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Four questions on European consumers' attitudes toward the use of genetic modification in food production

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Abstract

Four questions on European consumers' attitudes to the use of genetic modification (GM) in food production are posed and answered: (1) how negative are consumer attitudes to GM applications in food production? (2) How do these attitudes affect perception of and preference for products involving GM applications? (3) How deeply rooted are these attitudes? (4) Will the attitudes change due to more information and/or product experience? Drawing on two major studies researching these questions, it is concluded that consumer attitudes towards GM in food production are negative, that these negative attitudes guide the perception of food products involving the use of GM and lead to a range of sweeping negative associations which overshadow potential benefits perceived, that these negative attitudes are embedded in a system of more general attitudes, especially attitude to nature, to technology, and alienation from the marketplace, implying that they are deeply rooted, and that they will not easily be changed by information. They may change, however, due to own experience with products produced using GM and involving clear consumer benefits.

Keywords: Genetic modification; Consumer behaviour; Attitudes

Industrial relevance: Consumer attitudes towards the use of genetically modified foods or food ingredients are a highly relevant issue world wide. Although they are currently considered as negative by European consumers the authors offer important aspects for food producers and food scientists: (1) understanding consumer attitudes towards food technologies and using this understanding proactively in the development and marketing of food products; (2) consumer perception and hence market acceptance should have a much larger role in R&D policies and contacts with the market should start as early as possible; (3) currently decision makers in industry and government lack basic knowledge about the functioning of market communication and address consumers with approaches doomed to failure.

1. Background: consumers and food technology

Consumers use a range of criteria in evaluating food products and making purchase decisions. Sensory aspects, especially appearance and taste, have always been paramount. Health considerations have attained almost equal attention as appearance and taste during the last decades. Convenience in purchasing, storing, preparing and eating food is a third group of criteria, and one the importance of which is rapidly rising.

A fourth group of criteria is a relative newcomer to the range of consumer purchase considerations: the way the product has been produced. Twenty years ago, most consumers had only diffuse ideas about and likewise only diffuse preferences for various forms of food production. It usually amounted to that 'home-made' is good and 'industrially produced' is not so good; with a number of craftsman-type production forms (like street corner bakeries) somewhere in between. Today, this has clearly changed. Consumers have ideas about the benefits of organic production, about how animal mass production has caused BSE, and about ethical issues in fish farming. Not all consumers are equally concerned, and even among those concerned these concerns do not always affect their purchase decisions—but these concerns are clearly present in the public debate, and they have changed the way in which food products are marketed and chosen.

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The discussion about genetic modification has been catalytic in this respect. Genetic modification (GM) is the one technology related to food production that has caused most public debate. It is also the one where the perception gap between consumers on the one side and producers and scientists on the other side has been most pronounced and most visible. Most scientists are enthusiastic about the ways in which GM can change biotechnology, and food producers are enthusiastic (or, at least, have been) about the potential of GM applications for increased process efficiencies and new products. But consumers have been sceptical. As a result, uneasiness pervades. Producers are aware of the technological possibilities, but most of them are hesitant in exploiting them. Retailers have become alert, and some try to strengthen their position by taking consumer concern for GM seriously. Regulators at the EU level on the one side don't want the European food industry to loose competitiveness in GM applications, but have on the other side realised both the consumer concern and its potential usefulness in fighting market entrants from outside the EU.

But the GM debate should not be seen as an isolated phenomenon. It should be seen in the context of the development sketched above: an increased consumer interest in food production technology. We have the GM debate today, but tomorrow we may have a debate on magnetic field or radiowave treatments. It is therefore important that we understand some of the basic mechanisms of these consumer concerns. Why are consumers concerned? How do these concerns develop, and how do they affect consumers' purchase decisions? Will they disappear when we give consumers more information about the technologies in question?

It is in answering these questions that the social sciences can make a contribution. In economic terms, the technology used in food production is, for consumers, a credence characteristic, because the product does not usually look, smell or taste different because of the new technology. The role of production technologies in consumer decision-making is therefore, to a large extent, a question of perceptions, inferences, and attitudes. In order to analyse them, we need an approach that transcends the boundaries of traditional economics and embraces psychological approaches to the analysis of consumer behaviour.

2. Four questions on consumer reactions to GM in food production

In the remainder of the paper we will try to answer four questions, which we believe are central for understanding consumer concern about GM in food production. In answering these questions, we will draw on two major international research projects dealing with consumer reactions to GM applications in food.[1] Both projects employ a consumer science approach and draw on consumer psychology as their theoretical base. The four questions are:

1. How negative are consumer attitudes to GM applications in food production?
2. How do these attitudes affect perception of and preference for products involving GM applications?
3. How deeply rooted are these attitudes?
4. Will the attitudes change due to more information and/or product experience?

The aim in answering these questions is to go beyond the mere fact that consumer attitudes to GM are negative by casting light on how these attitudes come about, which effect they have, and how they change.

