

# Biotechnology and the European public

**The latest European sample survey of public perceptions of biotechnology reveals widespread opposition to genetically modified (GM) food in much of Europe, but public attitudes to medical and environmental applications remain positive.**

George Gaskell, Nick Allum, Martin Bauer, John Durant, Agnes Allansdottir, Heinz Bonfadelli, Daniel Boy, Suzanne de Cheveigné, Björn Fjaestad, Jan M. Gutteling, Juergen Hampel, Erling Jelsø, Jorge Correia Jesuino, Matthias Kohring, Nicole Kronberger, Cees Midden, Torben Hviid Nielsen, Andrzej Przystalski, Timo Rusanen, George Sakellaris, Helge Torgersen, Tomasz Twardowski and Wolfgang Wagner

Data from the fourth Eurobarometer survey carried out in November 1999 suggest that Europeans have become increasingly opposed to genetically modified (GM) foods, but remain supportive of medical and environmental applications of biotechnology. In general, where the public perceives genuine moral difficulties and/or no real benefits, it is unwilling to accept the perceived risks of new biotechnologies. Greater support for the cloning of human cells and tissues than for the cloning of animals suggests that moral concerns attach specifically to particular applications and not necessarily to underlying molecular biological techniques. Furthermore, greater opposition to GM foods than to GM crops suggests that, for the public, food safety outweighs environmental concerns. Whereas both supporters and opponents feel insufficiently informed about the topic, supporters are more trusting of government and industry, but less trusting of environmental groups. With even supporters wor-



rying about the “unnaturalness” of biotechnology, a clear implication of this survey is that policymaking and regulation need to augment risk and safety considerations with additional assessment criteria that reflect the public’s concerns.

## Changing attitudes

With the integration of agrochemicals, GM foods, and pharmaceuticals, the life sciences conglomerate was one of the corporate visions for the 21st century. But confronted by a consumer revolt and supermarket boycotts of GM foods in Europe, threats of trade wars, and ultimately shareholder disaffection, the life science companies on both sides of the Atlantic have had to reassess their strategy. What went wrong and what are the lessons for the future?

In 1997, we reported that the European public was ambivalent on biotechnology<sup>1</sup>. In that third Eurobarometer survey on public perceptions of biotechnology in 1996, we found broad support for medical applica-

tions of gene technology, opposition to the use of transgenic animals in medical research, and signs of concern about agricultural and food biotechnologies<sup>2</sup>. This signal went unheeded by both industry and regulators until it was too late. Since then, agricultural and food biotechnologies have been beset by controversy.

The fourth Eurobarometer survey on biotechnology was conducted in each European Union (EU) country using a multi-stage random sampling procedure, which provided a statistically representative sample of national residents aged 15 and over. The total sample within the EU was 16,082 respondents (weighted to 1,000 per EU country, except Luxembourg, which was represented by 600 respondents). The survey questionnaire was designed as part of a larger study involving the comparative analysis of public perceptions, media coverage, and public policy in relation to biotechnology from 1973 to the present.

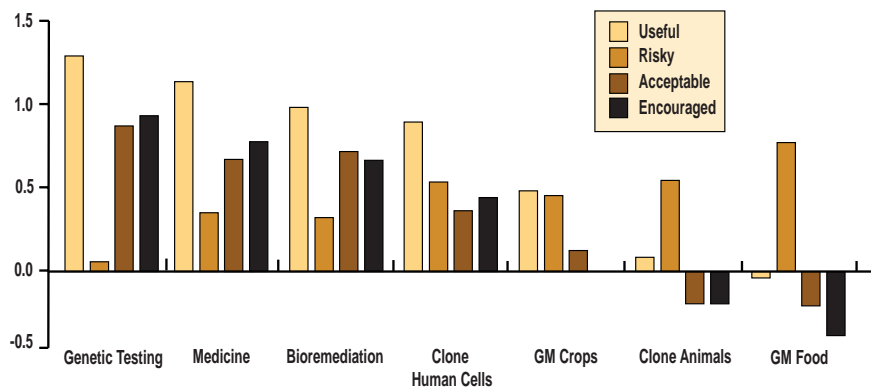
## Usefulness and moral acceptability

The latest survey’s results show that the secular trend of declining optimism about biotechnology has continued. When asked “will biotechnology improve our way of life in the next 20 years?” only 46% of respondents in 1999 were optimistic, compared with 50% in 1996 and 53% in 1993. In contrast, levels of optimism in five other technologies, for example solar energy and telecommunications, have remained high and stable over the same period.

