Producer Biotech Food Knowledge Differences: Findings from a Three-State Survey

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Over the years, public opinion in the United States on agricultural biotechnology has shifted from one of extreme consumer concern to one of indifference. This paper analyzes gender, ethnic, education, age, and household-income differences in producers' biotechnology knowledge. Mail questionnaires were used in collecting data. Responses to selected questions were analyzed using the Statistical Package for the Social Sciences. Chi-squares tests showed statistically significant differences in biotechnology knowledge among farmers who participated in the three-state survey.

Although most public-opinion studies have focused on consumer attitudes towards biotechnology (Schilling et al. 2003; Onyango et al. 2003; Alexander and Schleman 2003; Pew Initiatives on Food Biotechnology 2001, 2002a, 2002b, 2004; Medina et al. 2004), there have been rather limited studies on the attitudes of producers. The few producer studies available have focused on adoption issues (see, for example, Fernandez-Cornejo and McBride 2002). For years since their introduction into foods, the debate on genetically modified organisms continues to attract the attention of consumers, producers, and policymakers, with much of the debate centering around issues of safety, environment, labeling (information), politics, and the long-term nutritional impacts of genetically modified ingredients in the food system (Phillips 2002). In an effort to fill the existing gap in the literature, this paper provides information on producer biotechnology knowledge from a 2003 mail survey of randomly selected producers in Arkansas, North Carolina, and Tennessee.

Worldwide, the adoption of transgenic (genetically modified) crops continues in a steady upward path. According to the International Service for the Acquisition of Agri-Biotech Applications, the growth of transgenic crops increased 15% in 2003, compared to 12% in 2002. Between 1996 (when GM crops were first commercially introduced) and 2003, the global area planted in genetically modified crops expanded 40-fold, from 1.7 million hectares in 1996 to 67.7 million hectares in 2003 and to 81 million hectares in 2004 (James 2003, 2004). In total, 8.25 million farmers have benefited from biotech crops in 2004, an 18% increase from the 7 million farmers in 2003 (James 2004).

Data and Methodology

A questionnaire developed by researchers and extension professionals and administered by the National Agricultural Statistics Service (NASS), was used in collecting information from randomly selected farmers in Arkansas, North Carolina, and Tennessee. The mailed questionnaire was developed and pre-tested in 2003 in the three states following focus-group meetings used in sorting out issues that are important to producers for inclusion in the questionnaire. The sampling frame used in selecting farmers to survey was developed from existing NASS databases. Responses from 163 farmers were analyzed. Using the Statistical Package for the Social Sciences (2004), chi-square tests of independence were used in analyzing data collected.

Results

Of the 163 surveys obtained, responses from each of the participating states were as follows: Arkansas, 47 (28.8%); North Carolina, 52 (31.9%); and Tennessee, 64 (39.3%). Most (32.5%) participants were between 45 and 54 years of age. In terms of

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education, most of the participants in the survey had trade or vocational school backgrounds and some college without degrees. About 25.4% had associate or bachelor's degree. More than 35% had a combined family income between $50,000 and $99,999. While 90% of the farmers in the survey were male, only 8% were female (Table 1).

Biotechnology Knowledge

Six dimensions of knowledge were tested: knowledge of biotechnology in crop production, knowledge of biotechnology in food production, knowledge of biotechnology food benefits, knowledge of biotechnology food risks, knowledge of biotechnology regulation, and knowledge of the science of biotechnology. Respondents to the survey were asked to indicate how much they had heard or read about specific biotechnology issues identified in questionnaire. Results of the analyses indicate that most farmers in Arkansas, North Carolina, and Tennessee still had heard from "nothing" to "some" about important issues surrounding biotechnology. Very few participants (8.0%) heard "a lot" about the science of biotechnology, while 30.1% heard nothing. Crop production with biotechnology, on the other hand, had the smallest number of people who had heard nothing (17.8%), compared to 26.4% who had heard "a lot." These numbers indicate a weak level of knowledge about biotechnology (Table 2). Other studies have confirmed these findings for consumers.