2.1. Consumer attitudes to GM in food production

It is well known that European consumers' attitudes towards GM in food production are negative. Numerous opinion polls, with the Eurobarometer surveys as the most well known one, have shown that consumers do not like the idea of genetically modified organism in their food (Bredahl, Grunert & Frewer, 1998; European Commission, 1997, 2000; Frewer & Shepherd, 1995; Durant, Bauer & Gaskell, 1998).

Tables 1 and 2 show data from seven European countries (details of these studies can be found in Bredahl, 2001; Lähteenmäki et al., 2002). Attitude to genetic modification in food production was measured by a 3-item scale ('Applying gene technology in food production is extremely bad—extremely good,' 'Applying gene technology in food production is extremely foolish—extremely wise,' I am strongly against—strongly for applying gene technology in food production,' Cronbach's alpha >0.8 in all cases). The tables show that the average support for genetic modification in food production is, as expected, quite low. There are some national differences, though: the attitude is most negative in the Scandinavian countries and Germany, and is most positive in Italy, with the UK and Finland in a middle position. These differences become even more clear when we look at the percentage of consumers with an extreme attitude, here defined as the percentage of respondents ticking the most positive or the most negative category in response to all three items. Incidentally,

[1] The project 'Consumer attitudes and decision-making with regard to genetically engineered food products' was supported by the EU under FAIR contract PL96-1667. This project was coordinated by the first author, and participating institutions in addition to the MAPP Centre were IFR (UK), ISIDA (Italy), VTT (Finland), the University of Potsdam (Germany) and two industry partners. The project 'Consumers and biotechnology' was supported by the Nordic Industrial Fund under grant P98098. It was coordinated by Liisa Lähteenmäki (VTT, Finland), and participating institutions were the MAPP Centre (Denmark), SIK (Sweden) and MATFORSK (Norway).

Table 1
Attitude to genetic modification in food production in Denmark, Germany, the UK and Italy—means and extreme score frequencies (scale 1–7, data collected in 1998)

	Denmark ($n=505$)	Germany ($n=516$)	UK ($n=499$)	Italy ($n=511$)
Mean score	2.80[a]	2.94[a]	3.47[b]	3.90[c]
Extremely negative attitude (i.e. a score of 1)	25.4%	16.7%	8.9%	4.3%
Extremely positive attitude (i.e. a score of 7)	0.8%	1.4%	0.6%	1.0%

From Bredahl, 2001. Mean scores with different letter are significantly different (Scheffe's test, $P<0.01$).

Table 2
Attitude to genetic modification in food production in Denmark, Finland, Norway and Sweden—means and extreme score frequencies (scale 1–7, data collected in 1999)

	Finland ($n=204$)	Sweden ($n=169$)	Norway ($n=199$)	Denmark ($n=181$)
Mean score	3.49[a]	3.28[a,b]	2.90[b]	2.82[b]
Extremely negative attitude (i.e. a score of 1)	5.4%	16.0%	15.6%	21.5%
Extremely positive attitude (i.e. a score of 7)	0.0%	1.2%	0.5%	0.6%

Unpublished material from Nordic study, see footnote 1. Mean scores with different letter are significantly different (Scheffe's test, $P<0.01$).

Table 3
Product characteristics for yoghurt choice task

Acronym	Fat content	Production method	Additives	Texture
'Whole'	3%	Traditional	None	Smooth
'Skim'	0,5%	Traditional	None	Thin
'Addit.'	Fat-free	Traditional	Antioxidants, Stabilisers	Smooth
'Gen. mod.'	Fat-free	Genetically modified	None	Smooth

Based on Bredahl, 1999.

we can also note that there also exist consumers with an extremely positive attitude—but in very small numbers (e.g. 0.6% in the UK).

These figures measure attitude to GM in food production. We know from other studies that consumer attitude is more favourable with regard to GM application in medicine (e.g. European Commission, 2000; Frewer, Howard & Shepherd, 1997). We also know that within the food area, it does make a difference whether the GM involves a modification of the raw material itself (sugar made from modified sugar beet) or whether GM material is only used as support in the production process, so that the GM material is no longer present in the final product (e.g. use of enzymes which have been produced using GM micro-organisms). The latter is relatively more acceptable to consumers (Grunert et al., 2001).

Attitudes have several functions with regard to human behaviour. They can guide perception, and they influence behaviour. We now turn to the question how these attitudes affect perception of and preference for products involving GM applications.

