Consumer Perception of Organic and Genetically Modified Foods

Health and Environmental Considerations

BY

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Abstract

The aim was to study consumer attitudes to and perceptions of organic and genetically modified (GM) foods and factors influencing the purchase/non purchase of these two types of foods. Data were collected by two questionnaire surveys (random nation-wide samples of 2000 consumers, response rate 88% and 39% respectively) and one interview study (n=40).

A majority of the consumers had positive attitudes towards purchasing organic foods but few reported purchasing organic foods regularly. The most common beliefs about organic foods were that they are more expensive and healthier. Choice of organic foods was related to the perceived consequences for human health and to environmentally friendly behaviour. Perceived positive health consequences appeared to be a stronger motive for purchasing organic foods than were environmental benefits.

Attitudes towards genetic engineering (GE) appear to be dependent on the application area. Medical applications were generally more easily accepted than were food and agricultural applications. However, all medical applications were not equally accepted. Consumers had generally rather negative attitudes towards GM foods, which were perceived as not being healthy. GM of animals for food production was perceived more negative than GM of plants. Tangible benefits of GM foods, like being better for the environment or healthier, seemed to have a potential to increase willingness to buy.

The results indicate that the attitudes to organic and GM foods differ: the attitude to organic foods is positive while the attitude to GM foods is more negative. Further, the perceptions of organic and GM foods are opposed in relation to health. The purchase of organic foods and the potential willingness to purchase GM foods appear to be related to positive consequences for health and the environment.

Keywords: consumer perceptions, organic foods, genetically modified foods, food choice, health, environmental concern

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Sammanfattning
I denna avhandling har konsumenters uppfattningar om och inställning till ekologiska och genmodifierade (GM) livsmedel undersöks. Faktorer som påverkar att man köper/vill köpa eller inte köper/inte vill köpa har också studerats. Data har samlats in med hjälp av två svenska enkätstudier (slumpmässiga urval av 2000 personer, svarsfrekvens 58 och 39 %) och en intervjustudie (n=40).


Attityden till genteknik var generellt negativ. Inställningen verkade till stor del bero på inom vilket område tekniken tillämpas och vilken typ av organism som modifieras. Många av de intervjuade hade en nyanserad bild av tekniken och få var odelat positiva eller negativa till GM. Generellt sett accepterades tillämpningar inom det medicinska området lättare än tillämpningar avsedda för jordbruk eller livsmedelsproduktion. GM av mikroorganismer och växter var lättare att acceptera än modifieringar som involverade djur och människor. Enkätundersökningen visade att majoriteten av konsumenterna är negativt inställda till GM livsmedel. Många ansåg att GM livsmedel inte är hälsoamma. GM för att ge livsmedlen ”extra kvaliteter” till nytta för konsumenten verkar kunna påverka viljan att köpa GM livsmedel. ”Bättre för miljön” och ”nyttigare” var de två kvaliteter som verkar ha störst påverkan.

Studierna visar att uppfattningen om ekologiska och GM livsmedel skiljer sig åt på ett flertal punkter men att de också har något gemensamt: positiva konsekvenser för miljö och hälsa verkar ha en möjlighet att påverka både köp av ekologiska livsmedel och en framtida vilja att köpa GM livsmedel.
“We do not inherit the Earth from our parents – we borrow it from our children.”

Unknown originator
Papers included in the thesis

This thesis is based on the following papers, which are referred to in the text by their Roman numerals:


III Magnusson, M. K. & Koivisto Hursti, U.-K. Consumer acceptance of employing genetic modification in food production, agriculture and medicine. (Submitted)


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## Abbreviations

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<th>Description</th>
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<tbody>
<tr>
<td>GE</td>
<td>Genetic Engineering</td>
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<tr>
<td>GHI</td>
<td>General Health Interest</td>
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<td>GM</td>
<td>Genetic Modification/Genetically Modified</td>
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<td>GMO</td>
<td>Genetically Modified Organism</td>
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<td>LPI</td>
<td>Light Product Interest</td>
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<td>NPI</td>
<td>Natural Product Interest</td>
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<td>OQ</td>
<td>Original Questionnaire</td>
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<td>SQ</td>
<td>Short Questionnaire</td>
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<td>TPB</td>
<td>Theory of Planned Behaviour</td>
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Introduction

Life style includes a number of behaviours among which food choice and food consumption are two important factors for human health. The foods we eat influence our physical as well as our psychological health status. Many of the increasing health problems are related to food choice. Thus, it is important to have extensive knowledge about factors related to people’s food preferences and choice to be able to help them to promote their health. The focus of the present thesis is perceptions and choice of organic and genetically modified foods, and motives for choosing/not choosing these two kinds of foods.

Food choice

What foods we choose to eat is influenced by many interrelated factors (Shepherd, 2001; Shepherd & Sparks, 1994). A number of models have been suggested to describe effects of likely influences (Shepherd & Sparks, 1994). However, neither of the models include an estimation of the magnitude of the effects of the suggested factors nor the interaction between them (Shepherd & Sparks, 1994). Thus, they are rather registers of factors likely to have an influence on food choice, and offer variables that can be useful to investigate (Shepherd & Sparks, 1994). Some models propose three main categories of factors influencing food acceptance: factors related to the food, the individual and the environment (e.g. Randall & Sanjur, 1981; Shepherd, 1985; Figure 1). The model suggested by Shepherd (1985) describes the major factors that are important to take into consideration when studying consumer food choice. The focus of the present thesis is primarily on the variables described under “Person” (Figure 1). Some “Economic and Social” factors will also be investigated.
The food

From a physiological perspective, humans have a demand for certain amounts of energy, nutrients, vitamins and minerals to maintain a good health status. The chemical composition of food (e.g. amount of carbohydrates, fat, protein) affects the individual (Shepherd & Sparks, 1994). State of satiety/hunger also plays a part. High-energy foods are preferred to low-energy foods when we are hungry (Booth, 1982).