Arkansas farmers seemed to have more knowledge of biotechnology in crop production than did Tennessee or North Carolina farmers. When asked how much they had heard or read about biotechnology in crop production, almost 32.6% of Arkansas farmers indicated that they heard a lot, compared to 30.8% of North Carolina farmers and 19.4% of Tennessee farmers (Table 3a). Similar knowledge levels were observed for the knowledge of biotechnology in food production (Table 3b). While 17.4%

Table 1. Descriptive Statistics for Selected Variables.

Characteristic	% Response*
GENDER	
Male	90.2
Female	8.0
AGE	
Less than 45	12.9
45–54	32.5
55–64	23.3
65+	29.4
EDUCATION	
Less than 12th grade, no diploma	9.2
High school graduate, including GED	21.5
Trade or vocational school, some college, no degree	27.0
Associate or bachelor's degree	24.5
Graduate or professional	16.6
HOUSEHOLD INCOME	
Less than $10,000	4.3
$10,000–$24,999	14.1
$25,000–$49,999	20.3
$50,000–$99,999	35.6
$100,000+	15.3

* Percentages may not add up to 100 due to rounding error or missing cases.

Table 2. Overall Level of Biotech Knowledge.

	Response category (%)			
	Nothing	A little	Some	A lot
Crop production	17.8	24.5	29.4	26.4
Food products	17.8	32.5	34.4	14.1
Benefits	22.1	22.7	35.6	18.4
Risks	27.0	30.1	23.9	16.0
Regulations	35.0	23.3	27.6	12.3
Science	30.1	28.8	30.7	8.0

Table 3a. Level of Biotechnology in Crop Production Knowledge by State.

How much have you heard or read about biotechnology in **Crop production?**	State			Total %
	Arkansas	North Carolina	Tennessee	
Nothing	17.4	15.4	21.0	18.1
A Little	23.9	21.2	29.0	25.0
Some	26.1	32.7	30.6	30.0
A Lot	32.6	30.8	19.4	26.9
N	46	52	62	160

Table 3b. Level of Biotechnology Knowledge in Food Production by State.

How much have you heard or read about biotechnology in **Food production?**	State			Total %
	Arkansas	North Carolina	Tennessee	
Nothing	15.2	21.2	17.5	18.0
A Little	37.0	25.0	36.5	32.9
Some	30.4	40.4	33.3	34.8
A Lot	17.4	13.5	12.7	14.3
N	46	52	62	160

of Arkansas farmers had heard a lot, 13.5% and 12.5% of North Carolina and Tennessee farmers, respectively, had (Table 3b).

There were interesting results concerning knowledge of the benefits and risks of food produced with biotechnology. More farmers in North Carolina (25.0%) had heard a lot about biotech food benefits than had farmers in either Arkansas (17.8%) or Tennessee (14.1%). A total of 22.2%, 21.2%, and 23.4% of the farmers in Arkansas, North Carolina, and Tennessee, respectively, had heard or read nothing about these benefits (Table 3c).

Three agencies are charged with regulating biotechnology in the United States: the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the United States Department of agriculture (USDA). The three agencies have specific roles in the regulatory process. Many farmers in the survey had heard or read very little about regulations concerning food produced with biotechnology. A total of 33.3% of the farmers in Arkansas, 34.6% in North Carolina, and 38.1% in Tennessee had heard or read nothing about regulation of foods produced with biotechnology (Table

3e). North Carolina farmers had heard or read the most (21.2%) about regulations of biotech-produced food, compared to Arkansas (13.3%) and Tennessee (4.8%) farmers. Farmers did not fare better when asked how much knowledge they had of the science of biotechnology (Table 3f).