How does this decline in optimism affect public perceptions of specific applications of biotechnology? Figure 1 shows that the public clearly distinguish between different applications of biotechnology. Europeans are neutral about agricultural biotechnology and opposed to both GM foods and the cloning of animals. In contrast, and despite the opposition to GM foods, perceptions of medical biotechnologies (genetic testing and the production of pharmaceuticals), and environmental biotechnologies (bioremediation) are very positive.

*The International Research Group on Biotechnology and the Public includes Wolfgang Wagner, professor, Johannes Kepler University, Linz, Austria, Helge Torgersen, senior researcher, Austrian Academy of Science, Vienna, Erling Jelsø, professor, Roskilde University, Roskilde, Denmark, Timo Rusanen, lecturer, University of Kuopio, Kuopio, Finland, Daniel Boy, director of research, National Foundation of Political Science, Paris, Suzanne de Cheveigné, senior researcher, CNRS-UPR 36, Paris, Juergen Hampel, senior researcher, Centre of Technology Assessment, Stuttgart, Germany, Matthias Kohring, scientific assistant, Friedrich Schiller University, Jena, Germany, George Sakellaris, senior researcher, National Hellenic Research Foundation, Greece, Agnes Allansdottir, lecturer, University of Siena, Siena, Italy, Cees Midden, professor, Eindhoven University of Technology, Eindhoven, The Netherlands, Jan M. Gutteling, lecturer, University of Twente, Enschede, The Netherlands, Torben Hviid Nielsen, professor, Centre of Technology and Culture University of Oslo, Oslo, Tomasz Twardowski, professor, Institute of Bioorganic Chemistry, Poznan, Poland, Jorge Correia Jesuino, professor, Graduate Institute of Employment and Business, Lisbon, Björn Fjaestad, professor, Mid Sweden University, Stockholm, Sweden, Heinz Bonfadelli, professor, University of Zurich, Zurich, Andrzej Przystalski, professor, Adam Mickiewicz University, Poznan. The Group is coordinated by George Gaskell, director, Methodology Institute, London School of Economics (G.Gaskell@lse.ac.uk), Martin Bauer, lecturer, London School of Economics, London, and John Durant, professor, National Museum of Science and Industry, London.*

## FEATURE



**Figure 1. European attitudes to seven applications of biotechnology. Perceived use, risk, and moral acceptability as determinants of public support. Respondents were asked whether they thought each of seven biotechnologies was useful (red), risky (green), or morally acceptable (yellow), and whether it should be encouraged (blue). Mean scores across Europe are given on a scale ranging from -2 to +2. Genetic testing was defined as the use of genetic tests to detect inheritable diseases such as cystic fibrosis. Medicines was defined as the introduction of human genes into bacteria to produce medicines or vaccines, for example, to produce insulin for diabetics. Bioremediation was defined as the use of genetically modified bacteria to clean up slicks of oil or dangerous chemicals. Clone human cells was defined as the use of cloned human cells or tissues to replace a patient's diseased cells that are not functioning properly. Crops was defined as the transfer of genes from incompatible plant species into crop plants to increase resistance to insect pests. Clone animals was defined as the use of cloned animals, such as sheep, to produce milk that can be used to make medicines and vaccines. Food was defined as the use of modern biotechnology in the production of foods, for example, to make them higher in protein, keep longer, or change the taste.**

There are two further striking findings. The first is that whereas the cloning of animals for medical purposes is widely rejected, the cloning of human cells and tissues for similar purposes receives moderate support. This suggests that the public is making judgments beyond specific techniques, such as cloning, to take into consideration the scope of intervention, whole versus part cloning, and its intended uses. Second, the greater opposition to GM foods over GM crops suggests that consumer traits are more worrying than agronomic traits. In other words, Europeans are more concerned about food safety than environmental impacts.

Figure 1 shows a consistent pattern in the structure of public perceptions across the seven applications of biotechnology. As the perceived usefulness of applications declines, perceived risk increases and moral acceptability/support declines. Usefulness, the "Achilles heel" of the first generation of GM food products, is a precondition for support. Indeed, the absence of consumer benefits from GM foods may accentuate perceived risks and moral concerns. Thus, biotechnologies perceived to have substantial benefits, for example, in health care, are supported despite a level of risk (e.g., GM medicines and cloning human cells), but biotechnologies perceived to have only modest benefits, have no support, even though the risks may be modest (e.g., GM crops).