Another factor of significance, not explicitly included in Shepherd’s model (1985), is biology. Humans appear to have an innate preference for sweet foods (Shepherd & Sparks, 1994). Newborn infants accept sugar water that is placed on their tongues and show positive facial expressions, and they reject bitter tasting water by showing negative facial expressions and spitting.
out the bitter tasting substance (Steiner, 1979). This derives from the fact that humans are omnivores and may utilise a wide variety of nutrient sources (Rozin, Fallon & Pelchat, 1986). Substances with a sweet taste often indicate calories and that they are safe to eat while substances with bitter tastes are associated with toxicity (Rozin, 1989).

The sensory properties of the food are also important for human food choice. However, the perception of these attributes and their importance for food choice vary between individuals and they are therefore dealt with in the next section.

The person

Perception of food quality

Food quality can be evaluated from many perspectives. Hoffman (1994) suggests four partial qualities: sensory, nutritive, hygienic-toxicological and technological. He argues that different customers (e.g. consumers, technologists, inspectors) will attach importance to different qualities. From the consumers’ perspective, the main interest lies in the nutritive and sensory values of foods (Hoffman, 1994). Food inspectors focus foremost on hygienic issues and technologists are most interested in the technological aspects of the raw material (Hoffman, 1994). However, in countries with a functioning inspection system, these qualities are taken for granted since they are usually controlled before the foods reach the consumers (Hoffman, 1994).

Consumer food choice depends to a large extent on the individual’s perception of qualities related to the food. These qualities can be divided roughly into two broad categories, those with a sensory characteristic and those with a non-sensory characteristic. In accordance with Hoffman’s (1994) proposal, research has demonstrated that consumers consider the sensed characteristics of food to be the most important factors in their food choice (e.g. Torjusen, Lieblein, Wandel & Francis, 2001; Wandel & Bugge, 1997). Taste is one of the most important criteria for food choice (Grankvist & Biel, 2001; Holm & Kildevang, 1996; Land, 1998; Torjusen et al., 2001; Wandel & Bugge, 1997). Appearance (Wandel & Bugge, 1997), odour (Shepherd & Farleigh, 1989), and freshness (Land, 1998; Schifferstein & Oude Ophuis, 1998; Torjusen et al., 2001; Wandel & Bugge, 1997) are other important factors. However, studies indicate that consumers are becoming increasingly interested in non-sensory characteristics. Among the most notable are the absence of food additives, preservatives and residues...
(Wandel, 1994; Wilkins & Hillers, 1994), nutritional value (Jolly, 1991; Schifferstein & Oude Ophuis, 1998; Torjusen et al., 2001; Wandel, 1994; Wandel & Bugge, 1997), and how the food was produced (Land, 1998; Torjusen et al., 2001). Qualities related to ethical issues, for example animal welfare and fair-trade may also be considered, and of importance for food choice. One considerable difference between sensory and non-sensory qualities is that non-sensory attributes are difficult to perceive or out of control of the consumer. Thus, for those who attach great importance to such attributes, trust may become a key issue.

Perception of food production methods
Hoffman’s (1994) quality model from the consumer perspective does not only comprise sensory and nutritive qualities, but also “production quality”. Consumers have become more aware that production and processing methods may have negative impacts on human health and the environment (da Costa, Deliza, Rosenthal, Hedderley & Frewer, 2000). Two production methods that differ from conventional food production are organic production and genetic modification (GM). The perception and acceptance of these production methods vary substantially. Organic agriculture is often associated with naturalness and “in harmony with nature”. Organic foods are foremost associated with health and concern for the environment. Grankvist and Biel (2001) investigated the correlation between the purchase frequency of eco-labelled foods and eight purchase criteria (price, product familiarity, environmental consequences, qualities, personal experience, package attractiveness, effects on own health, taste). They found that health and environmental consequences were the only criteria that correlated substantially with the choice of eco-labelled alternatives (Grankvist & Biel, 2001).

Organic foods are perceived as being healthier than conventional foods (Grankvist & Biel, 2001; Torjusen, Nyberg & Wandel, 1999), and health-related reasons are also the major motives for purchasing organic foods (von Alvensleben, 1998; Ekelund, 1989; Huang, 1996; Mathisson & Schollin, 1994; Schifferstein & Oude Ophuis, 1998; Tregear, Dent & McGregor 1994; Wandel & Bugge, 1997). Positive environmental consequences are also a reason for choosing organic foods, but are apparently not as strong motives as health (von Alvensleben, 1998; Ekelund, 1989; Mathisson & Schollin, 1994; Schifferstein & Oude Ophuis, 1998; Tregear et al., 1994).

The situation for GM and GM foods is characterised by some differences compared to organic foods. GM foods are often linked with unnaturalness (Bredahl, 1999; Frewer, Howard & Shepherd, 1996; Grove-White, Macnaghten, Mayer & Wynne, 1997; Grunert, Lähteenmäki, Nielsen, Poulsen, Ueland & Åström, 2001; Koivist Hursti, Magnusson & Algers,
Many consumers also think that GM and GM foods may have potential negative effects on nature and human health (Bredahl, 1999; Grunert et al. 2001). However, the acceptance of GM foods may be influenced by tangible benefits. Findings concerning willingness to purchase GM foods with tangible benefits are ambiguous, but some results indicate that benefits like “more nutritious” and “better for the environment” may have a positive influence on purchase willingness (Freweir et al., 1996). However, a Nordic study indicates that although benefits considered as relevant are added to GM foods, these do not compensate for the negative associations with GM (Grunert et al., 2001). Consumers also consider the characteristic “non-GM” as a value per se (Grunert et al., 2001).