3. Consumer perceptions of and preferences for food products involving the use of GM

In order to put the question of attitudes towards GM in the context of the perception and choice of concrete food products, various choice sets were constructed, where consumers had to rank order a number of products, one of which involved the use of GM (details in Bredahl, 1999). The GM product, though not currently on the market, was realistic and constructed in such a way that the application of GM resulted in a benefit to the consumer. Table 3 shows a choice set for yoghurt. The GM product was constructed in such a way that it could solve a dilemma for consumers: many consumers prefer a low-fat yoghurt, but producing yoghurt based on skimmed milk results in a runny, non-attractive consistency. Using additives can change this, but many

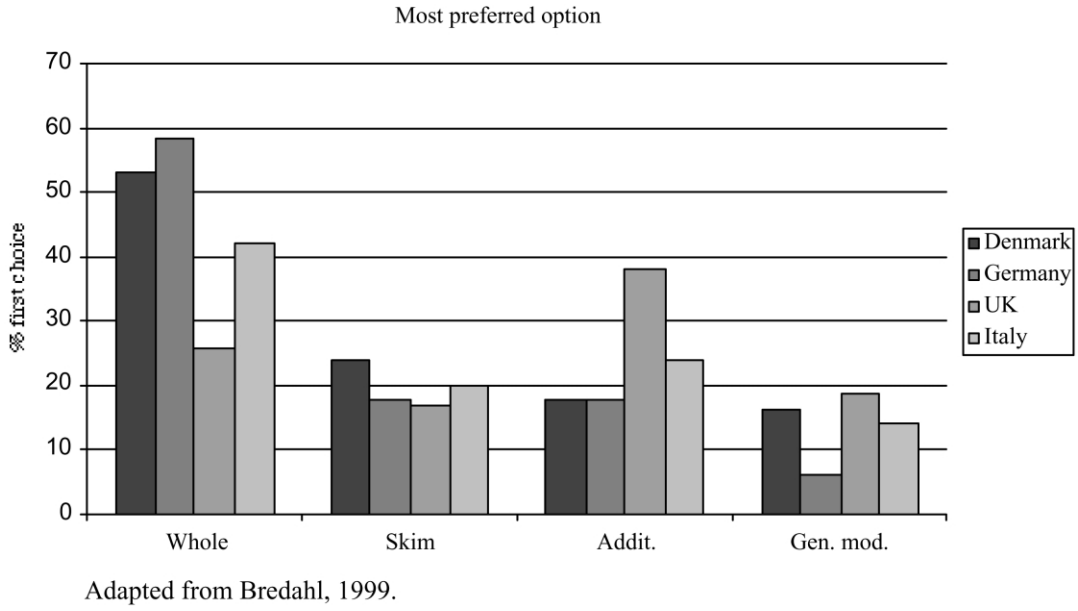


Fig. 1. Most preferred yoghurts in choice task.

consumers don't like additives either. By using a GM starter culture, the yoghurt can be fat-free, have the right creamy consistency, and still no additives. The GM product thus provided a good basis for the formation of positive consumer preferences.

Consumers inspected the four products as dummies (yoghurt cups with appropriate labels) and rank ordered them according to preference. They then had to explain the reasons for their ranking. These reasons were usually given by the respondents in the form of product attributes. Consumers were then asked for the underlying expected consequences and values of their liking or disliking of the named product attributes, using the laddering interview technique (Grunert & Grunert, 1995; Reynolds & Gutman, 1984, 1988). Results were coded, and hierarchical value maps summarising the major links of associations determining consumer preferences were constructed employing the method advocated by Reynolds and Gutman.

Fig. 1 shows the most and least preferred products in the four countries participating in the study. The genetically modified product is least preferred throughout, although the degree of rejection is somewhat lower in the UK than in the three other countries.

Why is the GM product rejected in spite of the benefits it carried for the consumer? A possible reason may be that consumers did not perceive the benefits, or that they were regarded as irrelevant. We can gain insight into the reasons by inspecting the hierarchical value maps in Fig. 2 (only those for Germany and the UK are shown for space reasons). These maps are to be read as follows: at the bottom, they show those product attributes consumers gave as reasons for their preference ranking. Above these, we have the more abstract product attributes, consequences of product use and life values motivating the importance of these attributes. We can thus see which attributes were important for consumer preferences, and why.

