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A ROLLERCOASTER RIDE

Do genetically modified crops have a future in Europe?

KEY THEMES

- First- versus second-generation genetically modified crops.
- Three fundamental concerns.
- Segmenting the attitudes of consumers.

What worries Europeans?

When, in 2010, the European Food Safety Authority commissioned a Eurobarometer survey throughout the European Union (EU) on food-related risks, it emerged that Europeans were most worried about pesticides in their fruit and vegetables, and that their concerns were increasing. They also said that genetically modified organisms (GMOs) were a source of concern, though less so than pesticides.

The impact of ecofriendly varieties

The findings about opinions on pesticide use are thought-provoking in the light of two recent, significant developments in biotechnology.

One is a field trial of new GM wheat that began in the UK in 2013 at the Rothamsted Institute in Hertfordshire. A synthetic gene has been added to this wheat, causing it to give off an insect signalling chemical – a pheromone called farnesene – that deters cereal aphid pests. If the trial is a successful proof-of-concept, then the ensuing GM wheat will need less chemical insecticide spraying, will leave fewer chemical residues and will better support biodiversity.

The second development is a field trial of the Fortuna potato initiated by BASF, one of the world's leading chemical companies. Current potato production in Europe can involve a lot of chemical spraying against the fungus that causes potato blight – as many as 12–15 applications per crop. The Fortuna variety, however, contains two extra genes taken from a wild potato from the mountains of Mexico that is blight-resistant. Again, here is a potential crop with consumer and environmental benefits.

Potato blight was held largely responsible for the Irish famine of the mid-19th century, when a million people died and the population fell by around 25 per cent.

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However, a cloud hangs over the future of this GM potato: public resistance has led BASF to end its biotech research in Europe. It makes no business sense for the company to continue developing the potato in the EU, and the research has been relocated to the USA.

Here then is the issue. These ecologically friendly crops that reduce the use of chemical pesticides would seem to herald the long-awaited second-generation GM crops, conferring obvious consumer and sustainability benefits rather than

BOX 19.1 The Eurobarometer

The European Commission has been monitoring the evolution of public opinion in its Member States since 1973 by means of Eurobarometer surveys. These are designed both to offer a snapshot of how Europeans are thinking and feeling about the major issues of the day, and to inform decision making and the spread of information. The technique involves face-to-face interviews with a statistically representative sample of approximately 1,000 adults in each Member State.

The attitudes to genetic modification reported in this chapter come from Eurobarometer surveys on biotechnology and life sciences for the European Commission's Directorate-General for Research and Innovation.

mainly rewarding biotech companies and farmers, as has been the case with first-generation GM crops. But how will such crops be viewed by the European public, with its anxieties over chemicals in food?

Towards the second generation

The Eurobarometer on biotechnology and the life sciences explored attitudes to a second-generation GM apple. Growers typically need to spray their crops frequently with pesticides and fungicides to combat diseases such as canker, scab and mildew. However, the virtually inedible crab apple, which can cross-breed naturally with commercial varieties, contains genes that provide resistance to such pests.

The quickest method of introducing these genes into edible crop varieties is genetic engineering using the process of cisgenics, when genes are introduced from the same or a conventionally crossable species.

The Eurobarometer team wanted to find out whether these cisgenic crops would be more or less acceptable to the public than transgenic varieties, where the genes are introduced from what is frequently a totally different plant species or a bacterium. Respondents were asked whether modifications within a species were more acceptable than those that cross the species barrier. And they were also asked what they thought of GM food in general.

In principle, there should be no difference between attitudes to cisgenics, transgenics and GM in general, as the basic molecular process is similar. In practice, however, as

Responses to questions that used the umbrella term "GM food" got quite different results from questions about cisgenic and transgenic apples, even though respondents had been told that the process for producing cisgenic and transgenic apples and GM food is effectively the same.

Table 19.1 Public perception: safety, environmental impacts and the naturalness of genetically modified foods, 2010

EU 27, excluding "don't know"

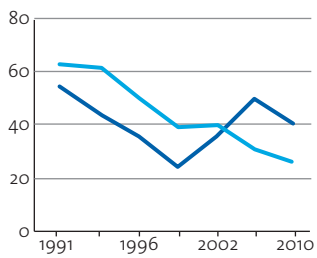
Responses (%)	GM food	Transgenic apples	Cisgenic apples
Safe/not risky	27	37	53
Not harmful to the environment	30	55	63
Unnatural	76	78	57
Support	27	33	55

Source: European Commission, 2010

Table 19.1 shows, there were contrasting perceptions of the safety, environmental impacts and naturalness of GM food as a whole, and between cisgenic apples and transgenic apples.

