

Since 1991, a Eurobarometer team has conducted a public survey to find out about the opinions and perceptions of Europeans about biotechnology every 2 – 4 years. The most recent Eurobarometer was conducted in January and February 2010 and was published in November. A representative sample of 26,671 out of the total EU-27 population at the age of 15 years or older (almost 407 million people) was asked a wide range of questions about technologies in general, several applications of biotechnology and governance issues. Surveys were also conducted in Croatia and Turkey, two candidate countries of the EU, and three countries belonging to the European Free Trade Association, Switzerland, Iceland and Norway. For the purpose of this report we focused on the application of biotechnology in food and we analysed the data for the total EU-27 sample. In some cases we analysed a sample of the EU member states representing the major countries and showing the range from low to high ratings. Also data from previous Eurobarometers were used to analyse trends in public opinion about GM food. We investigated how the level of support is related to public perceptions on risks, benefits, naturalness and fairness and we analysed the impact of specific applications and the use of different technologies using genetic material from other species or from the same species. Previous analysis of public surveys about biotechnology have highlighted the importance of public trust in the regulatory process, public authorities and other professionals responsible for biotechnology, such as industry and environmental organisations. Therefore, we also analysed its impact on public support of GM food.

The level of support for GM foods is still decreasing

One of the questions asked in most of the Eurobarometers was whether the development of GM foods should be encouraged. We compared the results of the 2010 Eurobarometer with those of four previous Eurobarometers, in 1996, 1999, 2002 and 2005.

In 2010, only 23% of all EU-27 respondents more or less agreed that the development of GM foods should be encouraged, 61% of the respondents disagreed. The highest level of support was found in the Czech Republic (36% agreed, 49% disagreed) and the United Kingdom (35% disagreed and 45% disagreed). The lowest level of support was found in Greece, Cyprus, Lithuania, Bulgaria and Romania, where about 10% agreed and 61 - 77% disagreed. Table 1 (see next page) shows the total results of the 2010 survey.

The graphic in figure 1 shows the changes in the level of support in a number of EU member states over the last 14

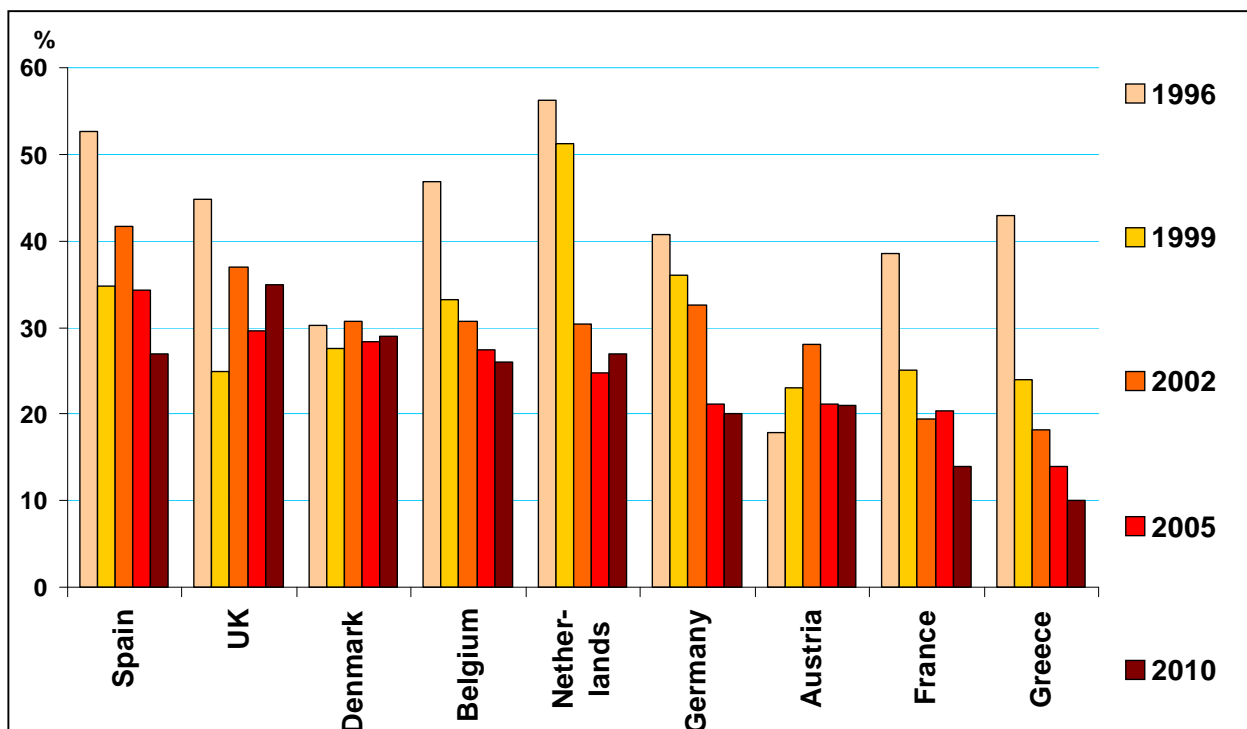


Figure 1: The level of support for development of GM Foods in a selection of EU member states 1996 – 2010 (% of respondents that totally agreed or tended to agree with development of GM foods, based on Eurobarometer data)

years, since the introduction of the GM soybeans. In most cases, the level of support declined steadily to an all-time low level in 2010. The level of support in Denmark and Austria more or less stayed at the same level and in the United Kingdom, where the 1999 dip was probably caused by the outbreak of mad cow disease in the late 1990's, opinions fluctuated. A similar historical analysis could not be made for the whole EU due to changes in EU membership over the years.