The perception of organic and GM foods seem to, at least to some extent, be dependent on naturalness. A Swedish focus group study showed that consumers perceive naturalness per se as something good (Wibeck, 1999). Findings from a U.S. study indicate that naturalness is a highly valued food characteristic (Rozin, 2003).

Thus, preference and choice of organic and GM foods are dependent on the perception of the production method. The perception of the different production methods and their resulting food products differ, but three characteristics appear to be central for both methods/foods: naturalness, and consequences for human health and for the environment. The perception of these characteristics is dealt with more in the Section “Food and health” and further.

**Individual factors**

Who the consumer is also influences the food choice. Thus, his or her actual habits, attitudes, beliefs and values play an important part in individual food choice. It is important to remember that “consumers” is not a homogeneous group of people. Food choice has been demonstrated to be dependent on demographic characteristics such as age, gender, educational level and income. The influences of demographic factors differ between food issues, and are therefore dealt with in the last section of the introduction.

**Habits**

Habits develop when a behaviour is adequately repeated (Verplanken & Faes, 1999), primarily in the same social and physical environment (Aarts, Verplanken & van Knippenberg, 1998). They can be regarded as automatic acts in the sense that they operate largely outside our awareness and are cognitively efficient (Verplanken & Faes, 1999). Once a habit has been established, it does not need a process of reasoning to occur, and that is why habits make it possible to execute actions in a rather mindless way (Aarts et
For obtaining certain goals, habits are functional. Habits are specific behavioural responses to specific cues in the environment (Verplanken & Faes, 1999) that are triggered by certain stimuli when a specific goal is to be reached (Aarts et al., 1998).

Food products are purchased frequently by most people and often in the same stores. Since they are purchased regularly, it is impossible for many people to make detailed considerations about a product’s pros and cons in every purchase situation. Thus, food choice is a behaviour that is to a large extent guided by habits. In line with this reasoning, Grankvist and Biel (2002) demonstrated that past purchase behaviour was an important predictor of future purchase behaviour for consumers who were regular buyers of organic foods.

It has been proposed that it is not possible to immediately change one habit into another (Lewin, 1958). The old habit has to be “unfrozen” before a new behaviour is acquired and then becomes habitual. A model suggested by Dahlstrand and Biel (1997) assumes that the behavioural change involves several phases. Different factors are assumed to be of importance in the different phases. General attitudes, values and norms are suggested to play a greater part in the early phases while factors of specificity, like beliefs about certain objects, are thought to be influential in the later stages (Dahlstrand & Biel, 1997). Activation of a general value or a change in the evaluation may result in testing of a new behaviour. Later, for a “new” behaviour to become a habit, personally rewarding consequences of a behaviour are required (Hull, 1943).

The assumption that general factors are more important initially and factors of a more specific character have a greater importance in the later stages was supported by a recent Swedish study (Grankvist, 2002). In the switch from conventional to eco-labelled products, general environmental factors were more influential in an early phase while beliefs about characteristics of eco-labelled products were more important in the later phases (Grankvist, 2002).

**Attitudes, beliefs and values**

In the early days of attitude research, social scientists assumed that attitudes mirrored behavioural dispositions (Ajzen & Fishbein, 1980). This belief was rather unchallenged until the late 1960s. Later research has demonstrated that human behaviour is influenced by several factors such as attitudes, habits, values, beliefs, and social norms. A number of theories/models have been developed to relate attitudes and norms to actual behaviour. One well-known model is “The Theory of Planned Behaviour” (TPB; Ajzen, 1991). The TPB model has been used to predict a variety of behaviours, including health-relevant behaviours (Conner & Sparks, 1996). The theory seeks to
explain behaviours, goals and outcomes that are not entirely under control of
the person (Ajzen, 1991). Behaviour is hypothesised to be a result of
behavioural intention. Further, behavioural intention is assumed to derive
from three conceptually independent determinants: attitude towards the
behaviour, subjective norm, and perceived behavioural control (Ajzen,
1991). Attitude reflects the individual’s overall evaluation of the behaviour
and is founded on behavioural beliefs about outcomes and evaluations of
those outcomes. Subjective norm is based on normative beliefs (the
influence of significant others regarding whether one should/should not
engage in a behaviour), and motivation to comply with other persons’
wishes. Perceived behavioural control is built on the individual’s possibility
to perform the behaviour successfully (Conner & Sparks, 1996).

Modifications of the theory have been suggested. For example, it has been
proposed that an individual’s sense of self-identity may affect her/his
behaviour independently of her/his attitudes towards the behaviour (Sparks
& Shepherd, 1992). The influence of self-identity on behavioural intention
has been tested empirically and there is evidence that self-identity is related
to behavioural intentions (Sparks & Shepherd, 1992). Sparks and Shepherd
(1992) added green consumerism as a concept of self-identity related to the
purchase of organic foods according to the TPB. They found that attitudes,
subjective norm, perceived behavioural control, past behaviour and green
consumerism all contributed independently to the explanation of the
intention to purchase organic vegetables (Sparks & Shepherd, 1992).

Research indicates that the relations between general attitudes and
behaviours are weak. Thus, there appear to be discrepancies between what
individuals think and what they do. However, if attitudes and behaviour are
measured at the same level of specificity, the correspondence is stronger.
Consequently, it is of importance how attitudes are measured when it comes
to establishing a relation to outcome. The concept “attitude” is often used
without being defined. A consequence of this is that it is sometimes difficult
to compare results from different attitude surveys.