While both GM food and transgenic apples were seen to be "unnatural" by three out of four respondents, transgenic apples were perceived as safer and less likely to harm the environment than GM food in general. This may be because respondents were told beforehand that transgenics have the benefit of limiting pesticide use. Even so, only one in three Europeans was found to support transgenic apples, remaining concerned perhaps about the unnaturalness of between-species manipulation. They do not like the idea of foreign genes.

Figure 19.1 Public views on biotechnology and genetically modified foods, 1991–2010



Optimism about biotechnology (zero represents equal proportions of optimists and pessimists)

Support for GM foods (percentage of respondents holding positive views)

Source: European Commission, 2010

More than one in two Europeans, however, supported the cisgenic crop, regarding it as safer, environmentally less harmful and not so unnatural. They compared the process to conventional hybridisation, with no worries about crossing a life-form barrier. In other words, there is cause for optimism over second-generation crops engineered using cisgenics. On the whole, however, the picture has been less rosy.

Public opinion, then and now

Figure 19.1 plots responses to Eurobarometer surveys from 1991 to 2010. Respondents were asked how optimistic they were about the potential for biotechnology and genetic engineering to improve people's lives, and whether developments in GM food should be encouraged and supported.

Their answers show a rollercoaster pattern. When biotechnology was at the laboratory stage in the early 1990s, a good proportion of Europeans were enthusiastic about its exuberant claims for feeding the world's hungry. But as the number of

applications for the novel technology began to grow, some, such as genetic testing for inherited diseases and disabilities and GM-based medicines gained support, while others – GM crops and food, and animal cloning – did not.

Optimism picked up again with sequencing and analysis of the human genome published in 2001, along with developments in gene therapy, pharmacogenetics, embryonic stem cells and some industrial biotechnologies. Then, between 2005 and 2010, there was another decline.

Support for GM food followed the same trend as optimism about biotechnology until 1999, with both showing a decline. But thereafter, GM lost more ground, driven by several events. Dolly, the sheep, raised fears about where science was going next. The 1996 "mad cow" crisis – bovine spongiform encephalopathy (BSE) – though it

BOX 19.2 Genetic modification – a bad start

Fear and distrust have hung over the whole biotechnology enterprise in Europe for a long time. In the late 1980s, even when the technology was still confined to the laboratory, close observers saw public perception becoming negative. According to Mark Cantley, then working in the European Commission: "Public and political opinion was learning to see gene technology, genetic engineering, biotechnology and so on as a single, vague and disquieting phenomenon."

Clearly, education and information were needed to overcome public fears and build trust through scientific, financial, political and environmental accountability. But the warnings went unheeded.

Most scientists, industry and politicians kept their heads in the sand, enthusing over what they perceived as the undoubted health, agricultural and environmental benefits of the new technology. Initially, as the first consumer products came on the market, their confidence was justified.

First to arrive (1987) was vegetarian cheese that had a biotech enzyme in place of traditional animal rennet. Next came the genetically modified tomato, Calgene's Flavr Savr in the USA (1994), subsequently marketed in the UK (1996) through Zeneca's genetically modified tomato purée, which offered 20 per cent more weight than a can of ordinary purée of the same price.

At first, the new products fared well in the marketplace and there was little public debate or consumer resistance, leading industry, shops and government to assume that genetically modified foods had met with consumer acceptance. But this relative optimism over biotechnology and support for genetically engineered food was to erode a great deal over the coming decades.

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The importation of GM soybeans into Europe in 1996 gave rise to media headlines predicting "Frankenfoods".

had nothing to do with genetic modification, pointed up the limitations of scientific expertise. And the importation of GM soya into Europe in 1996 started up a bitter debate: hostility from consumer, environmental and non-governmental organisations, media headlines predicting "Frankenfoods", supermarket boycotts and, eventually, a Europe-wide moratorium on the planting of GM crops.

What really concerns the public?

There is not – and probably never can be – one single cause of Europe's declining support for GM food and crops. The continent has a diversity of social concerns and political opinions, with a wide range of groupings and movements getting involved in the debates, from anti-globalisation lobbies and supporters of natural foods to environmentalists and consumer rights activists.

At the same time, there have been some fairly consistent national attitudes in Europe. From 1996 to 2010, the UK remained the most supportive of GM food while Denmark, Norway, Sweden and Austria consistently showed relatively low levels of support. At the same time, support almost halved in most countries, and in some, such as France, fell even more.

While national events may play a role in these results, the basic causes appear to be common across Europe, namely:

- public perceptions of GM;
- obvious benefits to the biotechnology companies and farmers but an apparent absence of benefits to the consumer;
- food and culture.

Public perceptions of genetic modification

When people read or think about biotechnological innovations their hopes, fears and expectations come into play: their imagination is stirred. They move beyond the reality of any given new technology or product to look at it in the context of past experience or to judge its potential for positive or negative impacts.