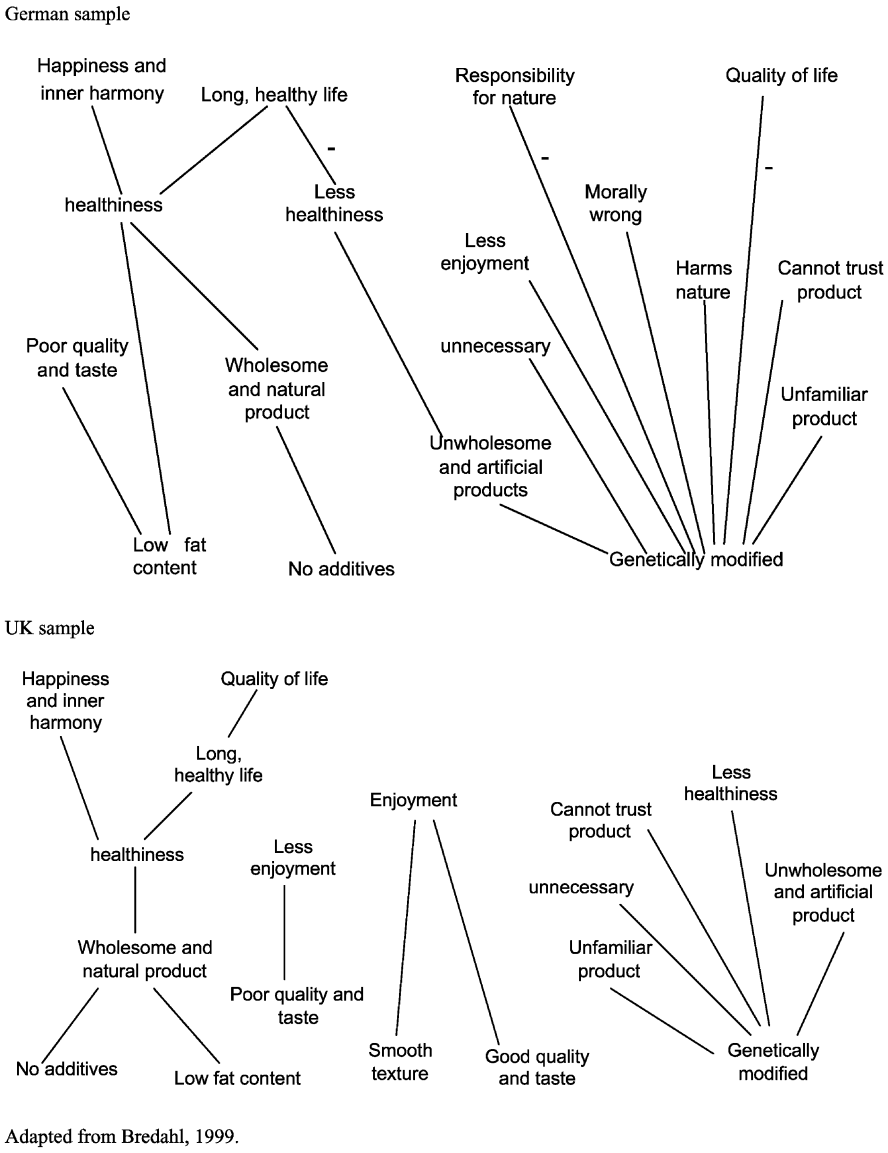
We see that the benefits of the GM product were perceived, and that they were relevant. Consumers appreciate the low fat content, the lack of additives and the smooth texture for reasons of health and enjoyment. However, these positive aspects of the products seem to be overcompensated by the wide range of negative, sweeping, though somewhat diffuse associations to the fact that the product was produced using GM.

This pattern has been corroborated in a number of studies (Bredahl, 1999; Grunert et al., 2001). In general, the most common associations to the attribute 'produced by GM' are that the product is unhealthy, that the technology is unfamiliar and untrustworthy, that it harms nature and that it is ethically wrong.

The conclusion is clear: the general attitude to GM in food production has a strong influence on the perception and evaluation of concrete food products.

4. Attitudes towards GM in food production: Bottom-up or top-down processing?

Broadly speaking, there are two classes of theories on attitude formation in social psychology, which we can term bottom-up and top-down approaches (Scholderer, Bredahl & Frewer, 1999). They are not contradictory in the sense that when one is true the other is wrong; rather, they describe two basic mechanisms in the way, in which people form attitudes, both of which may be



Adapted from Bredahl, 1999.

Fig. 2. Hierarchical value maps indicating consumer associations to yoghurt involving GM material.

present to different degrees in any concrete case. We briefly turn to this distinction because it is crucial for answering questions 3 and 4.

The bottom-up formation of attitudes implies that the attitude towards an object is formed based on the knowledge about the object. People form beliefs about characteristics of the attitude object, and some of these characteristics they like, whereas others they don't like. The resulting attitude toward the object will then be a weighted average of the evaluation of its perceived characteristics (known examples of this approach are the Fishbein attitude theory, Fishbein, 1963, and the McGuire attitude change model, McGuire, 1969). When the attitude object is GM in food production, consumers may perceive various characteristics of GM-based production—e.g. that it can solve environmental problems, that it can result in lower food prices, that it is a threat to human health, that nobody knows the long-term consequences. Some of these characteristics are good, others are bad. The overall attitude towards GM in food production will then be some kind of average of the evaluation of these perceived characteristics of the technology.

The top-down formation of attitudes regards an attitude as embedded into a system of general attitudes and values. These general attitudes function as guidance in deriving attitudes towards more specific objects in a way which preserves the evaluative tendency of the higher-order attitudes (e.g. Katz, 1960; Rokeach, 1968). When the attitude object is GM in food production, more abstract and general attitudes can include general attitude to nature, attitude to technology, etc.