Table 1: Opinions about the statement: “The development of GM food should be encouraged” (Eurobarometer 2010, in %)

Country	Totally agree	Tend to agree	Tend to disagree	Totally disagree	DK	Average rating*
UK	7	28	27	18	20	-10.7
Czech Republic	6	30	32	17	15	-11.7
Slovakia	5	27	38	15	15	-13.7
Portugal	3	22	26	17	32	-15.3
Ireland	3	19	16	20	42	-16.0
Malta	3	17	19	23	38	-20.7
Spain	6	21	22	27	24	-21.3
Netherlands	7	20	38	25	10	-24.0
Poland	6	18	30	27	19	-25.0
Hungary	5	22	29	29	15	-26.3
Denmark	5	24	30	30	11	-27.0
Belgium	7	19	35	30	9	-28.3
Finland	7	20	31	33	9	-29.7
EU 27	5	18	28	33	16	-31.3
Estonia	5	19	29	33	14	-31.3
Italy	3	17	32	32	16	-34.0
Sweden	5	21	28	39	7	-36.3
Romania	3	8	22	39	28	-40.7
Austria	4	17	25	45	9	-43.7
Germany	4	16	27	45	8	-44.7
Bulgaria	4	6	27	42	21	-45.0
France	2	12	28	43	15	-46.3
Slovenia	4	16	27	49	4	-48.7
Luxembourg	3	14	23	49	11	-49.0
Cyprus	1	7	24	50	18	-54.7
Latvia	3	10	28	52	7	-55.0
Lithuania	3	7	22	55	13	-57.0
Greece	3	7	24	58	8	-60.7
Croatia	4	8	20	57	11	-57.0
Turkey	3	2	12	62	21	-62.3
Israel	9	29	34	24	4	-16.7
Norway	8	19	28	34	11	-29.0
Switzerland	6	12	30	41	11	-41.0

* Average rating = $(3 \times \text{“Totally agree”} + 1 \times \text{“Tend to agree”} - 1 \times \text{“Tend to disagree”} - 3 \times \text{“Totally disagree”})$

Support for encouragement of GM foods shaped by perceptions

Previous analysis of Eurobarometer data demonstrated that the level of support for biotechnology applications does not only rely on the citizen’s knowledge, but also on their perception of the usefulness, the risks and its implications for the “natural order” (Gaskell, 2000). Analysis of the most recent survey data provides more insight into the relationship between the level of support for encouragement of GM foods and perceptions of nine issues, such as safety, environmental effects, the impact on national economies and developing countries, and perceptions of naturalness. This analysis has been done in three steps:

1. First of all, for each country and each statement the average rating on a scale of -100 ~ +100 was calculated;

$$\text{Average rating} = \frac{(3 \times \text{“Totally agree”} + 1 \times \text{“Tend to agree”} - 1 \times \text{“Tend to disagree”} - 3 \times \text{“Totally disagree”})}{3}$$

Table 1 presents an example of the results of step 1

2. In the second step, the average rating of each country was plotted in nine graphics with the horizontal axis representing the average rating of support for further encouragement and the vertical axis representing the average rating of the statements about the nine issues.
3. In the third step a linear trendline was constructed and a correlation coefficient (R^2) was calculated using Excel software. The gradient factor A in the trendline equation $y = Ax + b$ is an indicator for the effect of an issue on the support for encouragement of GM foods. The correlation coefficient, which can range between 0 and 1, is an indicator for the strength of the correlation. ($R^2 = 0$ meaning there is no correlation at all; $R^2 = 1$ if all points are perfectly on the trendline and correlation is perfect). We can consider R^2 also an indicator for the relevance of the perception of an issue.

Step 2 and 3 resulted in figures like the one below, showing how perceived safety and support are related.

