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### Abstract

The results of this study may encourage researchers, educators, and industry professionals to change behavior and to collaborate with journalists and the social institution of mass media to inform consumers about food biotechnology. Eighty-eight journalists for 65 of the nation's largest newspapers provided data for the study. Major findings were as follows: journalists' knowledge of food biotechnology was relatively low; most journalists considered genetic modification of plants as "acceptable," and journalists had greatest faith in "university scientists" as sources. Too, "Writers" rather than "Editors" had greater acceptance of genetically modified organisms, greater faith in sources, and less fear of using biotechnology to produce food.

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## Abstract

The results of this study may encourage researchers, educators, and industry professionals to change behavior and to collaborate with journalists and the social institution of mass media to inform consumers about food biotechnology. Eighty-eight journalists for 65 of the nation's largest newspapers provided data for the study. Major findings were as follows: journalists' knowledge of food biotechnology was relatively low; most journalists considered genetic modification of plants as "acceptable," and journalists had greatest faith in "university scientists" as sources. Too, "Writers" rather than "Editors" had greater acceptance of genetically modified organisms, greater faith in sources, and less fear of using biotechnology to produce food.

Most agricultural innovations are marketed to the users of the technology—farmers; thus, there is little effort to inform consumers. Food biotechnology, however, differs because consumers perceive it to affect the food they eat (Hoban, 1996). This direct effect launches food biotechnology into a public discourse, one that is often played out in the media (Peterson, 1996). Rogers (1983) found that mass media are the primary source that increase people's awareness about agriculture. Mass media have great influence on public

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perception, which Rogers calls the Hypodermic Needle Model. According to the model, media “direct immediate and powerful effects” (p. 272) by figuratively injecting information into society. Researchers in this study wanted to know journalists’ **knowledge, attitudes and perceptions** of food biotechnology.

## **Literature Base**

Agriculture is perceived by most consumers as slow-paced and sustaining. Consumers may not know the rapid rate of change that biotechnology has brought to agriculture. The United States (U.S.) Food and Drug Administration, Department of Agriculture, and Environmental Protection Agency approved the first genetically modified seed for commercial row crop production in 1996. Dispersed throughout approximately 400 million U.S. crop acres, genetically modified seed was planted by farmers on an estimated 5 million, 30 million and 60 million acres during 1996, 1997 and 1998 respectively (NABCI, 1998). A major concern (Naisbitt, 1990) is meaningful dialogue, in lay terms, with end-users (consumers) of the technology. Hallman (1995) measured consumer perceptions by asking consumers about the term “genetic engineering.” About 20% of consumers responded negatively: “frightened,” “escaping virus,” “Nazi/Hitler,” “mutants,” and “mad scientist.” Four percent mentioned “medical advances,” “better food,” or “progress”; and 25% of the consumers responded neutrally with answers such as: “DNA,” “plants,” or “people.”

To learn how journalists and scientists felt about one another, Chappell and Hart (1998) sampled 4,000 journalists and scientists. They found that neither group believed it was doing a good job of explaining science to the public. They concluded that those transferring scientific information to the public should engage in systematic, continuing education exposing them to scientists and research processes. According to the literature, it is important for biotechnology researchers, educators, and industry professionals to collaborate with journalists to enhance their collective efforts to inform the public about food biotechnology.

## **Research Objectives**

The research objectives were:

1. To investigate and determine the knowledge, attitudes, and perceptions held by metropolitan journalists regarding food biotechnology;

2. to investigate the relationship among knowledge, attitudes/ perceptions regarding food biotechnology, and selected personal and situational characteristics of journalists.

## Methods/Procedures

The target population was metropolitan journalists at 96 of the nation's largest newspapers according to daily circulation. They had a cumulative circulation of 30 million readers.

A census of 376 journalists with "beats" in business, environment, agribusiness, features, food, health/medical, and science/ technology were identified from *Editor and Publisher Yearbook*, (1997). These beats were used because benefits and risks associated with biotechnology cross a variety of disciplines; therefore, public discourse in the news

is framed in many contexts (Duhe', 1993; Peterson, 1996).