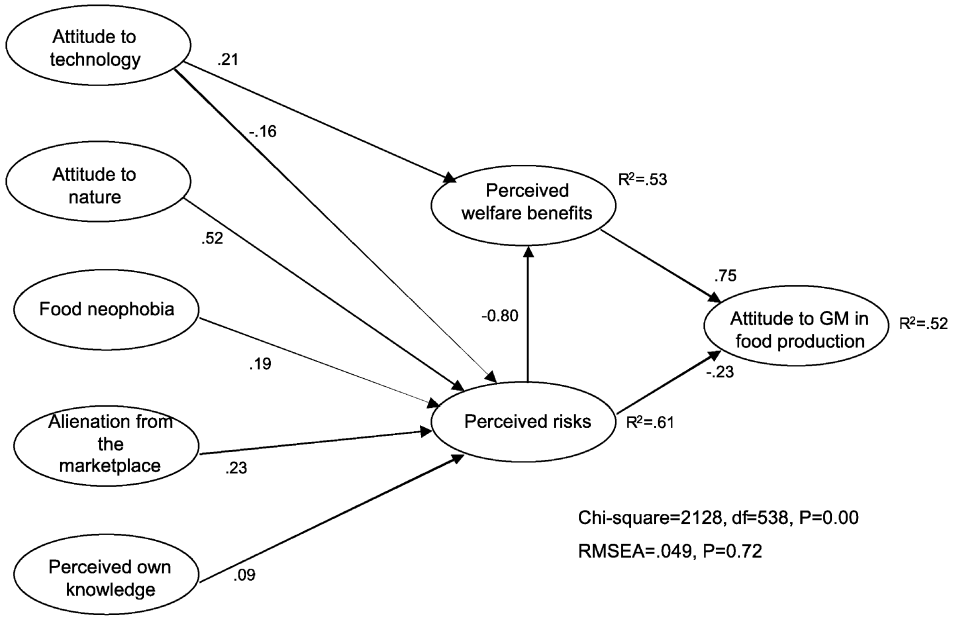


Fig. 3. Explaining consumer attitude to use of GMOs in food production.

The distinction is important for answering our question on how 'deeply rooted' consumer attitudes to GM in food production are. We know from the Eurobarometer studies (European Commission, 2000) that consumer knowledge about potential applications of genetic modification is limited, and that their general knowledge about the topic is limited as well. For instance, 35% of European consumers believe that ordinary tomatoes do not contain genes, whereas genetically modified tomatoes do, and 24% believe that their genes can change by eating genetically modified food, with another 34% answering 'don't know.' We usually expect attitudes based on such limited knowledge to be weak and easily changed. However, this does not hold when strong top-down processing occurs. The more the attitude towards GM is characterised by top-down processing, the more it is related to more general, strongly held and stable attitudes. The question how 'deeply rooted' attitudes towards GM are can therefore be reframed into the question to which extent it is embedded in a system of more general, more abstract attitudes, rather than coming about as an averaging of concrete beliefs about the technology.

In order to shed light on this question empirically, the following potential determinants of attitude towards GM in food production were investigated (drawing on work of Allison, 1978; Bearden, Lichtenstein & Teel, 1983; Borre, 1990; Frewer, Hedderley, Howard & Shepherd, 1997; Hamstra, 1991, 1995; Pliner & Hobden, 1992; Sparks, Shepherd & Frewer, 1994):

- General attitudes:
  - Attitude to nature (man as part of nature, living in harmony with nature);
  - Attitude to technology (technology as good for mankind);
  - Alienation from the marketplace (not understanding the market, distrust in that the market functions in a way which is to the consumers' advantage);
  - Food neophobia (reluctance to try new food products);
  - Concrete beliefs about the technology;
  - Perceived risks (for the environment, for human health, unnatural, long term consequences unknown, causes allergy, interferes with wild species in nature, benefits producers only);
  - Perceived benefits (healthier products, better quality, better standard of living, solves environmental problems, reduces prices, increases choice of products).

The results (described in more detail in Bredahl, 2001) provided strong evidence for the presence of top-down processing in the formation of attitudes towards GM in food production. Fig. 3 shows a structural equation model that was estimated on the basis of pooled data from the UK, Germany and Denmark. It shows that the extent to which consumers perceive GM

Table 4
Generic information strategies

	Balanced/general information	Product-specific information	Conventional product advertising
Amount of information	Medium	Low	Low
Focus and specificity	Technology, consumer policy	Product	Product
Main proponents	Industry associations	Consumer organisations, retailers	Communication managers in life sciences and food processing companies
Preferred channels	Brochure	Package label, info sheet	Print advertisement
Primary target variables	Knowledge, trust	Knowledge	Product evaluation
Are evaluations communicated?	Partially	No	Yes

Adapted from Scholderer et al., 1998.

in food production to be risky is, to a large extent, a function of the general attitudes listed above. Attitude to nature has the strongest influence, but attitude to technology, food neophobia, and alienation from the marketplace have significant effects as well. And to which extent one perceives benefits in the application of GM is to a large extent determined by the extent to which one perceives risk: the perception of risks prevents the perception of benefits.

It follows that consumer attitudes to GM in food production are deeply rooted: they mirror more general attitudes towards nature, technology, food and the market.