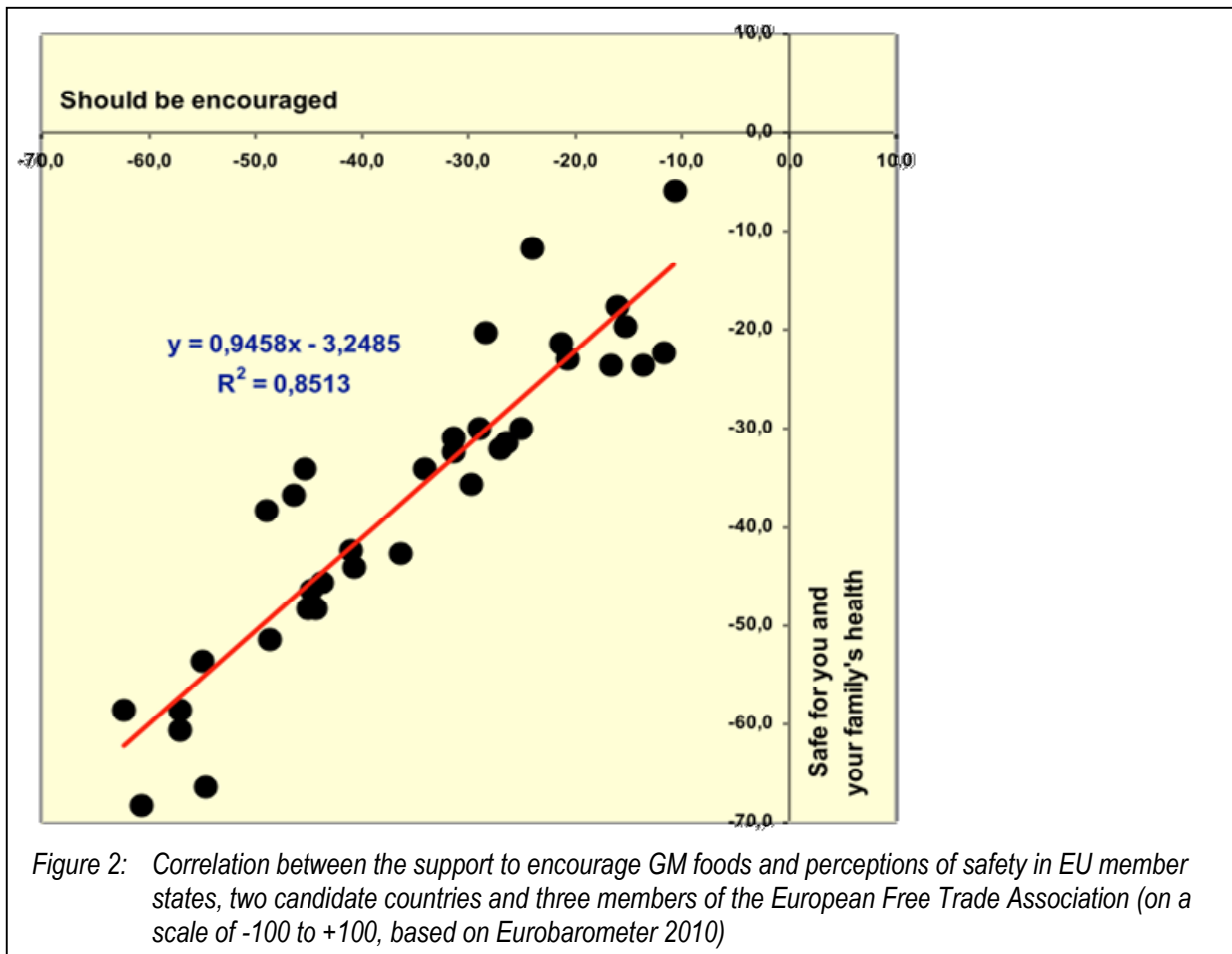


Figure 2: Correlation between the support to encourage GM foods and perceptions of safety in EU member states, two candidate countries and three members of the European Free Trade Association (on a scale of -100 to +100, based on Eurobarometer 2010)

The total results are presented in table 2. The issues are ranked in order of their significance.

Table 2: Correlation between support for encouragement of the development of GM foods and perceptions of several aspects of GM foods in member states, two candidate countries and three members of the European Free Trade Association (Based on Eurobarometer 2010)

Biotechnology	Correlation coefficient (R ²)	Strength	Effect (Gradient A in $y = Ax + b$)
is safe for you and for your family's health	0.8513	high	0.9458
is safe for future generations	0.8435	high	0.9474
is <u>no</u> harm to the environment	0.6704	moderate	0.6991
makes you feel uneasy	0.6423	moderate	-0.9422
helps people in developing countries	0.6153	moderate	0.7322
is good for the national economy	0.5776	moderate	0.7244
is <u>not</u> good for you and your family	0.5687	moderate	-0.7283
is fundamentally unnatural	0.4051	low	-0.5257
benefits some people and puts others at risk	0.0992	very low	-0.3285

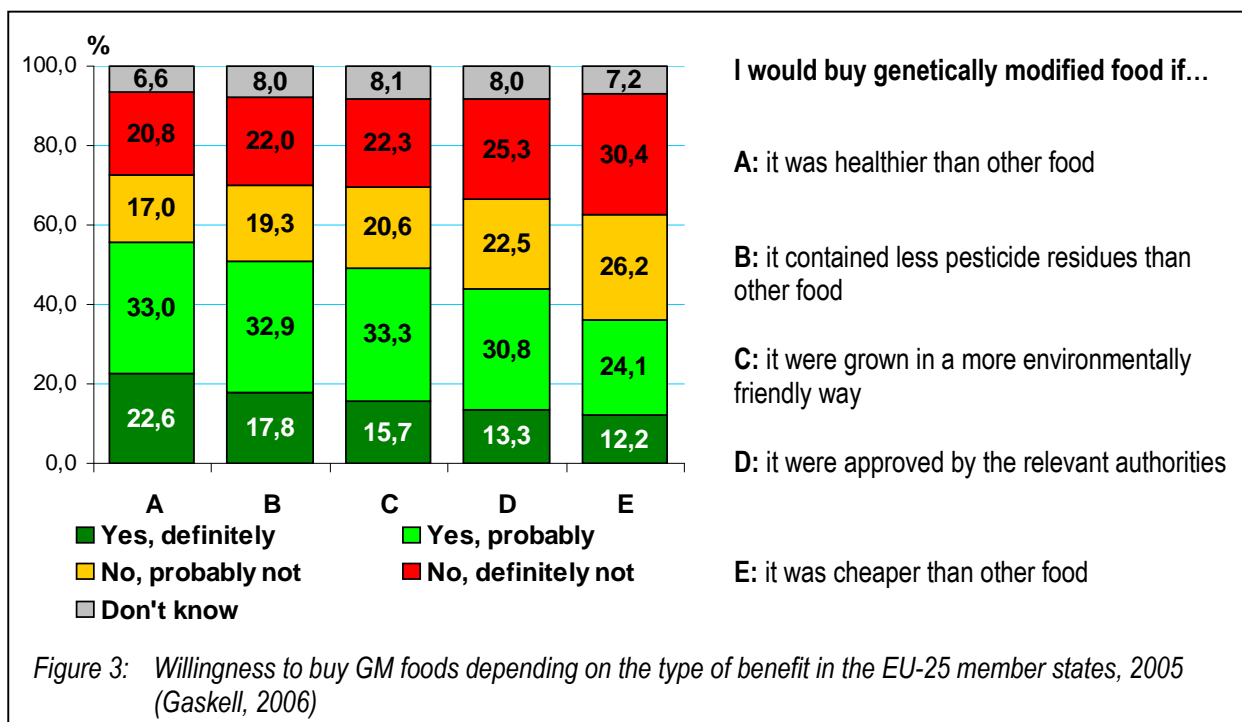
This analysis tells us that:

