foods with genetically engineered ingredients are being sold in supermarkets right now | 73% | 7% | 20% |
| There are no federal regulations on genetically engineered foods and crops in the U.S. right now | 16% | 47% | 38% |
| There are new medicines developed through genetic engineering that are now on the market in the U.S | 53% | 7% | 40% |

## Results

The survey responses showed that 52 percent of the respondents claimed that they had some or more knowledge of biotechnology. However, only about 3.9 percent said they knew 'a lot' about genetic engineering or biotechnology. The other 44 percent did not claim to have much knowledge about biotechnology.

The results from the survey respondents that accurately assessed their true knowledge about genetic engineering or biotechnology are summarized in Table 2. Thus, validation of the responses on the question of claim to know about the biotechnology was checked.

The survey included a question on 'food safety' to see if the respondents believed in the integrity of the regulatory process. Sixty one percent of students said that they did not feel that the regulatory process was enough to ensure 'food safety'. However, 56 percent of the respondents also confessed that they seldom read food labels that list ingredients.

Figure 1 shows that social science students claim less knowledge about biotechnology compared to those in biological science. Sixty four percent of respondents majoring in biological sciences claimed some or more knowledge about biotechnology. The difference between social and biological sciences was found statistically significant when their attitudes towards biotech foods were compared (t-value = 2.811, p-value = 0.0051). While comparing the social and natural science students in the study, it was found that the former had more apprehensions than their latter counterparts regarding biotechnology. However, this result was not statistically significant (t-value = 1.246, p-value = 0.2133).

The respondents were also asked their opinions on various statements regarding everyday use of biotechnology. Seventy one percent of the respondents agreed that further genetic engineering will be beneficial to humankind. Such was the response by students to the direct statement irrespective of their actual level of

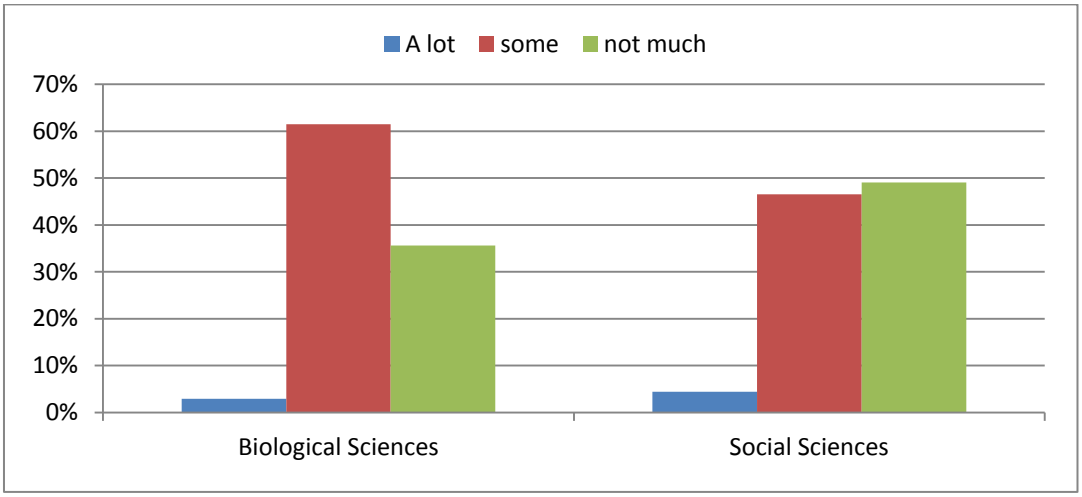


**Figure 1**. Extent of claim of knowledge about biotechnology by TSU students majoring in social and biological sciences

knowledge about biotechnology. Additionally, 75 percent of the respondents supported the use of biotechnology in creating new medicines and treatments for human diseases. However, only 19 percent were in favor of using biotechnology in the development of crop varieties and animal breeds. These results indicated the confusion among the respondents since they see biotechnology being useful on one hand, but were not in favor of using it for crops and food improvements (Table 3).