The researcher developed a 63-item instrument based on research by Duhe' (1993), Barton (1992), and the *North Carolina Nationwide Survey on Biotechnology* (as cited in Duhe', 1993). The instrument measured **knowledge, attitudes, and perceptions**. These three constructs were quantified in nine specific scales to determine:

1. Knowledge,
2. acceptance of genetically modified organisms,
3. acceptance of specific food biotechnology practices,
4. attitudes toward effects of biotechnology,
5. the level of importance placed on food biotechnology research,
6. faith in sources of food biotechnology information,
7. the level of importance placed on investigative reporting style when the subject is about food biotechnology,
8. attitudes toward potential obstacles to acceptance of food biotechnology, and
9. perceptions regarding rate of acceptance of food biotechnology as a farm practice.

Journalists' knowledge about food biotechnology was measured using multiple choice items. Attitudes and perceptions were measured from responses on Likert-type scales. Content validity of the

instrument was determined by twelve scientists from journalism, agricultural education, agronomy, entomology, and biochemistry at Texas A&M University and Texas Tech University. A pilot study of journalists with similar newspapers established face validity of the instrument.

Telephone calls to all 96 newspapers were initiated to update the list of journalists at each organization. Data collection involved seven contacts with journalists:

1. An introductory letter,
2. the original questionnaire and cover letter,
3. a postcard reminder following the questionnaire,
4. follow-up telephone calls made randomly to one-third of the nonrespondents (115 journalists),
5. a second questionnaire and cover letter,
6. a postcard reminder following the second questionnaire, and
7. telephone calls made randomly to 50% of the nonrespondents ( $n=169$ ).

Research instruments were returned by 65% ( $n=62$ ) of the newspaper organizations representing metropolitan journalists in 31 States. Eighty-eight usable questionnaires received during a 3-month data collection period ending April 30, 1998, served as the data source for this study. Because date of response was not correlated with the attitude/perception scales and because date of response and knowledge yielded a statistically significant but "low" (Davis, 1971) correlation ( $r=.21, p=.046$ ), the researchers, considering the exploratory nature of this study, made inferences to the target population. Data were analyzed with SPSS® (SPSS, Inc., 1998).

## **Results and Conclusions**

Complete and usable research instruments were returned by 88 (23%) of the journalists from 62 (65%) of the 96 news papers involved in the study. One-half of the journalists identified their primary responsibility as "Editor" and one-half considered their primary responsibility to be "Writer." Fifty-seven percent ( $n=50$ ) of the responses were from females; 43% ( $n=38$ ) were male. Ninety-five percent ( $n=83$ ) of them had earned Bachelor's degrees, 16% ( $n=14$ ) held Master's degrees, and 2 percent ( $n=2$ ) had doctorates. The median years of journalism experience was 19.7.

Twenty percent ( $n=18$ ) of respondents said their families owned agricultural property while 23% ( $n=20$ ) indicated they had lived on a farm/ranch. Eighty-three percent ( $n=72$ ) of the respondents indicated they had read or studied about biotechnology within the previous six weeks. Ninety-two percent ( $n=81$ ) of the journalists indicated they were “aware” or “somewhat aware” of how biotechnology affects their food, health, and environment. Thirty-nine percent ( $n=34$ ) of the journalists had contributed to articles on biotechnology. These journalists covered seven journalistic beats including Business (17%,  $n=15$ ), Environment (10%,  $n=9$ ), Agribusiness (9%,  $n=8$ ), Food (30%,  $n=26$ ), Features (12%,  $n=11$ ), Health/Medicine (14%,  $n=12$ ) and Science/Technology (8%,  $n=7$ ).

Nine items measured journalists’ knowledge about food biotechnology. Scores revealed a lack of knowledge about food biotechnology with a sample mean of 30% correct answers. One would expect an average of 25% on a multiple-choice test with four choices with no knowledge of the subject matter. Their low level of knowledge was similar to knowledge levels of consumers (Bruhn, 1997). Interestingly, almost 75 % of the respondents indicated that their level of scientific knowledge was “average,” “somewhat high,” or “high.” Thus, their perceived level of knowledge was higher (at least in a qualitative sense) than their assessed level of knowledge.