5. Perspectives for change of consumer attitudes to GM in food production: consumer information and direct product experience

The presence of top-down processing in the formation of attitudes towards GM in food production suggests that these attitudes are not easily influence or changed, because there will be a tendency to sustain the congruence between the attitude towards GM and the more general attitudes and values in which it is embedded. However, as noted above, the presence of top-down processing does not mean that bottom-up processing does not exist, only that its influence on attitudes may be weaker.

We therefore now turn to the question of whether and how attitudes to GM in food production change due to bottom-up processing. Such change can in principle come about in two ways: by information, and by own experience. Attitude change by information has been widely discussed, and many people in industry believe that a solid, well-designed information campaign would be able to solve much of the problem of consumer rejection of GM applications. The effects of direct experience have been less in focus, mostly because the number of products such experience can be based on is still quite limited.

Expert focus groups with representatives from industry, science, consumer organisations, environmental organisations and regulators indicated that views on how to inform consumers about GM in food production can be boiled down to a few generic information strategies (details in Scholderer, Balderjahn & Will, 1998). The three most important ones are summarised in Table 4. The first involves the provision of balanced information on the pros and cons of GM applications in food production, the type of information you usually would provide in a brochure. The second also involves balanced information, but it is product-specific and provided by media linked to the product, like labels, packaging and info sheets. Both strategies have a focus on providing information to the consumer, assuming that new insight into risks and benefits will influence attitudes by a bottom-up averaging type of process. The third strategy aims mainly at directly creating the positive affect via persuasive messages with a low information content.

The effect of these three information strategies has been investigated experimentally (details in Scholderer & Frewer, in press). Consumers had to make a choice between four products (in one study, the four yoghurts of Table 3, in another study four beers), one of which was labelled as genetically modified. A control group made the choice without other additional information, whereas three experimental groups received information which was prototypical of the three information strategies described above (glimpses from the information material can be seen in Fig. 4). Dependent measures recorded were consumers' attitudes towards GM in food production, as well as the choice made among the four products.