Focus group discussions in 11 European countries have tried to capture some of this complexity. From their findings, the public does not seem to be anti-science, but it does have considerable ambivalence about biotechnology, enthusiastically supporting applications designed to cure disease (so called red biotechnology), but worried about GM foods (green biotechnology). They voice this with expressions such as tampering, meddling and interfering with nature. "Nature" here carries two

Table 19.2 Public perception: dystopian imaginings

Statement	% of people who realised these statements were false			
	1996	1999	2002	2005
Ordinary tomatoes don't have genes but genetically modified ones do	35	35	36	41
By eating a genetically modified fruit, a person's genes could also become modified	48	42	49	54
Genetically modified animals are always bigger than ordinary ones	36	34	38	45

Source: European Commission, 2006

connotations: a complex biological system that we might disrupt, and a spiritual force. It is this spiritual image that carries the most weight in shaping moral objections, such as those expressed by the UK's Prince Charles.

Eurobarometer surveys spanning a decade of shifting awareness, as shown in Table 19.2, reveal that while the proportion of people rejecting misperceptions about food biotechnologies rose over the period, striking dystopian notions continued to persist among many.

Dystopia, a term coined by John Stuart Mill, the Scottish philosopher and political economist, is an imaginary place in which the condition of life is extremely bad. These misconceptions and concerns run deep. Survey respondents may not have been aware of holding these views before they were posed as questions, but, when asked, they tried to make sense of them and came up with answers shaped by a general unease about the technology, anxieties over food and a kind of magical thinking about adulteration, infection and monstrous outcomes – all of which combined to make them believe the worst.

The human imagination has always populated uncharted territory with monsters of one kind or another – a kind of default response to the unknown. True dragons have yet to come to light.

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Who benefits from genetically modified food?

The focus groups also revealed concerns about the absence of perceived benefits from biotechnology, including GM foods. And they raised the possibility of non-GM alternatives to achieve similar ends: why the need to modify food when there is plenty of good, wholesome food in the shops already? Why take risks when tried and tested alternatives already exist for achieving the same claimed benefits? The 2002 Eurobarometer looked at this in more detail. Figure 19.2 shows the results.

Four groups of people emerged. Those who thought GM was beneficial and without risk were labelled "relaxed"; beneficial and risky, "trade-off"; not beneficial and risky,

Figure 19.2 Public perception: risks and benefits of GM food, 2002

Statement		"GM food poses risks for future generations"	
		Agree	**Disagree**
"GM food will bring benefits to many people"	**Agree**	**Trade-off: useful and risky** 18% of total sample, of whom 52% encourage GM	**Relaxed: useful and not risky** 14% of total sample, of whom 81% encourage GM
	Disagree	**Sceptical: not useful and risky** 62% of total sample, of whom 17% encourage GM	**Uninterested: not useful and not risky** 6% of total sample, of whom 27% encourage GM

Source: Bennett and Jennings, 2013

"sceptical"; and not beneficial and not risky, "uninterested". A sizeable majority – 62 per cent – fell into the sceptical category, with few of them (17 per cent) thinking that GM should be encouraged. By contrast, 81 per cent of the relaxed group supported GM, but they represent a mere 14 per cent of the European population.

Agreed EU-wide controls on food labelling were first introduced in 1979. Further controls and a plethora of amendments have since been added, resulting in a complex array of labelling requirements – including ingredients, nutrition, allergens, shelf life, provenance...

Food, genetic modification and culture

Genetically modified foods date back only a few decades; producing, preparing and consuming food are as old as human society itself.

Over millennia, food has evolved beyond being simply a biological necessity to become a central feature of our culture. With food we not only take in calories, we also absorb beliefs and collective representations of ourselves – we are what we eat.

In the last 50 years, the Western world has moved from food shortages to surpluses, and with this have come anxieties. We are now torn between the appeal of cheap, convenient and palatable – often processed – food and the threats posed by factory farming, pesticides, pollutants and additives that replace natural ingredients. That may be why natural and organic produce has become so popular: it cuts down the perceived distance from farm to fork created by modern processed foods. Naturalness has become a common theme in food advertising – although in fact the amount of organic food sold in the UK and Europe is at most 3 per cent of all food sales and, with the exception of 2013, appears to be in decline.

With modern food production methods, the notion that we are what we eat has been replaced by "we don't know exactly what we eat so we don't know what or who we are". This has led people to try to re-identify with today's food through such strategies as demanding better food labelling, legal protection against chemicals and biotechnology, the adoption of alternative diets – vegetarian, organic, low calorie, low carbohydrate and so on. We look for food that we can trust.