- There is a strong relationship between how people perceive the safety (for themselves, their family and future generations) and their support for encouragement of GM foods. The more GM foods are perceived as safe, the bigger the support for encouragement;
- Concerning harm to the environment, the relationship with support for encouragement is not only weaker, the effect (Gradient A) is also weaker;
- Contrary to what the 1999 biotechnology Eurobarometer suggests¹, perceptions of naturalness appear to play a rather modest role. The fairness of the division of benefits and risks seem to play a minor role.

Applications put opinions in perspective

The results of previous Eurobarometers already demonstrated that citizens tend to differentiate their opinion about GM foods depending on the perceived benefits of the application. In 2002 and 2005 the respondents in the EU-25 member states were asked about their willingness to buy GM products with different benefits: cheaper, containing less pesticide residues, grown in a more environmental friendly way or healthier. The 2005 results are presented in figure 3.

¹ The results of the 1999 Eurobarometer suggest a dominant role of perceptions of naturalness in shaping public opinion about biotechnology. More than 70% of the EU-15 respondents agreed with the statement: "Even if GM food had benefits it is fundamentally unnatural". Whereas 'only' 56% agreed with the statement that GM food is not necessary and 50% agreed that the risks of GM food are unacceptable.



The ranking of benefits is the same for all EU-25 member states: 1) health; 2) less pesticide residues; 3) more environmentally friendly; 4) approved by relevant authorities and 5) price.

These questions were not repeated in the 2010 Eurobarometer. Instead, a number of questions was asked about GM apples with resistance to mildew and scab. As table 3 shows, in terms of encouragement this apple rated only slightly more positive than GM foods in general, which might be due to the fact that the connected potential benefits –less pesticide residues and more environmentally friendly apple production- were not mentioned in the phrasing of the question.

Table 3: Encouragement of GM food in general and scab / mildew resistant apples in the EU-27 member states (in %, European Commission, 2010)

Should be encouraged	Totally agree	Tend to agree	Tend to disagree	Totally disagree	Don't know	Average rating
GM food in general	5	18	28	33	16	-31.3
Scab and mildew resistant apples produced with horizontal gene transfer	7	22	26	31	14	-25.3
Scab and mildew resistant apples produced with vertical gene transfer	14	33	20	18	15	6.0

Encouragement of the apples was most favoured in the Czech Republic (39% in favour) the Netherlands, Hungary (both 37% in favour), Slovakia (36%), the UK and Belgium (both 35% in favour). In a few member states, especially in Cyprus, Lithuania, Bulgaria and Romania, the apples were far more appreciated than GM food in general. Nevertheless, in all countries the number of respondents in favour of encouragement of the GM apples did not outnumber those in favour of encouragement.

Techologies put opinions in perspective

During the past 20 years more sophisticated biotechnologies have evolved. At present, plant scientists and breeders apply DNA markers that allow for more targeted and faster conventional breeding. Also a number a genetic modification technologies have been developed that no longer result in plants that contain genetic material from other organisms and products that can not be distinguished from conventionally bred plants by means of DNA analysis. It is interesting to know whether ‘the public’ distinguishes between ‘traditional genetic modification’ and those new biotechnologies and what drives this distinction. Therefore, the question about the apples was split in: a) a scab resistant apple produced with ‘horizontal gene transfer’ and b) a similar apple produced with ‘vertical gene transfer’. Horizontal gene transfer was described as a process whereby an organism incorporates genetic material from another, unrelated organism. In the second form - vertical gene transfer - an organism receives genetic material from a related organism, or ancestor.

In the case of vertical gene transfer the number of respondents that favour encouragement (47%) outnumbers those not in favour (38%). This goes for all EU-member states, except for Italy, Germany, France, Slovenia and Luxembourg. Support is highest in Hungary (66%), Finland (64%) and the Czech Republic (62%), and lowest in Luxembourg (32%) and Italy (35%).