The instrument contained 40 items designed to assess journalists’ attitudes or perceptions regarding food biotechnology. The first scale assessed journalists’ acceptance of genetically modified organisms (GMOs). Journalists believed genetic modification of humans to be the least acceptable use of biotechnology (Table 1). Genetic modification of animals followed with nearly 41% selecting “highly unacceptable” or “somewhat unacceptable.” Journalists generally accepted genetic modification of forest/landscape plants, food crops, and microorganisms.

Another scale revealed that in general, journalists were ambivalent about the effects of food biotechnology on healthful foods, fish and wildlife, and family farms. However, they believed that there would be a positive effect of biotechnology on world hunger.

Journalists then were asked their opinions of the importance of biotechnology research leading to seven possible outcomes. Journalists considered food biotechnology research that benefits the environment and reduces the use of pesticides as most important.

<b>Table 1</b> <i>Descriptive Statistics Concerning Journalists' Acceptance of Genetically Modified Organisms</i>						
What is your current level of acceptance of genetic modifications of the following organisms?	<u>Scale name:</u> ...acceptance of genetically modified organisms.					
	Frequencies				<i>N</i>	Mean
	1	2	3	4		
a. Microorganisms	5	12	41	21	79	2.99
b. Forest/landscape plants	4	9	38	30	81	3.16
c. Food Crops	4	9	42	26	81	3.11
d. Animals	15	18	39	9	81	2.52
e. Humans	30	26	21	5	82	2.01
Scale Reliability = .87 (Cronbach's coefficient alpha)			Scale mean =2.77			
Legend: 1 = Highly unacceptable; 2 = Somewhat unacceptable; 3 = Somewhat acceptable; 4 = Highly acceptable.						

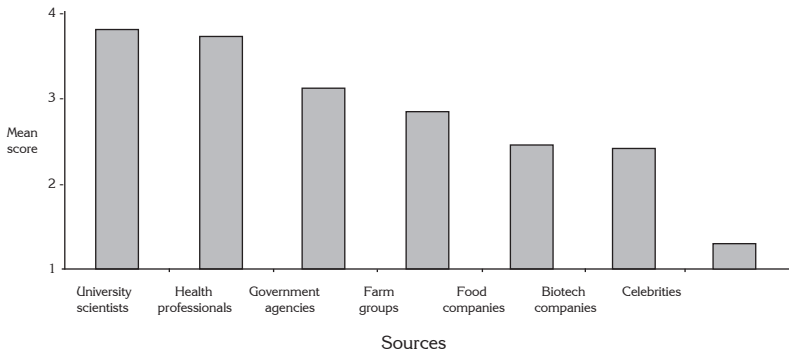
Hoban's (1996) earlier research found higher levels of consumer acceptance for agricultural biotechnology that offers relative advantage (e.g., human and environmental health, food quality).

Journalists' revealed most faith (Figure 1) in statements about food biotechnology from university scientists (mean=3.76 on a 5-point scale) and health professionals (mean=3.71). Journalists' faith in statements made by government agencies and by farm groups was moderate. They held less faith in statements made by biotechnology companies and food companies.

Journalists responded next to questions about specific journalistic styles. They considered investigation of claims and statements made by biotech companies, food companies, or activist groups as most important; and placed lesser importance on investigative reporting when the source is a university scientist. Journalists revealed that their preferred reporting style is investigative/interpretative.

Journalists were asked to express the degree to which they believe selected obstacles influence their acceptance of biotechnology in





**Figure 1. Journalists’ Faith in Sources in Declining Order.**

food production. Religious/ethical concerns about “tampering with nature” was rated low as an obstacle to acceptance (Table 2). Fears of genes moving unchecked to other life forms, fears of food safety consequences, and fears of environmental harm were moderately high. Journalists, in general, perceived that farmers will accept food biotechnology as a farm practice within 3.1 years while consumer acceptance will require 7.7 years. This finding supports earlier research in which about 50% of consumers thought that genetically engineered foods were benefiting them already; 75 % anticipated benefits from biotech foods within the next five years (IFIC, 1997). Still, one percent of the journalists perceived that farmers would never accept food biotechnology as a farm practice and three percent perceived that consumers would never accept food biotechnology as a farm practice.