There is evidence indicating that positive beliefs about product
characteristics may predict future purchase behaviour of organic foods.
Using a longitudinal design, Grankvist and Biel (2002) investigated the
influence of environmental consequences and beliefs about product
characteristics on the purchase frequency of organic foods. They found that
those who never purchased organic foods at the first measurement (M1) were
more likely to increase their purchase frequency at the second measure (M2)
if they perceived environmental consequences to be of high importance, and
did not think organic foods were much more expensive than conventional
foods. Consumers who “now and then” or “sometimes or often” purchased
organic foods at M1 were more likely to increase their purchase at M2 if they
at M₁ had positive product specific beliefs about organic foods (quality, exterior, appearance, health, taste).

Environmental, economic, social and cultural factors

Factors related to the environment also influence consumer food choice. Food choice may be based on factors such as price or brand. Individuals are also able to express their group belonging (cultural, religious, social status etc.) by choosing/avoiding certain food products.

Environmental and economic factors

Food consumption is very much linked to economic activity and a large share of the households’ income is spent on food purchases (Tangermann, 1986). Thus, the individual’s/household’s economy to a large extent influences what foods and what amounts of foods are bought (Tangermann, 1986). Price is a powerful determinant of food choice (Holm & Kildevang, 1996; Rozin, 1989).

Availability is another strong factor (Rozin, 1989), and is a prerequisite for food choice. The food store supply may also influence the consumer’s food choice. If a brand or a special product is not available, we may choose something else if we do not try another store. Brand is important for choice among some consumers (Corney, Shepherd, Hedderly & Nanayakkara, 1994).

What other significant people (e.g. family, friends) think or prefer may determine the food purchases. Food may also have a symbolic meaning. Food choice can and has been used for showing social class (Gofton, 1986).

Culture and religion

Culture or ethnicity also play a significant role in food choice. A culture comprises “rules” for which foods are considered edible and inedible. Foods regarded as inedible in one culture may be considered edible in another (Murcott, 1986). Rozin (1989) has stated that culture or ethnic group is the best predictor of human food preferences.

Religion may regulate food orders, for example what to eat, the combination of foods, and when to eat. In some religions, meat from certain animals is forbidden, e.g. Muslims do not eat pork, and Hindus do not eat beef. Some religions do also have rules for the combination of foods, e.g. Jewish people do not mix meat and milk in the same meal.
Food and health

Health-related attitudes also influence food choice (Roininen, Lähteenmäki & Tuorila, 2000; Steptoe, Pollard & Wardle, 1995) and consumers are conscious about the link between diet and health (Rozin, Fischler, Imada, Sarubin & Wrzesniewski, 1999). Many consumers are concerned that the food they eat may be harmful to their health (Holm & Kildevang, 1996; Wandel, 1994), and have an interest in issues related to food and health (Fagerli & Wandel, 1999; Wandel, 1994).

Healthy foods and healthy eating

Research indicates that there are a variety of perceptions among consumers concerning “healthy” and “unhealthy” eating (Povey, Conner, Sparks, James & Shepherd, 1998). Some perceptions are related to the nutritional content of foods, while others concern the combination of foods, an “overall” perception of a food product or the food manufacturing/preparation process.

A study of British consumers showed that healthy eating was associated with eating a balanced diet or a variety of foods, and eating foods containing fibre and vitamins (Povey et al., 1998). Foods the consumers perceived as healthy were vegetables, fruit, fish, brown/wholemeal bread and salads (Povey et al., 1998). Unhealthy eating was described in terms of foods having a high fat or sugar content, and fried foods (Povey et al., 1998). Foods most frequently described as unhealthy were chips, beef burgers, sausages, sweet foods (e.g. cakes), sweets and chocolate (Povey et al., 1998). Findings from a Finnish study demonstrated that respondents perceived fruits, vegetables, fish, low-fat dairy products and oatmeal porridge as healthful, while sweets, ice cream, fat-containing foods (e.g. sausages, french fries, hamburgers), coffee and soft drinks were perceived as not healthful (Roininen et al., 2000). Fish, fruits, potatoes and vegetables were also shown to be emphasised as important in a healthy diet among Norwegians (Fagerli & Wandel, 1999).

Roininen, Lähteenmäki and Tuorila (1999) have developed a scale that measures attitudes to health and taste. Health attitudes are measured by three subscales: General health interest (GHI), Light product interest (LPI), and Natural product interest (NPI). The health scales and their possibility to predict food choice have been investigated in a group of Finnish consumers (Roininen & Tuorila, 1999). The GHI and LPI scales appeared to be good predictors of the choice between a chocolate bar and an apple (Roininen & Tuorila, 1999). Respondents who rated low on the GHI/LPI scale chose the chocolate bar before the apple more often than respondents rating high on the GHI/LPI scale (Roininen & Tuorila, 1999). However, Roininen and...
Tuorila (1999) point out that this finding does not allow definite conclusions as the results are based on choice between only two foods in one consumer group. If future testing of the scales shows a similar pattern, this suggests that the sub-scales may be used for the prediction of healthy food choices (Roininen & Tuorila, 1999). In Study IV, the relation between the health scales and attitudes to GM foods are investigated.

Healthy foods are also associated with characteristics other than nutritional qualities. In a British study, consumers described healthy eating in terms of eating natural foods and fresh foods (Povey et al., 1998). In concordance with that, unhealthy eating was described in terms of eating manufactured or processed foods, or the preparation of foods of which the individual had no control (Povey et al., 1998). Santich (1994) investigated the perceptions of “good” and “bad” foods in a sample of women living in a low-income area in Australia. She found that good food was associated with natural and unprocessed foods, foods of which the individual had control over the production and “knows what goes into it” (Santich, 1994).