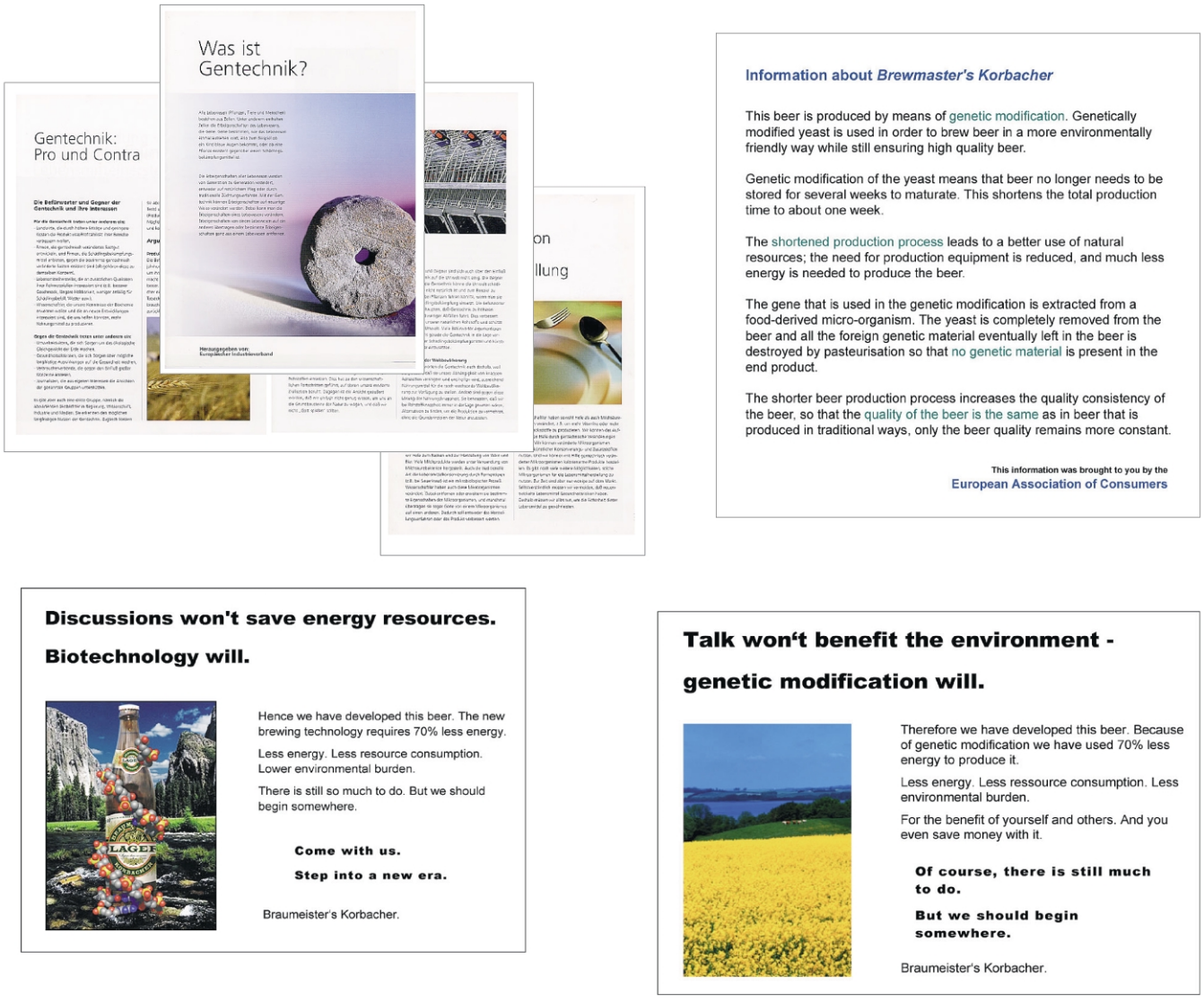
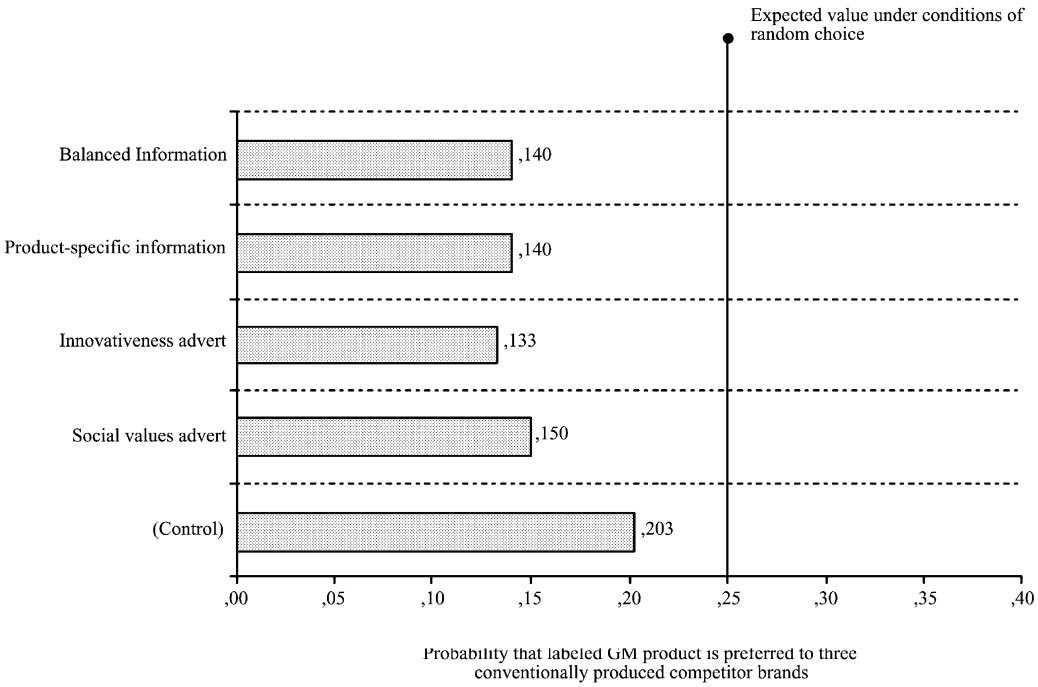


Fig. 4. Examples of information material used in information experiments.

Consumer attitudes towards GM in food production were not affected by the information provided. However, the information had another effect, which can be seen in Fig. 5. This figure shows the probability of choosing the GM product for the four experimental conditions. As can be seen, the control group—the group receiving no information except the label stating that the product was produced using GM—had the highest probability of choosing the GM product. Giving additional information—no matter which type—decreased the probability of choosing the GM product.

This result is easily explained by attitude theory (Fazio, Chen, McDoal & Sherman, 1982; Fazio & Zanna, 1981). The information does not change consumer attitudes, but it has an attitude activation effect: providing additional information on the attitude object makes consumers aware of their existing (negative) attitudes, which results in that these attitudes become more behaviourally relevant.

The effect of product experience (as opposed to information) was investigated in another study (details in Lähteenmäki et al., 2002). Respondents participated in a taste test of eight cheeses. Two weeks later they came to another taste test, this time involving only two cheeses. These cheeses were chosen in such a way that one cheese was the same as the one obtaining the highest preference in the first taste test, the other was the same as a cheese obtaining medium preference in the first taste test. Respondents were not aware of the fact that the two cheeses were identical with cheeses tasted in the first round. The second taste test involved three groups of consumers: a control group just tasting the cheeses and rating preferences for them, a first experimental group in which the preferred cheese was