Correlation ( $p < .05$ ) indicated that as journalists’ awareness of biotechnology’s effects on food, health, and the environment increased, assessed knowledge also increased. None of the personal characteristics of journalists were related to knowledge. Data supported the conclusion that editors were less accepting of genetically modified organisms (GMOs) than were writers. Journalists’ acceptance of GMOs was related to whether or not they had contributed to an article on biotechnology, to their perceived level of scientific knowledge, and to their perception of the rate of acceptance of food biotechnology as a farm practice.

There were two statistically significant relationships between journalists’ beliefs concerning the effects of biotechnology and other variables

<b>Table 2</b> <i>Descriptive Statistics Concerning Potential Obstacles to Journalists' Acceptance of Using Food Biotechnology.</i>							
To what degree do you consider each of the following to be obstacles to your acceptance for using biotechnology in food production?	<u>Scale name:</u> ...potential obstacles to acceptance of using food biotechnology.						
	Frequencies					<i>N</i>	Mean
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>		
a. Religious/ethical concerns*	25	18	24	12	6	85	2.48
b. Fear of genes moving to other plants, insects to other organisms.	5	9	16	36	19	85	3.65
c. Fear of food safety consequences.	7	9	21	31	17	85	3.49
d. Fear of environmental harm.	2	12	17	33	20	84	3.68
Scale Reliability = .86 (Cronbach's coefficient alpha)				Scale mean = 3.61			
*This item omitted from scale.							
Legend: 1 = Very low; 2 = Low; 3 = Neutral,; 4 = High; 5 = Very high							

1. Journalists whose families owned agricultural property tended to believe biotechnology would have more positive than negative effects on fish and wildlife, world hunger, family farms, and healthful foods ( $p < .05$ ).
2. Journalists' perceived level of scientific knowledge increased, they were more likely to consider biotechnology to have a positive effect ( $p < .01$ ).

There were two statistically significant ( $p < .05$ ) relationships between journalists' expressed faith in sources of food biotechnology information and background variables:

1. Their level of faith was related to their primary responsibility at the news organization, and to
2. whether or not they had lived on a farm or ranch.

Journalists' faith in sources was higher among writers than editors. This outcome agrees with Shudson (1995) who discovered that the social interaction between reporter (writer) and sources builds confidence in the exchange. Also, journalists' level of faith in sources was greater if they had lived on a farm or ranch. This finding is supported by marketing research of Schoell and Guiltinan (1995) who asserted that consumers' wants, motives, perceptions, attitudes, knowledge, personality, and lifestyle are influenced by family, friends, class, and the culture in which they live.

Finally, the degree to which journalists perceived various obstacles to acceptance of biotechnology was related to their level of awareness of biotechnology's effects and their primary responsibility in the news organization. The greater the journalists' awareness of food biotechnology's effect on food, health, and the environment, the lower the strength of specific obstacles to acceptance of food biotechnology. This conclusion supports Bruhn (1997) who contended that lack of awareness of agricultural practices and little knowledge about biotechnology drove people to oppose products of biotechnology.

## **Educational, Scientific, and Practical Importance of the Study**

Assessing the knowledge, attitudes, and perceptions of metropolitan journalists may enhance the technology transfer and consumer awareness efforts of agricultural communicators. In agriculture, the innovation diffusion equation must embrace consumer acceptance as well as producer adoption.