**Environmental concerns**

Motivation to perform environmentally friendly behaviour seems to vary between types of actions. The public seems to be more willing to participate in recycling than to purchase foods produced in an environmentally friendly manner (Grankvist, 2001). Previous research indicates that in food choice, environmental friendliness is not a criterion considered to be highly important for most consumers (Grankvist & Biel, 2001; Tojusen et al., 2001; Wandel & Bugge, 1997).

A number of studies have investigated the relations between environmental attitudes/concerns and behaviours. The correspondence between such attitudes and behaviours appears to be rather weak (Ebreo, Hershey & Vining, 1999; Tracy & Oskamp, 1983). In addition, performing one or more environmentally friendly behaviours does not necessarily imply that an individual is overall behaving environmentally friendly. Behaviours within the same domain, though, seem to be more closely intercorrelated than behaviours differing between domains. Grankvist (2001) demonstrated stronger relations between the self-reported purchase frequency of different eco-labelled foods \((r=0.30-0.56)\) than between the purchase of eco-labelled foods and recycling of several fractions \(\text{e.g. packages, bottles, batteries etc.)} \((r=0.14-0.28)\).
Organic foods

Production

The basic commitment of organic agriculture focuses on concerns for nature’s fundamental functions and the thought of global solidarity (KRAV, 2004). The goal of organic agriculture is to carry on a long-term sustainable agriculture (KRAV, 2004). The main characteristics of organic agriculture that are of relevance for the consumer are 1) no use of synthetic pesticides or 2) industrialised fertiliser, 3) animals should have the possibility to behave naturally, 4) security zones are used to separate fields from roads and conventional arable land, 5) no use of genetically modified organisms, and 6) restricted use of additives in processed foods (KRAV, 2004). The organic food labelling system in Sweden is administered mainly by an organisation, KRAV, which develops the standards for organic production, ensures that the standards are followed and promotes the KRAV-label. Most organic food producers in Sweden are connected to KRAV.

The Swedish Government has set a goal that by the year 2005, 20% of the arable land should be organically cultivated, and 10% of the milk cows and the cattle slaughtered (beef and lamb) should be in organic production (Jordbruksdepartementet, 2004). At present, 17% of the arable land is organically cultivated, and the goal regarding milk cows and cattle to be slaughtered is almost reached (Jordbruksdepartementet, 2004).

The potential benefits of organic agriculture and organic foods have been investigated from different perspectives. Environmental effects, nutritional content, and sensory characteristics of organic agriculture and foods in comparison to conventional agriculture and foods have been investigated, and are still under investigation. However, it is difficult to establish that organic agriculture has an overall effect better for the environment than conventional agriculture. In some respects, organic agriculture may be more environmentally friendly, while in other respects it is equally or possibly even less environmentally friendly than conventional agriculture. Research regarding eventual nutritional advantages of organic foods is ambiguous. It is difficult to demonstrate that a certain cultivation technique would give products with a different nutritional content solely because of the technique (Bruce & Lindeskog, 2003). Some studies suggest that the content of vitamin C may be higher in organic than in conventional foods (Bruce & Lindeskog, 2003; Williams, 2002). Toledo, Andrén and Björck (2002) found small or no nutritional differences between organic and conventional milk. In her review regarding the nutritional quality of organic foods, Williams (2002) concluded that some studies show a somewhat improved level of a few
micronutrients in organic foods, but that these small differences are unlikely to have health implications for consumers.

Organic agriculture also aims at warranting good health and welfare among domestic animals (Algers & Lund, 2003). Algers and Lund (2003) conclude that the present research is not extensive enough to undoubtedly demonstrate to what extent the goals regarding good health and concern are reached. However, there seem to be tendencies of health improvements in animals in well-managed organic production systems, with the exception of diseases caused by parasites (Algers & Lund, 2003).

Consumer perceptions of organic foods

In several studies, a majority of the consumers state that they have a preference for and an interest in organically produced foods (Ekelund, 1989; Wandel & Bugge, 1997; Wilkins & Hillers, 1994). Consumers also have positive beliefs about organic foods in comparison to conventional alternatives (Grankvist & Biel, 2001). Nevertheless, the proportion of regular purchasers of organic foods is low (von Alvensleben, 1998; Grankvist & Biel, 2001; Grunert & Kristensen, 1995; Roddy, Cowan & Hutchinson, 1996; Wandel & Bugge, 1997). Thus, there is a discrepancy between preferences and behaviour. This discrepancy may be due to several factors. Premium price appears to be one obstacle to the purchase (von Alvensleben & Altmann, 1987; Grunert & Kristensen, 1995; Jolly, 1991; Mathisson & Schollin, 1994; Roddy et al., 1996; Tregear et al., 1994), and limited availability is another (Jolly, 1991; Mathisson & Schollin, 1994; Roddy et al., 1996; Tregear et al., 1994; Wandel & Bugge, 1997). Consumer satisfaction with the conventional food supply may be an additional reason (Ekelund, 1989; Mathisson & Schollin, 1994).

There seems to exist a belief among consumers that organic foods have superior sensory attributes (Williams, 2002). However, scientific sensory research has only demonstrated small (Haglund, 1998) or no (Jonsäll, 2000) taste advantages of organically produced foods. In Haglund’s (1998) studies, a trained sensory panel scored higher for the sweetness of organically grown than for conventionally grown tomatoes. However, organic carrots had a stronger bitter-taste, were less sweet and less crunchy than the conventional carrots. The information that a product is organically produced has been shown to increase consumer preference (Johansson, Haglund, Berglund, Lea & Risvik, 1999). Johansson and colleagues (1999) performed a blind consumer preference test of tomatoes, and another preference test with either false or correct information about the production method (conventional or organic). They found that the information “organically produced” increased consumer preference but that the effect of information was more important
for the tomatoes that were less liked in the blind test (Johansson et al., 1999). Thus, consumer perceptions of organic foods having superior sensory attributes may be due to positive beliefs about the production method rather than scientific evidence.