Food biotechnologies appear to clash with these cultural norms and preferences. An extreme example is the cloning of animals for food products. Even though beef and milk from cloned cattle are routinely consumed in the USA, only 18 per cent of Europeans have been found to be willing to support the idea of animal cloning. The bringing together of food – an aspect of culture – with sensitivities about animals and genetic modification, has made the whole idea of cloning unpalatable.

The three explanations discussed above for Europe's resistance to GM food are probably not exhaustive. And their relative importance may differ from country to country.

Segmenting consumer attitudes

A survey of attitudes towards naturalness and the benefits of transgenic and cisgenic apples reveals five different classes of consumer, as shown in Figure 19.3, along with the proportion of Europeans that fall into each category.

Those in category one – giving strong support to both cisgenic and transgenic apples in terms of safety, naturalness and environmental impact – represent just 14 per cent of Europeans, less than those who strongly oppose both techniques (20 per cent). Virtually half of all Europeans are either moderately in favour (26 per cent) or moderately opposed (23 per cent). Most intriguing is the fourth category – strongly negative towards transgenic apples and very enthusiastic about cisgenic varieties. This echoes other survey findings showing support for cisgenic technologies while rejecting genetic transfer between organisms that would not naturally cross breed.

Taking a broader view, the percentage of people attracted by cisgenics is around 30 per cent in 20 of 32 European countries examined, including Denmark, Finland, Germany, Greece, Hungary, Ireland, Sweden and the UK. The question is: will this support increase as people become more familiar with the novel technology?

The introduction of disease resistance genes from crab apples into table varieties takes some 50 years through conventional breeding techniques. Cisgenesis speeds up the process.

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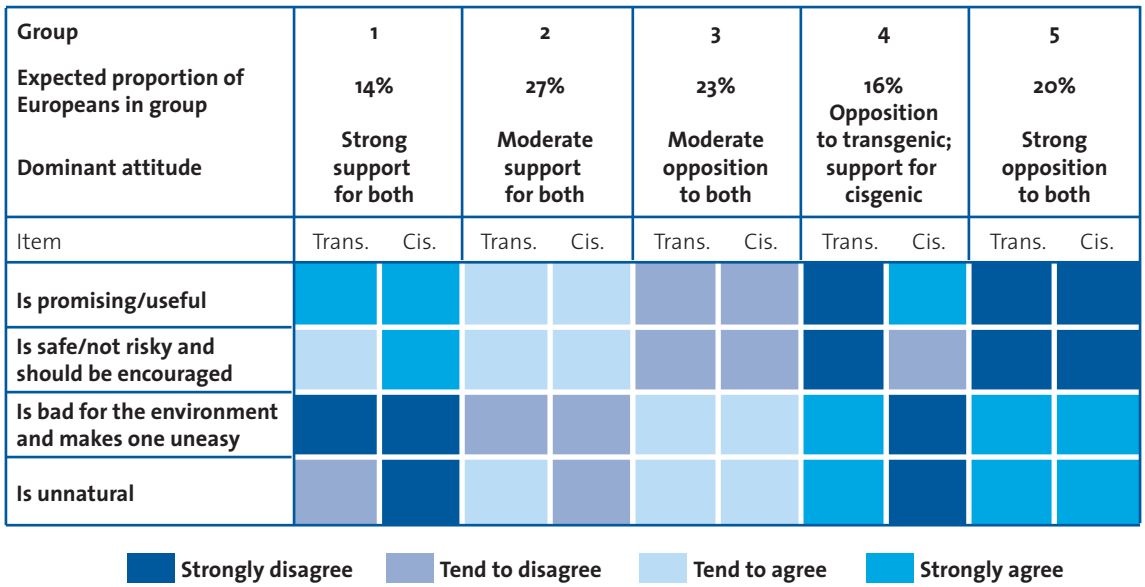
Figure 19.3 Public perception: segmenting European consumer attitudes, 2010



Source: Bennett and Jennings, 2013

Any future for genetically modified crops in Europe?

For the first generation of commodity crops, the outlook seems bleak. It is hard to imagine what might reverse the long downwards trend of public acceptance. For the second generation, however, there are grounds for optimism.

If cisgenic crops achieve the predicted benefits of reducing pesticide residues on fruit and vegetables – the leading food risk concern among Europeans – while supporting biodiversity through reduced chemical spraying, then the public may warm to them.

But public support should not be taken for granted. There has to be transparency about the actual procedures involved in engineering cisgenic crops and recognition that this may raise concerns about unnaturalness. Any benefits should be independently verified, and not overstated.

Lastly, the lessons of the past should not be ignored. The developers of the first generation of GM crops naively, and wrongly, assumed that any public resistance was irrational and would evaporate once GM products were on the market. That did not happen. Trust and consent have to be earned through engaging with the public, treating people as participants, not pawns.