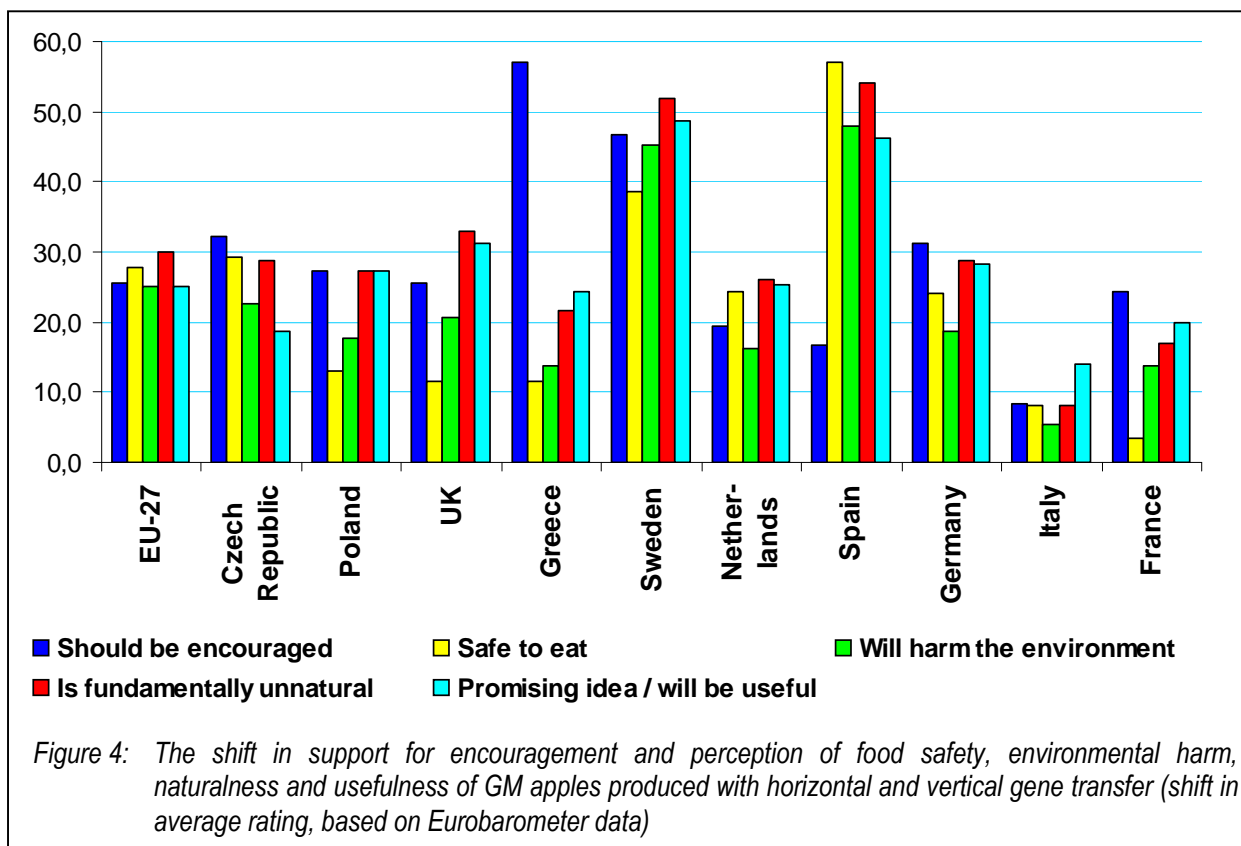
The column at the right side of table 4 shows the difference in rating between horizontal and vertical gene transfer. It shows that the average rating in the EU as a whole shifts from rather negative to slightly positive in the case of vertical gene transfer. The Italian respondents tend to distinguish very little between the two approached, whereas it appears to make a big difference to the Greek respondents whether the genetic modification has been done with genetic material from another species or from the same or a related species.

Table 4: Response to the statement “Scab / mildew resistant apples produced with horizontal and vertical gene transfer should be encouraged” in a number of EU-27 member states (in %, European Commission, 2010)

Country	horizontal gene transfer			vertical gene transfer			Difference in average rating*
	Agree	Disagree	Average rating*	Agree	Disagree	Average rating*	
EU-27	29	57	-25.3	47	38	0.3	+25.7
Czech Republic	39	50	-11.7	62	28	20.7	+32.4
Poland	29	48	-17.0	50	29	10.3	+27.3
UK	35	53	-16.0	54	33	9.7	+25.7
Greece	16	78	-50.7	53	38	6.3	+57.0
Sweden	25	69	-42.0	54	40	4.7	+46.7
Netherlands	37	57	-22.7	48	46	-3.3	+19.4
Spain	31	53	-22.7	45	39	-6.0	+16.7
Germany	25	69	-36.0	45	47	-4.7	+31.3
Italy	30	50	-18.0	35	44	-9.7	+8.3
France	24	62	-35.3	42	45	-11.0	+24.3

* Average rating =
$$\frac{(3 \times \text{“Totally agree”} + 1 \times \text{“Tend to agree”} - 1 \times \text{“Tend to disagree”} - 3 \times \text{“Totally disagree”})}{4}$$

Respondents were also asked to give their opinion about the impact of the two types of GM apples on product safety, the environment, usefulness and how they think about their naturalness. The shift in support for encouragement and the shift in perception of these issues has been visualised in figure 4.