As per the results from the survey responses regarding the opinions on how biotechnology should be used, more than two out of three respondents also supported biotechnology in terms of reducing pesticide usage. There was an equal split among the respondents regarding its effect on reducing cost of food production. Only 16 percent respondents were found against the idea of using biotechnology to improve nutritional content of the food. Fifty percent endorsed the idea of such application (Table 3).

In assessing the responses of students being favorable towards or opposed to biotechnology, it was found that juniors in natural sciences were overwhelmingly in favor. Despite this trend of being less wary, the difference from other group was not statistically significant.

Majority of the respondents with farm family background showed less concern about biotechnology compared to those with urban and non-farming rural backgrounds (Figure 2). Respondents from rural areas with no farming background showed the highest concern (52 percent). The result from ANOVA showed that the difference between respondents from farm family backgrounds and urban background was statistically significant with farm families being more in favor or biotechnology. (Mean = 2.6700, df = 3, p-value = 0.0085). However, the number of respondents was only 19, which is a very small proportion of those that were surveyed. The relationship between positive attitude towards genetically altered ingredients in food and farm backgrounds was found to be statistically significant (F-value = 3.92, df = 3, p-value = 0.0085). Thus, having a farming background tilted respondents toward favoring biotech products.

Figure 3 shows that in terms of the perception that one is eating DNA with food, a higher percentage of students from the biological

**Table 3.** Students' opinions on how Biotechnology should be used in the food and other usage.

| | Opinion | | |
|---|---|---|---|
| **Opinions on Use of Biotechnology** | **Favor** | **Against** | **Neutral** |
| Further scientific studies will be beneficial to humankind | 72% | 6% | 23% |
| To create new medicines and expand the treatments available for dealing with human disease | 75% | 4% | 21% |
| To reduce the use of pesticides in farming and improve the food safety | 68% | 5% | 27% |
| To develop crop varieties and conduct animal breeding | 19% | 44% | 37% |
| To improve the nutritional content of food | 50% | 16% | 34% |
| To reduce the cost of food production | 41% | 40% | 18% |