Positive beliefs about organic foods have been found to be connected with an increased choice of such foods (Grankvist & Biel, 2001). However, in Grankvist and Biel’s study (2001), the correlations between the purchase behaviours of different eco-labelled foods (milk, meat, potatoes, bread) were rather weak. This indicates that the organic label does not serve as a salient purchase cue across products (Grankvist & Biel, 2001).

Frequent organic food purchasers seem to differ from those who buy organic foods less frequently. Torjusen and co-workers (2001) found that the frequent buyers were more concerned with characteristics that demand reflection on the part of the consumer (e.g. “fewest possible additives”, “environmentally sound production”, “ethical and political considerations”, “animal welfare”). Further, consumers who found it important to support local business and to buy locally produced foods were more likely to purchase organic foods than were those who did not think local production was important (Torjusen et al., 2001). In a study of Dutch consumers, it was concluded that health is a more important purchase motive for incidental buyers than for heavy buyers (Schifferstein & Oude Ophuis, 1998). Heavy buyers bought organic foods for health as well as environmental reasons (Schifferstein & Oude Ophuis, 1998).

Rather few Swedish scientific studies have investigated consumer perceptions of organic foods. In the present Study I, consumer attitudes towards, and perceptions and beliefs about organic foods are investigated. Study II investigates the possibility to predict consumer attitudes and behaviour in relation to organic foods on the basis of perceptions of the likelihood of occurrence of environmental and human health consequences resulting from the choice of organic foods.

Genetically modified foods

Genetic engineering (GE) is a technique that makes it possible to interfere with the genes of living organisms (Nationalencyklopedien, 2003). In practice, it is possible to transfer genes between any species and such transfer can be made with great precision (Gentekniknämnden, 1997). Genetically modified (GM) microorganisms are used already for the development of new medicines, and GM organisms can also be of importance for the food industry. For example, cheese can be produced more easily by using GM chymosin (the active enzyme in rennet, which naturally
exists in the stomach of calves, and causes the milk protein to clump together). Also, GM bakery yeast allows dough to rise faster because of a greater production of carbon dioxide (Gentekniknämnden, 1997). GM plants and seeds are presently in use in food production and agriculture. The highest number of GM crops are grown in the U.S. where more than 30 kinds of crops are approved for commercial growing (Bioteknikcentrum, 2004). The most commonly grown GM crops in the U.S. are soy, maize, cotton and rapeseed (Bioteknikcentrum, 2004). Large amounts of GM crops are also grown in Canada, Australia, Argentina and China (Bioteknicentrum, 2004).

The development of GE has raised suspicions among consumers that this technology may carry unexpected and unwanted side effects. Moral and ethical issues also influence consumer acceptance of GM foods (e.g. Fjæstad, Olsson, Olofsson & von Bergmann-Wienberg, 1998). GM has also been perceived to tamper with Nature and be associated with “playing God”.

**Consumer perceptions of GE and GM foods**

European consumers have been found to hold a rather negative attitude towards GE in comparison to U.S. and Canadian consumers. However, there are differences in attitudes also between European countries (Gaskell, Bauer & Durant, 1998). In the third Eurobarometer, Sweden was among the countries showing least support for GE (Gaskell et al., 1998). Norway and Denmark were also non-supporters of GE while Finland was among the most supportive countries (Gaskell et al., 1998).

Previous research indicates that attitudes against GE are focused on how the technology is used rather than towards the technology per se (Frewer, Hedderly, Howard & Shepherd, 1997c), and that the public tends to reject or accept applications on a case by case basis (Frewer, Howard & Shepherd, 1997a). Attitudes seem to vary between application areas of the technology (Fjæstad et al., 1998; Frewer & Shepherd, 1995; Gaskell et al., 2000) but also between applications within the same domain. Acceptance also appears to depend on the organism being manipulated (Frewer et al., 1997a). Attitudes towards modification of microorganisms and plants are usually more positive than attitudes towards modification of human genetic material or animals (Frewer et al., 1997a; 1997c; Saba, Rosati & Vassallo, 1998; Sparks, Shepherd & Frewer, 1994). The acceptance of GE within different application areas is investigated in Study III.

Several factors seem to influence the acceptance of and attitudes towards GE and GM. Among the most notable are perceived risk (e.g. Frewer et al., 1997a; Sparks et al., 1994), moral and ethical considerations (e.g. Bredahl, 1999; Fjæstad et al., 1998; Gaskell et al., 1998) and consumer benefit (e.g.
Frewer, Howard, Hedderly & Shepherd, 1997b). The low acceptance of GM, particularly in agriculture and food production, has been suggested to depend on the fact that most modifications so far have exclusively benefited the producers. Thus, it has been proposed that if GM foods would provide tangible benefits for consumers, their acceptance would increase. However, it has been demonstrated that consumers distinguish between different types of benefits and that not just any benefit would dramatically increase consumer willingness to purchase GM foods (e.g. Frewer et al., 1996; 1997b; Grove-White et al., 1997). A recent Nordic study that investigated consumer preferences for GM foods with tangible benefits demonstrated that the proposed benefits did in most cases not compensate for the disadvantages associated with GM (Grunert et al., 2001). Foods not being GM were positively associated with health, safety and to some extent enjoyment, while GM foods were associated with uncertainty, unnatural and harming nature (Grunert et al., 2001). However, two benefits seem to have a potential appeal for consumers; benefits to human health and to the environment (Frewer et al., 1996; 1997b). Frewer and co-workers demonstrated that the willingness to purchase GM tomatoes (1996) and GM cheese (1997b) increased if they were more nutritious and provided environmental benefits. In Study IV, attitudes to GM foods and the influence of tangible benefits on consumer willingness to purchase GM foods are investigated.