In 1999, as in 1996, perceptions of moral acceptability appear to act as a "veto." Thus, cloning of human cells is generally regarded as useful, risky,

and morally acceptable; and the overall response of Europeans is that this technology should be encouraged. In contrast, whereas the cloning of animals is also regarded as useful and risky, crucially it is seen as morally unacceptable; and the overall response of most Europeans is that this technology should not be encouraged. Perhaps for the public, as was demonstrated in much of the media coverage, the cloning of Dolly the sheep opened Pandora's Box: a presage of human cloning and eugenics.

### Analyzing perceptions

In the 1996 survey, a large percentage of people gave "Don't Know" responses to the questions about the applications and some 51% of Europeans said that they "had never talked to anyone about biotechnology before." To eliminate what are called "nonattitudes"<sup>3</sup>, 1999 respondents were additionally asked whether or not they had heard about each application before giving judgments of usefulness, risk, moral acceptability, and encouragement. This question increased the percentage of "Don't Know" responses in 1999, complicating time series comparisons of attitudes based on the

entire sample. As a result, the following analysis uses only those respondents who gave a full set of responses to the key attitude questions (i.e., no "Don't Know" responses). These people may be assumed to have better formed opinions and to constitute comparable subsamples for 1996 and 1999.

We collapsed judgments of use, risk, moral acceptability, and encouragement into a dichotomy (useful/not useful, risky/not risky, etc.) to model patterns of response (logics) over the four dimensions of attitude. This produces 16 possible combinatorial "logics," of which in practice only three were widely used at an average of more than 10% across the seven applications (see Table 1). These three logics were the following: supporters (for whom risk is not an issue), risk-tolerant supporters (who perceive risk, but then discount it), and opponents (who take a contrary position to that of supporters).

Table 2 shows the logics of support for each of the seven applications in 1999, and time series comparisons with the 1996 Eurobarometer in the four applications selected for time series comparison. Over the past three years, support and risk-tolerant support for the health care-related biotechnologies of genetic testing and medicines has held roughly constant. Among Europeans with well-formed attitudes genetic testing remains at over 90% support in 1999, with GM medicines falling marginally from 91% in 1996 to 87% in 1999. In contrast, a moderate decline in support for the production of GM crops and a sharp decline in support for GM foods have taken place. In 1996, for example, 61% of Europeans opting for one of the three common logics were either supporters or risk-tolerant supporters of GM foods, and 39% were opponents; but three years later, 47% were supporters or risk-tolerant supporters, and an overall majority of 53% were opponents of this technology. Overall, it appears that the secular trend in declining optimism about biotechnology reflects growing opposition to specific applications and not to wholesale rejection of modern biotechnology.

### Contentious biotechnologies

GM foods and animal cloning have been the most widely debated biotechnologies of recent years, and some questions about these two more familiar applications throw light

**Table 1. Three most common logics adopted by respondents in Eurobarometer survey<sup>a</sup>**

Logic	Classification	Useful	Risky	Morally acceptable	Encouraged
1	Supporters	Yes	No	Yes	Yes
2	Risk-tolerant supporters	Yes	Yes	Yes	Yes
3	Opponents	No	Yes	No	No

<sup>a</sup>These can be classified as supporters (for whom risk is not an issue), risk-tolerant supporters (who perceive risk, but then discount it), and opponents (who take a contrary position to that of supporters).

**Table 2. The logic behind respondents' judgments on seven applications of biotechnology<sup>a</sup>**

Application	Classification	1999	1996
Genetic testing	Supporters	51%	56%
	Risk-tolerant supporters	41%	38%
	Opponents	8%	7%
Medicines	Supporters	40%	48%
	Risk-tolerant supporters	47%	43%
	Opponents	13%	9%
GM crops	Supporters	34%	45%
	Risk-tolerant supporters	33%	34%
	Opponents	34%	21%
GM food	Supporters	22%	31%
	Risk-tolerant supporters	25%	30%
	Opponents	53%	39%
Bioremediation	Supporters	41%	—
	Risk-tolerant supporters	45%	—
	Opponents	15%	—
Clone human cells	Supporters	31%	—
	Risk-tolerant supporters	49%	—
	Opponents	15%	—
Clone animals	Supporters	24%	—
	Risk-tolerant supporters	33%	—
	Opponents	37%	—

<sup>a</sup>As a result of rounding, some groups do not add up to 100%.

on what may underlie support and opposition. A split-ballot procedure was used in the survey, in which each respondent answered the questions in the context of either GM foods or animal cloning (see Table 3).

Perhaps not surprisingly, the table shows that a substantial majority of those with the logic of opposition believe that GM foods and cloning animals “threaten the natural order,” are “fundamentally unnatural,” have “risks that are not acceptable,” and “pose dangers for future generations.”