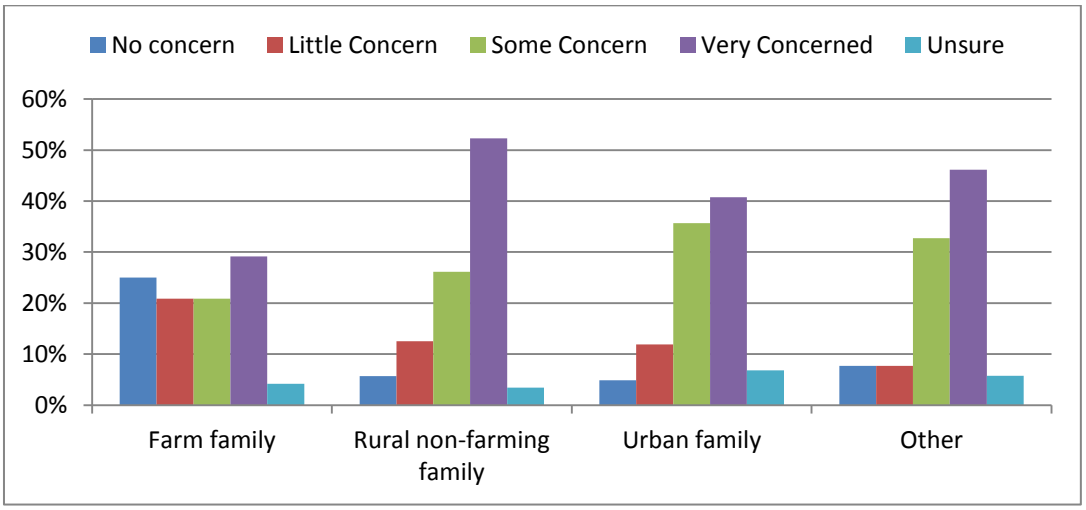


**Figure 2.** Level of concern about biotechnology shown by respondents with rural, urban and farming backgrounds

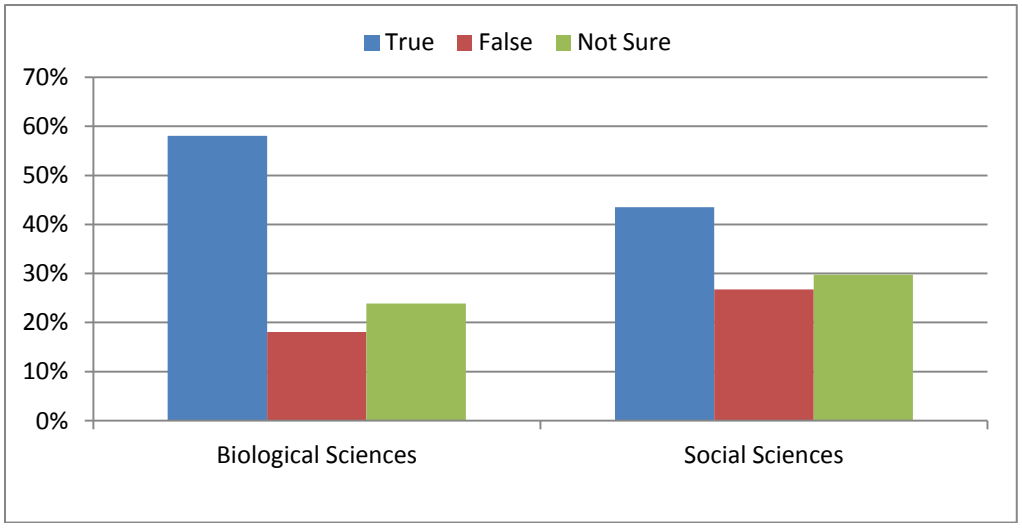


**Figure 3.** Comparison of responses among students in biological and social sciences pertaining to the perception that 'one eats DNA with food'.

**Table 4.** Statistically significant findings and relationships among the fear/favor and demographics.

| Relationship | Mean | p-value |
|---|---|---|
| Respondents with farm background have lower concerns about biotechnology | 2.6700 | 0.0085 |
| Respondents with less awareness have apprehensions about biotechnology compared to those with adequate knowledge | -0.1720 | 0.0010 |
| Respondents with social science majors favor the biotechnology compared to those with physical sciences majors | 2.2010 | 0.0439 |
| Difference between social and physical science students who claim knowledge | 1.2000 | 0.0380 |
| Difference between students enrolled in social vs. biological sciences who claim to have adequate knowledge | 0.1290 | 0.0051 |
| Biological science students have more knowledge compared to those in social sciences | 0.2570 | 0.0001 |
| Difference between biological and physical science students with true knowledge | -0.2360 | 0.0106 |

sciences answered 'yes' compared to students from social sciences. This confirms that students from biological sciences had better knowledge about the biotechnology than students from social sciences. The result was statistically significant (table 4).

Table 4 summarizes some important results and relationships that were found to be statistically significant after the analyses. The relationship between attitude towards biotechnology and demographic characteristics of the respondents is also shown. The relationship between true knowledge and acceptance of GMO was found to be statistically significant (p-value = 0.0010). Thus if a person was more knowledgeable about biotechnology, he/she would most likely consider GMO safe. A person with less knowledge was more skeptical and had concerns regarding GM foods.

Correlation analysis shows that the respondents were fairly honest and sincere in claiming their level of biotech knowledge. Students' claims about their own level knowledge and their true knowledge were found to be statistically correlated with a correlation coefficient of 0.227 and a p-value less than 0.001. This not only shows that the respondents' statements about their knowledge were accurate, but also supports the validity of the survey.