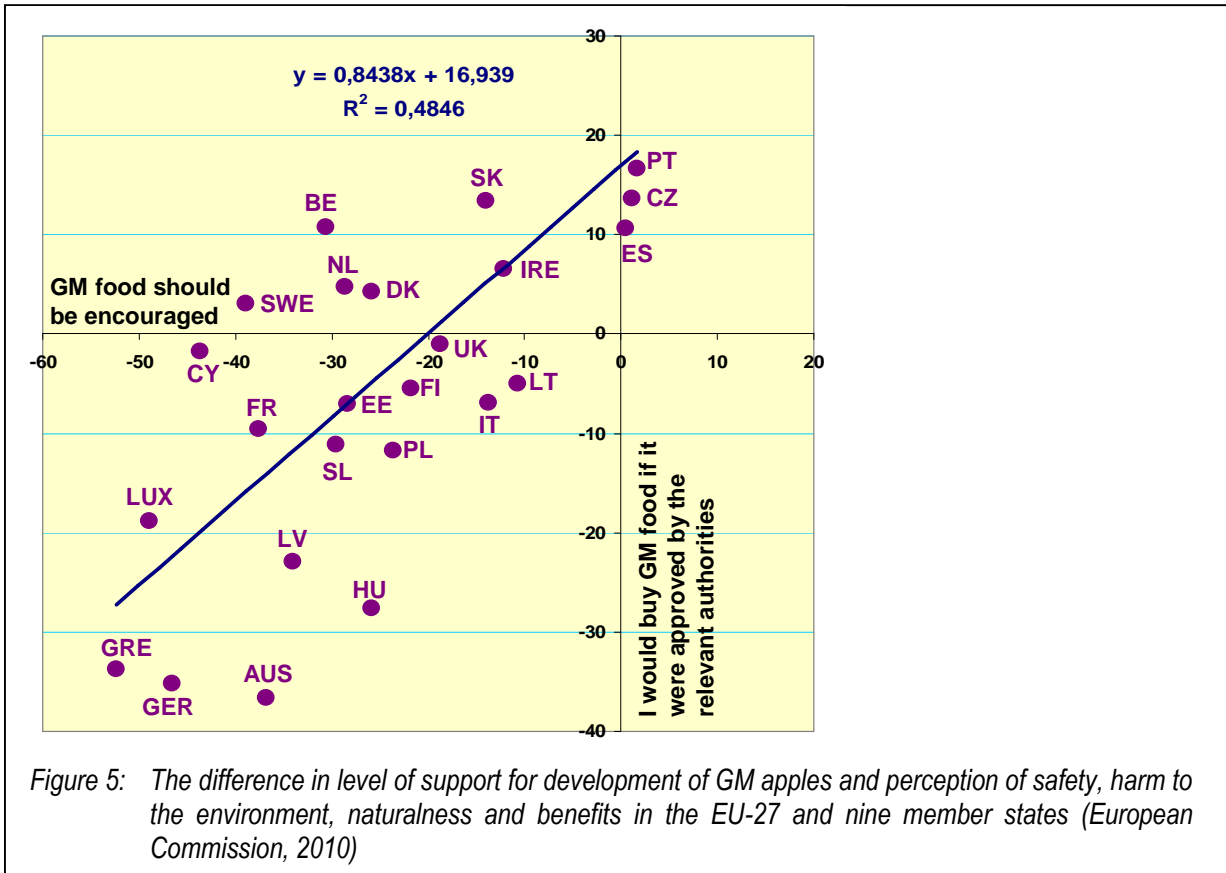
Although the shift in support for encouragement and the shift in perception of the four issues seems equally important in the EU-27, we see very different patterns between the selected member states. The findings suggest that:

- In several cases, the difference in perception of the naturalness is a dominant factor in shifting opinions about encouragement of GM apples produced with vertical gene transfer;
- In none of the cases, the impact on the environment is not the most dominant factor;
- The shift in perception of the food safety of the GM apple is far less relevant than the other issues in France, the UK, Greece and Poland;
- In few cases the shift in support for development of the GM apple seems related to other factors than the perception of the four issues. In Spain, for instance, the shift in support for development of the GM apple is relatively low compared to the shift in perception of the issues, whereas in Greece it is completely the other way around.