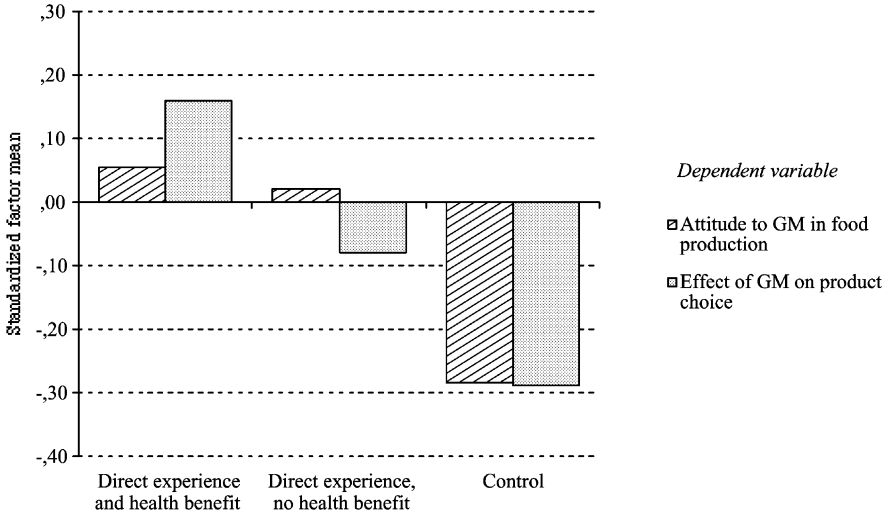


Adapted from Scholderer & Frewer, in press.

Fig. 5. Results from information experiment.

labelled 'produced with genetically modified starter culture,' and a second experimental group in which the preferred cheese was labelled 'produced with genetically modified starter culture; contains one third of the fat of the regular cheese.'

The results showed, not surprisingly, that preference for the cheese which was preferred in the first taste test was reduced when it was labelled as genetically modified. However, the most interesting result of this study was related to two post-experimental measures (see Grunert, Bech-Larsen, Lähteenmäki, Ueland & Åström, in press). After the taste test, respondents' attitude towards GM in food production was measured, and in addition they evaluated intention to buy a number of hypothetical cheese product concepts in a conjoint design. Fig. 6 shows the means of the general attitude



Adapted from Grunert, Bech-Larsen, Lähteenmäki, Ueland & Åström, in press.

Fig. 6. Effect of product experience.

towards GM in food production and of the part-worth utility associated with the use of a GM starter culture in the conjoint task for the three groups of the second taste test. The result is rather clear-cut: Those respondents who believed that they had tasted a GM cheese in the taste test had a less negative attitude towards GM in food production afterwards, and the negative contribution of the attribute 'produced using genetically modified starter culture' in the conjoint task, although still present, was smaller.

Taken together, the two experiments have a rather clear message: giving information is not likely to change consumer attitudes towards GM in food (at least not in the short run), whereas direct product experience may. However, the latter conclusion is not without qualifications: because of the experimental design, the cheese labelled 'GM' had a clear consumer benefit, namely the—according to the respondent's own preferences—superior taste. So the conclusion should rather be that direct experience with GM products involving a clear consumer benefit may change consumer attitudes.

6. Conclusions and implications

We have now tried to answer the four questions we posed in the beginning. The main conclusions are as follows:

- Consumer attitudes towards GM in food production are negative—and for a sizeable proportion of consumers extremely negative—across a range of European countries. There do exist, however, national differences.
- These negative attitudes guide the perception of food products involving the use GM and lead to a range of sweeping negative associations that overcompensate for potential benefits perceived.
- These negative attitudes are embedded in a system of more general attitudes, especially attitude to nature, to technology, and alienation from the marketplace. They can therefore be said to be deeply rooted.
- Consumer attitudes towards GM in food will not easily be changed by information. They may change, however, due to own experience with products produced using GM and involving clear consumer benefits.

In line of the more general context outlined in the beginning of this paper—consumers and food technology—we think the conclusions point towards three major implications.

Firstly, food producers and food scientists will have to get used to the fact that consumers are interested in the way food is produced and develop attitudes, possibly strong attitudes, towards certain technologies. Even though experts may dismiss these attitudes as irrational or unfounded, they form the psychological reality of consumers and may develop considerable force in the marketplace. Production technology will therefore become a competitive parameter in the marketplace. GM is presently the most clear-cut case, but others may follow. This makes life more difficult for food producers, but it also opens up new possibilities for product differentiation and value creation: understanding consumer attitudes towards food technology and using this understanding proactively in the development and marketing of food products becomes a potential source of competitive advantage.

Secondly, and following from the above, consumer perceptions and hence market acceptance should have a much larger role in R&D policies, both in industry and in research institutions. It becomes increasingly risky to invest in and develop a new technology for years before confronting the marketplace, since the marketplace may reject the technology in spite of the merits it may have in terms of increased efficiency or new product opportunities. Contact with the market and with opinion leaders should start as early as possible, preferably before strong and deeply rooted attitudes have been formed.

Thirdly, the GM case shows that many decision-makers, both in industry and in government, lack basic knowledge about the functioning of market communication. Either they want to address consumers as they would address peers (fellow scientists or fellow experts), or they want to address consumers as poor easily persuadable victims of the 'protest industry,' as a speaker once put it. Both approaches are doomed to failure.

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