This census revealed that journalists in the target population had fears related to genes moving unchecked to other organisms, food safety consequences, and environmental harm as obstacles to their acceptance of using food biotechnology. There is skepticism because industry and government have endorsed technologies without open public dialogue (Lewis, 1990). If their knowledge of the technology is so low, then what are their perceptions based on? They are

clearly not based on a thorough knowledge of the technology; and thus may be based on other experiences with science and technology: Alar scare, BST in milk, the sheep clone "Dolly." May (1969) suggests that consumers base their perceptions on past experience and knowledge; therefore, if a person has limited knowledge and experience about a topic, then he or she cannot accurately perceive it. Sanbonmatsu and Fazio (1990) have shown that perceptions are often based on already-present global attitudes toward similar topics or technologies when knowledge about the topic or technology is low. They also showed that attitudes based on global judgements lead to more unexpected behavior than do attitudes based on personal experiences.

Real or not, the perceptions consumers hold about the safety of biotech foods are likely to sway regulatory decisions, affect research and development, and ultimately delay the diffusion of innovations (Armstrong, 1991). Journalists in this study confessed that they do not have or desire to have "walking around knowledge" about biotechnology. Thus, they request easy and rapid access to information. Journalists play a significant role in public education and influence state and national legislative policy. However, they do not have experiences by which to reference happenings in agriculture. Therefore, biotechnology education targeting journalists is important.

The attitudes of journalists in this study were more positive toward plant biotechnology than animal biotechnology; so, biotechnology applications should be identified as individual and different practices, rather than identified by generic nomenclature simply as "biotechnology." Because journalists perceive genes moving unchecked to other organisms, food safety consequences, and environmental harm as obstacles to acceptance of biotechnology innovations, agricultural communicators and researchers should address these fears. Because journalists have greatest faith in university scientists and health professionals and less faith in biotechnology companies, private biotechnology companies may seek new and stronger partnerships with universities and health organizations. On the other hand, public universities and health organizations, while they might collaborate with private biotechnology, must establish collaborative models to solidify their image as an unbiased institution serving the public.

Because biotechnology is complex and journalists' knowledge about the science is relatively low, most journalists will employ this

reporting style. Because “news” must be marketable and articles about biotechnology compete with other stories for “play” in the newspaper, editors may be predisposed to choose news with sensational content. Journalists attached a high level of importance to human health, food quality, and environmental enhancements brought by biotechnology. These elements should be the focus of research and of educational messages. The acceptance of food biotechnology was greater among writers than among editors. In addition, news editors control most news “play,” therefore an awareness campaign for editors is needed.

Universities should extend their academic and research mission to include a marketing, media relations, and educational component for diffusion of innovations in food biotechnology. It is recommended that universities and industry provide electronic access to food biotechnology information.

Universities should develop a systematic approach that allows journalists to have personal experiences and personal contact with people who operate agricultural and food biotechnology enterprises. Universities should feature educational materials that communicate messages about biotechnology innovations that address the social, economic, and cultural impacts of innovations. University scientists must examine relationships with biotechnology industry to maintain their credibility as objective and unbiased.

One to three percent of the journalists perceived that farmers and consumers would never accept food biotechnology as a farm practice. Too, the culture in the news environment contributes to negative and sensational news that often gets prominent “play.” These elements and the presence of small but vocal activist groups who have access to media equate to a need for universities to develop proactive (public education) and reactive (dispute resolution, response) approaches to controversy about food biotechnology.

The knowledge gap between food producers and food consumers may widen. This does not fulfill John Naisbitt’s (1990) challenge to stay in touch with the end-users of high technology. Consumer education “in the news” may be the most important element to diffusing biotechnology innovations and to gaining public acceptance.

Innovation diffusion research involving journalists is difficult—inference to the entire population is threatened because of low response rates from journalists. Many journalists: viewed

this research as not being specific to their “beat;” were pressed by organizational policies disallowing their participation in the study and questions on professional ethics; lacked time to complete the questionnaire; and lacked knowledge of the subject. Thus, generalization to the population of metropolitan journalists is suspect. This study might justifiably be viewed as exploratory in nature, documenting baseline information about journalists’ knowledge, attitudes, and perceptions regarding food biotechnology.

## Key Words

Food Biotechnology, Crop Biotechnology, Agricultural Communications, News, Journalism, and Journalists, Genetically Modified Organisms, Transgenic plants, Innovation Diffusion.

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