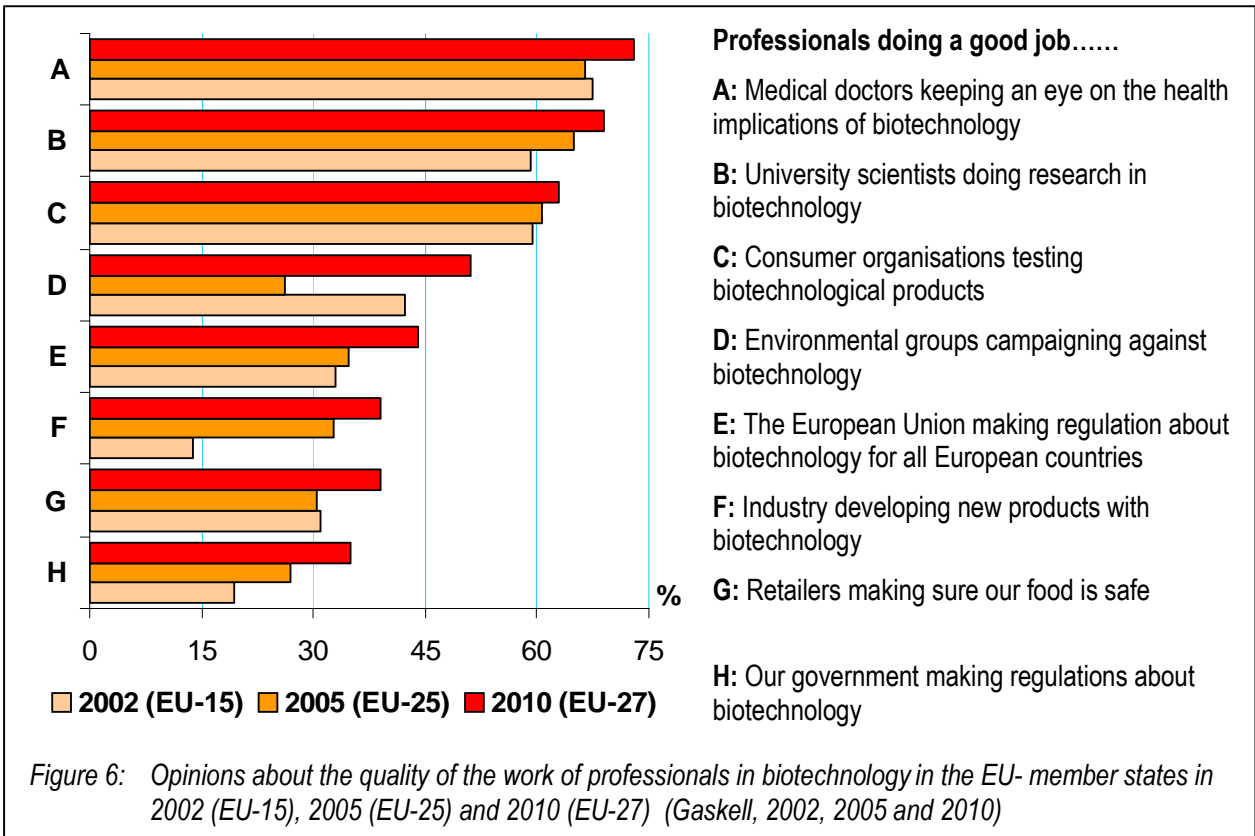
Attitudes towards those responsible for biotechnology

Analysis of several public surveys about biotechnology has demonstrated that trust in those who provide information and those who are responsible for a specific role in biotechnology plays an important role in the shaping of perceptions.

In the 2005 Eurobarometer respondents were asked whether or not they would buy GM food if it were approved by the relevant authorities. The average rating of the answers to this question gives an indication of the level of trust in the public authorities and the regulatory system. Figure 5 shows how support for GM food and trust in the regulatory authorities are related.