## Discussion

People's perceptions about biotechnology are related to their knowledge and adequate understanding of the fundamental concepts. More informed individuals had favorable opinions about biotechnology; therefore, efforts are required to increase knowledge among college students about biotechnology and GM crops. Students with farm background and education in natural sciences are more favorable as they seem to be aware of the benefits of GM crops.

Given the results about natural sciences students and perception of knowledge, there is need to strengthen biotechnology courses in natural sciences. Findings of this study are consistent with other similar studies that show university students have limited awareness about biotechnology. To enhance such

awareness there is a need to introduce the subject of biotechnology to students as part of their education. An unbiased attitude towards biotechnology by students should be based on factual understanding of the issues since they are future consumers, producers and policy makers.

There is also a need for more research on biotechnology from social and natural science perspectives. Equally important is the dissemination of the research results by various groups including journalists, extension personnel and educational institutions. Suffice it to note that the speed at which biotechnology progresses is driven by increasing collaboration and investment by the public and private sector institutions. Producers can decide to adopt or not to adopt the technology. Likewise consumers can decide to use or avoid biotech derived products but they cannot stop its progress.

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## Reference

1. Simonneaux L. 2000. Influence of cultural and disciplinary identity on the way teachers in agricultural education in France relate to knowledge in biotechnology. New Genetics and Society. 19:23-48.
2. Leislie G, Schibeci R. 2003. What do science teachers think biotechnology is? Does it matter? Australian Science Teachers' Journal. 49:16-21.
3. Brettell R. 1999. Keeping pace with rapid advances in agricultural biotechnology. Australian Science Teachers' Journal. 45:11-14.
4. Kirkpatrick G, Orvis K, Pittendrgh B. 2002. Interactive learning: A teaching model for biotechnology and genomics education. Journal of Biological Education. 37(1):31-35.
5. Aziz AN, Tegegne F, Wiemers R. 2009. Benefits of Hands-On Biotechnology Training Workshops for Secondary School Educators and College Students. Journal of Biotech Research. 1: 72-79.
6. Bagchi-Sen S and Scully J. 2007. Strategies and external relationships of small and medium-sized enterprises in the US agricultural biotechnology sector. Environment & Planning C: Government & Policy. 25:844-860.
7. Falk H, Brill G, Yarden A. 2008. Teaching a biotechnology curriculum based on adapted primary literature. International Journal of Science Education. 30(14):1841-1866.
8. Wilson E, Flowers J. 2002. Secondary educators' confidence in teaching agricultural biotechnology after training. Journal of Natural Resources and Life Science Education. 31:131-135.
9. Fritz S, Husmann D, Wingenbach G, Rutherford T, Egger V, Wadhwa P. 2003. Awareness and acceptance of biotechnology issues among youth, undergraduates, and adults. AgBioForum. 6(4):178-184.
10. Sterling LG, Habrendt CK, Kitto SL. 1993. Impact of education on the attitudes of college students toward biotechnology. Journal of Agricultural and Environmental Ethics. 6(1):75-88. DOI: 10.1007/BF01965616
11. Sohan DE, Waliczek TM, Briers GE. 2002. Knowledge, Attitudes, and Perceptions Regarding Biotechnology among College Students. Journal of Natural Resources and Life Science Education. 31:5(11) http://www.JNRLSE.org
12. Lamanauskas V and Makarskaitė-Petkevičienė R. 2008. Lithuanian University Students' Knowledge of Biotechnology and Their Attitudes to the Taught Subject. Eurasia Journal of Mathematics, Science & Technology Education. 4(3):269-277.
13. Wingenbach GJ, Rutherford TA, Dunsford DW. 2003. Agricultural Communications Students' Awareness and Perceptions of Biotechnology Issues. Journal of Agricultural Education. 4:80-93.