Even more notable and surprising are the views of the supporters. Here an outright majority believes that the two applications “threaten the natural order” and are “fundamentally unnatural,” and between one third and one half are concerned about the acceptability of the risks and the dangers for future generations. That the two most prominent applications of biotechnology are troubling, even to those who have expressed overall support, can hardly be ignored.

### Societal influences

Other questions were asked to provide insights into the societal influences on the opinions of supporters and opponents. For example, around 80% of both groups say that they are “insufficiently informed about biotechnology,” and similar percentages say that they would “take the time to read or watch something about biotechnology in the media.” The fact that supporters and opponents alike feel poor-

ly informed points to the need for information campaigns, but equally that the effects of such information may be unpredictable.

Supporters and opponents generally agree that newspapers, ethics committees, doctors, and consumer organizations are “doing a good job for society” (a proxy for trust) in respect of biotechnology. There are also striking differences: more opponents (75%) than supporters (49%) think environmental organizations are “doing a good job for society on biotechnology,” whereas supporters are more likely than opponents to think this of government (69% versus 51%) or industry (61% versus 17%). These results suggest that the public sees governments as aligned with industry in the promotion of biotechnology, whereas environmental groups tend to appeal to the opponents among the public. In contrast, newspapers, doctors, and consumer

organizations are seen as more impartial.

The supporters are more likely to be younger, male, and better educated. Opponents are more likely to agree with statements such as “ordinary tomatoes do not contain genes, whereas genetically modified ones do” and “by eating a genetically modified fruit a person’s genes could be infected.” Agreeing to items of this kind reflects not only a lack of scientific knowledge, but also an inclination to believe in statements conjuring up menacing images of biotechnology, such as the likelihood of adulteration and infection. A logistic regression using the above measures of trust, age, gender, education, and knowledge shows that each independently and significantly predicts the probability of opposition. In other words, holding all the others constant, a change in any one of these independent variables is associated with a change in the probability of a respondent being an opponent (all regression coefficients are statistically significant at  $p < .05$ , Nagelkerke’s  $R^2$  (explained variance) = .30).

Not surprisingly, only a small number of opponents say they would buy GM foods such as cooking oil (9%), or eat eggs from chickens fed on GM corn (7%). But, again, what is surprising is that only around 50% of supporters of GM foods say that they would be prepared to buy them, suggesting that even this group would endorse the demand for the labeling of GM foods. The clear implication for European governments is that any move to introduce GM foods without labelling would be deeply unpopular across all sections of the public.

### National attitudes

We now turn from Europe as a whole to the results for the EU member states, plus Norway. In all countries, public attitudes toward genetic testing, medicines, bioremediation, and (with the exception of Greece) cloning human cells/tissues are positive. Public attitudes toward GM foods and animal cloning are negative in all but Finland and Spain. Portugal has a positive attitude toward animal cloning, but a negative attitude toward GM foods (see Table 4). On GM crops, there is a wider spread of opinion

**Table 3. Response of both supporters and opponents of GM foods and animal cloning to four concerns**

Concerns	Percentage who agree with concern			
	Supporters		Opponents	
	GM foods	Clone animals	GM foods	Clone animals
Threatens the natural order	54%	64%	89%	93%
Even though there are benefits, it is fundamentally unnatural	57%	72%	92%	94%
The risks are not acceptable	34%	41%	80%	83%
Poses danger for future generations	40%	48%	85%	84%

## FEATURE

Table 4. Level of support and opposition for seven applications of biotechnology

Country <sup>a</sup>	Application <sup>b</sup>						
	Genetic testing	Medicine	Biore-mediation	Clone human cells	GM crops	GM food	Clone animals
Greece	++	+	++	-	-	--	--
Norway	+	+	+	+	--	--	--
Austria	+	+	+	+	--	--	-
Luxembourg	++	++	+	+	--	--	-
Sweden	++	++	+	+	-	--	-
Denmark	++	++	++	++	-	--	-
France	++	++	++	++	-	-	-
Ireland	++	++	++	+	-	-	-
UK	++	++	++	+	-	-	-
Belgium	++	++	+	++	+	-	-
Germany	++	++	++	+	+	-	-
Italy	++	++	++	++	+	-	-
Netherlands	++	++	++	++	+	-	-
Finland	++	++	++	+	+	+	-
Portugal	++	++	++	++	++	-	+
Spain	++	++	++	++	++	+	+

<sup>a</sup>Countries arranged in order from most negative to most positive attitude to biotechnology.