Socio-Economic Variables and Farmers' Biotechnology Knowledge

In order to test for differences in the six knowledge dimensions by gender, ethnicity, age, level of education, and family income, the chi-square tests of significance were applied to data collected. The tests were accomplished by using 2 × 2 contingency tables on reclassified variables shown in Table 4. There were significant gender differences for all knowledge variables tested. Strong ethnic differences ($\chi^2 = 9.190$, $p \leq 0.005$) were observed in biotech crop-production knowledge and a weaker, though statistically significant, ethnic difference ($\chi^2 = 4.601$, $p \leq 0.05$), was observed for biotech food knowledge. There were significant age differences except for knowledge of biotech food regulation.

Table 3c. Level of Biotechnology Benefits Knowledge by State.

How much have you heard or read about **Benefits of food produced with biotechnology?**	State			Total %
	Arkansas	North Carolina	Tennessee	
Nothing	22.2	21.2	23.4	22.4
A Little	28.9	13.5	26.6	23.0
Some	31.1	40.4	35.9	36.0
A Lot	17.8	25.0	14.1	18.6
N	45	52	64	161

Table 3d. Level of Biotechnology Risk Knowledge by State.

How much have you heard or read about the **Risks of food produced with biotechnology**?	State			Total %
	Arkansas	North Carolina	Tennessee	
Nothing	28.9	29.4	25.8	27.8
A Little	35.6	29.4	29.0	31.0
Some	17.8	19.6	33.9	24.7
A Lot	17.8	21.6	11.3	16.5
N	45	51	62	158

Table 3e. Level of Biotechnology Regulation Knowledge by State.

How much have you heard or read about **regulation of foods produced with biotechnology?**	State			Total %
	Arkansas	North Carolina	Tennessee	
Nothing	33.3	34.6	38.1	35.6
A Little	22.2	25.0	23.8	23.8
Some	31.1	19.2	33.3	28.1
A Lot	13.3	21.2	4.8	12.5
N	45	52	63	160

Table 3f. Level of Biotechnology Science Knowledge by State.

How much have you heard or read about the **Science of biotechnology?**	State			Total %
	Arkansas	North Carolina	Tennessee	
Nothing	22.2	36.5	32.3	30.8
A Little	37.8	25.0	27.4	29.6
Some	31.1	26.9	35.5	31.4
A Lot	8.9	11.5	4.8	8.2
N	45	52	62	159

Table 4. Chi-square Values for Biotech Crop Production Knowledge by Selected Variables.

	Biotech crop production knowledge,	Biotech food knowledge	Knowledge of biotech food benefits	Knowledge of biotech food risks	Knowledge of biotech food regulations	Knowledge of biotech science
Gender	7.757***	4.179*	12.743***	12.752***	7.284**	3.790*
Ethnicity	9.190***	4.601*	3.479	2.660	1.830	2.291
Age	9.333***	9.405***	7.119**	5.451*	3.575	4.699*
Level of education	9.523***	9.638***	13.922***	5.884*	7.412**	7.147**
Farm income	6.381***	6.549**	9.169***	3.123	1.593	2.694

Gender: [0,1] where 0 = male; 1=female.
Ethnicity: [0,1] where 0 = African American; 1 = all other ethnic groups.
Age [0,1] where 0 = less than or equal to 25 years of age; 1 = older than 25 years.
Level of education [0,1] where 0 = High school or less than high school; 1 = Beyond high school.
Farm income [0,1], 0 = Income less than or equal to $49,999; 1=Income greater than $50,000.
* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.005$

All knowledge dimensions differed significantly for the education levels considered, and there were significant differences in knowledge of biotech crop production, biotech food knowledge, and benefits of biotech food given the family-income levels used in the study. Interestingly, there were only weak to moderately weak differences in knowledge of biotech science for gender, age, and level of education.

Conclusions and Implications for Food Distribution Research

While it is important to know how consumers perceive genetically modified products in the food system, it is equally important to seek information on issues that are of interest to producers. One important finding of this paper is that the level of producer biotechnology knowledge is still quite low. Producers' knowledge of biotechnology was related to the gender, ethnicity, age, and family income of the farmer. The findings from this study are highly relevant to food-distribution issues and should be of interest in policy discussions.

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