Most studies that have investigated attitudes to and willingness to purchase GM foods have employed questionnaire or interview techniques. As many European consumers (particularly Swedish) have a limited experience of GM foods, questions on foods they have never seen (or bought) may be rather hypothetical. Of course, they may have opinions about GM foods, but these may not reflect how they really would act if GM foods were for sale. In an attempt to investigate “real” behaviour, some researchers have used product exposure (Bredahl, 1999) or exposure to foods on photographs/pictures (Frewer et al., 1996) as stimuli. Only few researchers have utilised real tasting. In a recent Nordic study, cheeses were used as real product alternatives (Lähteenmäki, Grunert, Ueland, Aström, Arvola & Bech-Larsen, 2002). As there are no GM cheeses available in any of the countries, conventional cheeses were labelled as being GM. The tasting task for those in the experimental groups included tasting of one conventional cheese and one cheese labelled as GM (with either health or taste benefits stated). One group served as a control group and tasted only conventional cheeses (two kinds). All groups rated liking and willingness to purchase the tasted cheeses. After the tasting, respondents filled out a questionnaire that comprised several attitude measures and demographic characteristics. The results demonstrated that although consumers’ general attitude towards gene technology was rather negative, this did not make
them reject the GM cheeses when they were presented as real product alternatives. Thus, overall negative attitudes to GT do not necessarily imply that specific products of GE will be rejected.

Demographic differences

There may be differences in attitudes to and perceptions of healthy foods and healthy eating, environmental concern, organic foods and GM foods depending on gender, age, educational level and family income. Demographic differences concerning perceptions of organic foods and GM foods are investigated in Studies I and IV, respectively.

Gender

Women appear to be more interested in healthy (Roininen et al., 1999, Roininen & Tuorila, 1999; Wandel, 1994) and natural foods than men (Roininen et al., 1999; Roininen & Tuorila, 1999). Studies indicate that women eat fruits and vegetables more frequently than do men (Becker, 1999; Fagerli & Wandel, 1999). They also think it is more important to follow recommendations given by health experts than men do (Fagerli & Wandel, 1999).

Women also seem to perceive that environmentally friendly product attributes are more important (Ebreo et al., 1999) and perform more environmentally friendly behaviours than men (Olli, Grendstad, Wollebaek, 2001). Thus, studies demonstrate that women tend to be more interested in organic foods than men (Mathisson & Schollin, 1994; Wandel & Bugge, 1997). A Norwegian survey showed that women were more likely to prioritize environmental aspects as a food quality than did men (Wandel & Bugge, 1997).

Men appear to be more positive to GE than women (Fjæstad et al., 1998; Gaskell et al., 1998; Koivisto Hursti et al., 2002; Olofsson & Olsson, 1996).

Age

Environmental concern has been proposed to depend on age, younger people being more environmentally concerned than the older ones (Olli et al., 2001). However, the relationship between age and environmental behaviour seems to be more complex (Olli et al., 2001).

There is some evidence that the motive for purchasing organic foods may depend on age. A Norwegian study found that younger consumers based their purchase of organic foods on considerations for the environment and
animal welfare, whereas the older respondents stated that their own health was the most important reason (Wandel & Bugge, 1997).

Age also seems to influence attitudes to GE (Fjæstad et al., 1998; Koivisto Hursti et al., 2002; Olofsson & Olsson, 1996). However, the findings have been contradictory. In some studies, younger consumers have been more positive (Koivisto Hursti et al., 2002; Sparks et al., 1994), while in others, the older subjects have demonstrated the most positive attitudes (Fjæstad et al., 1998; Olofsson & Olsson, 1996).

**Education and income**

Differences have been reported in food consumption related to education and income levels (e.g. Fagerli & Wandel, 1999). A Norwegian study demonstrated that the consumption frequency of fresh fruits and vegetables increased with an increasing level of education, while the consumption of whole milk decreased with education level or family income (Fagerli & Wandel, 1999). However, a higher family income was associated with a lower consumption frequency of fresh vegetables (Fagerli & Wandel, 1999). Thus, this study suggests that educational level is a more important factor for healthy eating than is family income.

Higher education is positively associated with environmental concerns, but empirical studies show a less consistent effect of education (Olli et al., 2001). Ebreo and co-workers (1999) found small differences between educational levels, but higher education was negatively associated with the environmentally friendly product attributes related to animal life. Wandel and Bugge (1997) showed that consumers with the highest education appeared to be more likely to prioritize environmental aspects as a food quality. Those with higher education were also more willing to pay more for organic foods (Jolly, 1991; Wandel & Bugge, 1997). Torjusen and co-workers (2001) found a positive relationship between household income and likelihood of purchasing organic foods.

The acceptance of GT is also linked to education and income. Among U.S. consumers, those with more formal education were more likely to accept GT than those with less formal education (Hoban, 1996). European opponents to GE had lower educational levels than the supporters (Gaskell et al., 1998). Consumers with higher incomes appear more likely to accept GM products (Hoban, 1996).
Aims

The general aim was to study consumer attitudes to and perceptions of organic and genetically modified foods and motives for purchasing/not purchasing these two types of foods.

Specific aims were:
1. To investigate possible gender, age and educational differences with respect to attitudes and perceptions of organically produced foods (Study I).

2. To investigate attitudes to, purchase frequency of, and beliefs about organic foods, and to study important purchase criteria (Study I).