<sup>b</sup>In the table, ++ indicates strong support, + indicates weak support, - indicates weak opposition, and -- indicates strong opposition

between countries, but only a few take a strongly positive (Portugal and Spain) or negative (Austria, Luxembourg, and Norway) position.

In general, the European countries that were relatively more negative in 1996 (e.g., Austria, Sweden, and Denmark) have remained negative in 1999. However, Greece has become one of the more critical member states, whereas Germany, Italy, and the Netherlands have all become relatively more positive. In 1999, as in 1996, Finland, Portugal, and Spain remain the most supportive of biotechnology.

Further insights into changes in public perceptions over the past three years can be seen by comparing shifts in attitudes of respondents who fall into the category of "opponents" when queried about genetic testing (a positively perceived application)

and GM food (a negatively perceived application) across the 15 member states. Table 5 shows the percentages of respondents in each member state who opted for the logic of opposition to GM foods and genetic testing. Note that this analysis excludes "Don't Know" responses and is based on 100% being the sum of supporters, risk-tolerant supporters, and opponents.

In the case of GM foods, we find a general increase in levels of opposition. In five member states—Austria, Denmark, Germany, the Netherlands, and Sweden—this increase is small. In four of these five member states, this pattern of relative stability reflects unchanging opposition, whereas in just one (the Netherlands) it reflects unchanging support. In an additional six member states—Belgium, Greece, Italy, France, Luxembourg, and the UK—we find a substantial increase

in levels of opposition to GM foods over the past three years. Here, patterns of widespread public ambivalence about GM foods in 1996 appear to have given way to widespread public hostility in 1999.

The results on genetic testing in Table 5 show that, despite the sharp increase in opposition to GM foods, there is strong public support across virtually the whole of Europe for genetic testing (a finding that also holds for GM pharmaceuticals). This result suggests that discrimination between different applications has increased over recent years, and that by the same token the high-profile public debate about agricultural and food biotechnology has had little impact on European attitudes toward medical biotechnologies.

## Conclusions

To explain more fully why attitudes toward specific biotechnologies have changed in different European countries, we need to go beyond survey research to understand the wider economic, social, and political contexts in which biotechnology is developing. Our ongoing research will integrate further analysis of these survey data with parallel studies of media coverage and policy developments in the European member states. In the meantime, however, three things are apparent. First, if an application of this technology has no clear benefits, it is unlikely to receive public support: why "meddle with nature" without a good reason? Second, although public concerns about particular biotechnologies have increased in recent years, there has been no erosion in the overwhelming support for medical applications. Third, that so many, even among the supporters of biotechnology, should be troubled about its implications for the "natural order" suggests that the next stages in international debate and decisionmaking must go beyond evidence based on solely scientific risks. The moral and ethical dimensions of biotechnology that underlie public concerns need to be understood and taken into account. Today, more than ever before, the "second hurdle" of public opinion (after the first regulatory hurdle) constitutes a crucial challenge for the scientific, industrial, and political supporters of biotechnology.

## Acknowledgments

This article was written with support of the European Commission, Research Directorate-General (QLRT-1999-00286).

Table 5. Levels of opposition to GM food and genetic testing in European states in 1996 and 1999

	Opponents to genetic testing			Opponents to GM food		
	1996	1999	Change	1996	1999	Change
Greece	3%	9%	6%	51%	81%	30%
Norway	22%	22%	0%	56%	65%	9%
Austria	26%	22%	-4%	69%	70%	1%
Luxembourg	9%	16%	7%	44%	70%	26%
Sweden	8%	9%	1%	58%	59%	1%
Denmark	9%	9%	0%	57%	65%	8%
France	4%	6%	2%	46%	65%	19%
Ireland	4%	6%	2%	27%	44%	17%
UK	3%	4%	1%	33%	53%	20%
Belgium	5%	10%	5%	28%	53%	25%
Germany	13%	10%	-3%	44%	51%	7%
Italy	3%	5%	2%	39%	51%	12%
Netherlands	7%	4%	-3%	22%	25%	3%
Finland	5%	9%	4%	23%	31%	8%
Portugal	3%	4%	1%	28%	45%	17%
Spain	4%	6%	2%	20%	30%	10%

- Gaskell, G et al. Europe ambivalent on biotechnology. *Nature* **387**, 845-847. (1997).
- Durant, J., Bauer, M.W. & Gaskell, G. *Biotechnology in the public sphere: a European source book* (Science Museum Press, London; 1998).
- Schuman, H. & Presser, S. Public opinion and public ignorance: the fine line between attitudes and non-attitudes. *Am. J. Sociol.* **85**, 1214-1225 (1980).