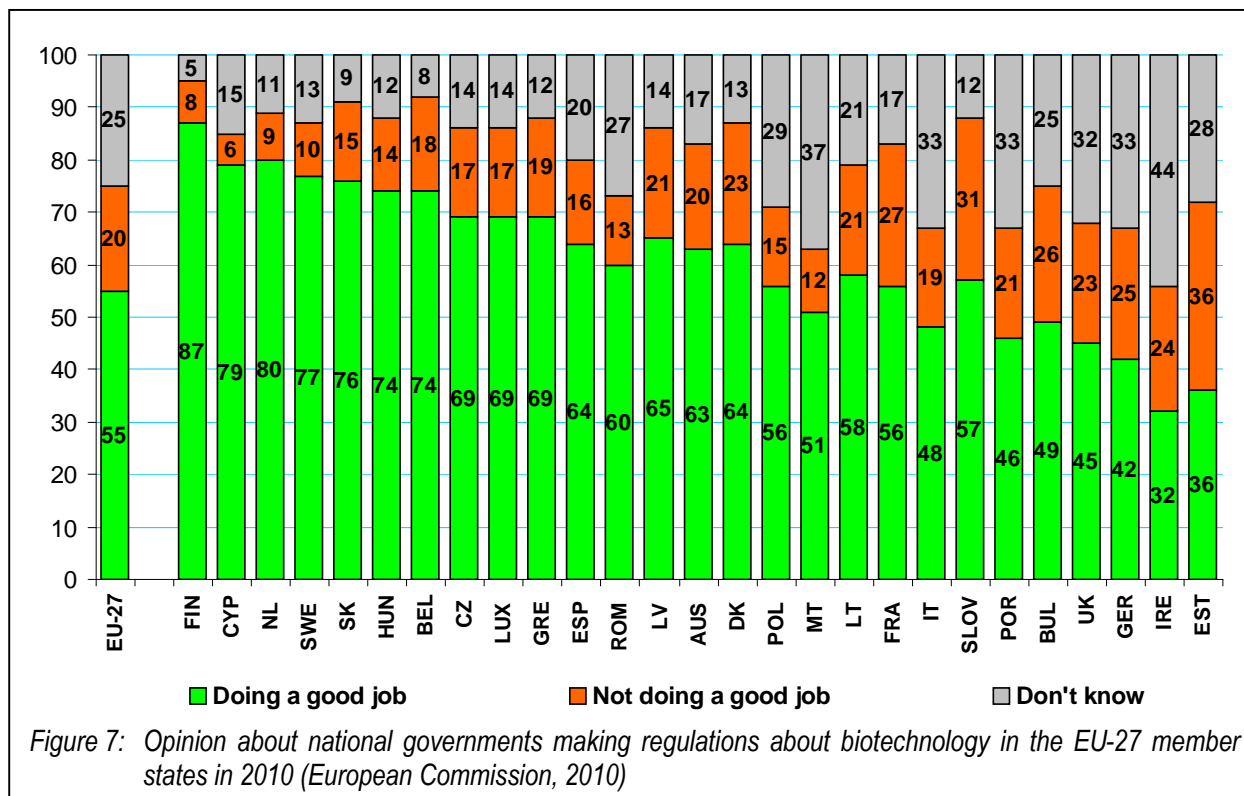


In the last three Eurobarometers respondents were asked who they think are doing a good job for society. As we can see, the general trend is a more positive appreciation of all professionals' jobs over the past eight years.



The results show that:

- Most respected in the area of GM food are university scientists doing research in biotechnology and consumer organisations testing biotechnological products;
- Environmental organisations campaigning against biotechnology rated considerably lower in the 2005 survey. This pattern was found for all EU-15 member states, with extreme low results in Belgium, the Netherlands, and the three Scandinavian countries;
- The appreciation of industry developing new products with biotechnology increased significantly. This pattern was also found for all EU-15 member states, except for Greece, where industry's appreciation decreased between 2005 and 2010. The increase was particularly strong in Belgium and Sweden, and stayed rather low in Germany and Greece;
- Although the appreciation of national governments making regulations about biotechnology increased, they rate relatively poor. Government's ratings decreased in Greece, Ireland and Portugal, remained more or less stable in Germany, the Netherlands and Austria and increased in the other EU-15 member states. The graphic in figure 7 demonstrates that in 2010 trust in national governments and legislation was relatively high in Finland, Cyprus and the Netherlands and relatively low in the UK, Germany, Ireland and Estonia.



Conclusions

Despite many efforts to inform the public about biotechnology, the support for GM foods in the European Union has decreased more or less constantly since the introduction of the first large scale GM application in soybeans in 1996. In 2010, the low level of support for GM foods is primarily related to negative perceptions of the safety for humans, both now and for future generations. The impact of GM foods on the environment comes on the second place. Contrary to what the 1999 biotechnology Eurobarometer suggests², perceptions of naturalness appear to play a

² The results of the 1999 Eurobarometer suggest a dominant role of perceptions of naturalness in shaping public opinion about biotechnology. More than 70% of the EU-15 respondents agreed with the statement: “Even if GM food had benefits it is fundamentally unnatural”. Whereas ‘only’ 56% agreed with the statement that GM food is not necessary and 50% agreed that the risks of GM food are unacceptable.

rather modest role in shaping the negative attitude towards GM food. The division of benefits and risks does not seem to play a role at all.

Notwithstanding the general negative public attitude towards GM foods, data from previous European biotechnology surveys suggest that many citizens distinguish between different application types. GM food with health or environmental benefits gets more support in terms of 'willingness to buy' than GM food that is cheaper than other food.

European citizens also tend to distinguished between GM food (scab and mildew resistant apples) with genes from other species (using horizontal gene transfer) and GM food with genes from the same or related species (using vertical gene transfer or cisgenesis). The cisgenic apples are significantly more appreciated by those who responded to the 2010 Eurobarometer, although the distinction is not equally significant in all EU-27 member states.

In several countries the role of the positively perceived safety of the cisgenic apples is an important factor too. Although their environmental impact and the usefulness of the application and approach seem to be less dominant factors, they still do play a role in shaping citizens' perception.

The most intriguing finding, however, concerns the role of people's perception of naturalness. While the perception of naturalness appeared to be a minor factor in the general support (encouragement) for GM food, in the case of production methods the perception of naturalness of the transformation method seems to be the dominant factor in the shift of support (encouragement) in most member states. This looks like contradicting results, which is hard to explain. Does this mean that the role of the perception of naturalness starts playing a different role as soon as the technology seems closer to conventional breeding, or are people just confused because of the terminology that was used in the phrasing of the questions? Further qualitative research, using interviews or focus groups that confront participants with different breeding techniques could provide more insight to this question.

Analysis of the data from 2005 survey shows that there is a relationship between the level of trust in the regulatory process and the level of support for GM foods. Analysis of the data from the 2002, 2005 and 2010 surveys also shows that although the general situation is improving, most member states need to investigate what causes the relatively low level of trust in their regulatory role in biotechnology and put more efforts in trust building.

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This paper was drafted by LIS Consult as part of the interactive consumer approach in the EU-SOL project. EU-SOL is an international network of plant scientists from universities, research institutes and industry who do research on the development of high quality crops of the Solanacea family: mainly tomato and potato. The consortium brings together expertise across a wide variety of disciplines across the EU and several other countries – from taxonomy to molecular biology to consumer integration. The aim of the EU-SOL project is to develop high quality



tomato and potato varieties with improved traits important for consumers, processors and producers. The project particularly focuses on mapping, isolating and characterizing genes underlying important traits such as healthiness, nutritional value, taste, flavour, fragrance, shelf-life, starch composition, yield and plant architecture. The EU-SOL project is supported by the European Commission through the 6th framework programme. Contract number FOOD-CT-2006-016214

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