3. To investigate the extent to which attitudes to purchasing organic foods are related to purchase behaviour of organic foods, and interpretations of possible attitude-behaviour concordance or discrepancies (Study I).

4. To investigate the possibility to predict consumer attitudes and behaviour in relation to organic foods on the basis of a) consumer perceptions of the likelihood of occurrence of environmental and human health consequences as a result of their choice of organic foods, and b) on the basis of “environmental concern” operationalised as the frequency of self-reported recycling and other environmentally friendly behaviours (Study II).

5. To investigate consumer acceptance of applications within three areas of genetic modification: food production, agriculture and medicine, and attitudes towards modifying different organisms; humans, animals, plants and microorganisms. Further, to investigate motives/reasons for acceptance or rejection of employing genetic engineering in these areas and with different organisms (Study III).
6. To investigate possible gender, age and educational differences with respect to attitudes and perceptions of GM foods (Study IV).

7. To investigate consumer willingness to purchase genetically modified foods with tangible benefits (Study IV).

8. To study possible relationships between interest in natural foods, light food products and healthy eating, and attitudes towards foods produced by means of genetic engineering (Study IV).
Method

Subjects and procedures

Studies I and II – Attitudes towards and choice of organic foods

A postal questionnaire was mailed to a random sample of the Swedish population (n=2000) drawn from the national population register (Sema InfoData, Sweden). Those not responding were sent two reminders. Details about the sample, its characteristics and response rates are presented in Table 1. The demographic characteristics correspond rather well with those of the Swedish population (Statistics Sweden, 2003; Table 1), but there is an overrepresentation of respondents with two or three years of upper secondary school education (Table 1). The questionnaire was focused on four organic foods: milk, meat, potatoes and bread. These foods were chosen because they represent staple foods in the Swedish diet and at the time of the study, their availability and price varied. Most questions were focused on the organic varieties of the four organic foods and concerned purchase rather than consumption.

The questionnaire comprised two sections. The first dealt with questions regarding the perceived importance of purchase criteria whether the foods are conventionally or organically produced (healthy, good taste, shelf-life, cheap, organically produced and some product specific criteria measured on five-point unipolar scales, endpoints: “not at all important”, “very important”), general attitudes towards buying the four target foods (five-point bipolar scales ranging from “very bad” to “very good”, “very unimportant” to “very important”, “very foolish” to “very wise”), and intentions to purchase organic milk, meat, potatoes and bread (five-point unipolar scale, endpoints: “not at all likely” to “very likely”). Questions concerning the purchase frequency of the four target organic foods (seven-point unipolar scale ranging from “never” to “always”), perceived
availability of these products (five-point unipolar scales, ranging from “not at all likely” to “very likely”, and “very easy” to “very difficult”), and beliefs about their characteristics as compared to their conventionally produced counterparts (healthier, tastier, longer shelf-life, more expensive and some product specific characteristics, five-point unipolar scales, endpoints: “not likely” to “very likely”) were also included in this section. There were two versions of this first part of the questionnaire. In one, respondents were asked about milk and meat and in the other, potatoes and bread. Half of the sample (n=1000) received the milk and meat version (52% response rate) and the other half (n=1000) the potatoes and bread version (48%). Results from the first section are presented in Study I.

The second section concerned respondents’ perceptions of the likelihood and importance of occurrence of 17 possible consequences of purchasing organic foods in general (Appendix 1, five-point unipolar scales, end points: “not at all likely/important”, “very likely/important”). They were also asked about the frequency of their performance of recycling glass, paper/metal/plastic packages, newspaper/paper and batteries (five-point unipolar scales ranging from “never” to “always”), and about eight environmentally friendly behaviours (e.g. refrain from car driving to spare the environment; five-point unipolar scales, endpoints: “never”, “very often”). A more detailed presentation is available in Appendix 1. Study II deals foremost with the questions in the second section. However, some questions from the first section were also investigated. These were the ones concerning attitudes, the importance of the purchase criterion “organically produced”, intention to purchase, and purchase frequency of organic foods.
Table 1. Descriptive characteristics of the subjects in Studies I, II and IV (%., unless otherwise indicated). OF = Organic foods, GM = Genetically modified foods

<table>
<thead>
<tr>
<th></th>
<th>Study I (OF)</th>
<th>Study II (OF)</th>
<th>Study IV (GM)</th>
<th>The Swedish population**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects (n)</td>
<td>1154</td>
<td>1154</td>
<td>786</td>
<td></td>
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<tr>
<td>Response rate</td>
<td>58</td>
<td>58</td>
<td>39</td>
<td></td>
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<tr>
<td>Gender</td>
<td></td>
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<tr>
<td>Female</td>
<td>54</td>
<td>54</td>
<td>52</td>
<td>51</td>
</tr>
<tr>
<td>Male</td>
<td>46</td>
<td>46</td>
<td>48</td>
<td>49</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
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<tr>
<td>Mean</td>
<td>40.6</td>
<td>40.6</td>
<td>41.9</td>
<td>40.7</td>
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<tr>
<td>18-25</td>
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<tr>
<td>26-35</td>
<td>23</td>
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<tr>
<td>36-45</td>
<td>22</td>
<td>22</td>
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<tr>
<td>56-65</td>
<td>17</td>
<td>17</td>
<td>21</td>
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<tr>
<td>Education</td>
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<td>Elementarya</td>
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<td>Universityc</td>
<td>27</td>
<td>27</td>
<td>30</td>
<td>28</td>
</tr>
</tbody>
</table>

*Studies I and II were conducted on the same sample. **Statistics Sweden, 2003; 2004. aElementary school or nine year compulsory education, bTwo or three years of upper secondary school, cUniversity or university college education

Study III – Acceptance of genetic modification

Forty subjects (14 men and 26 women) aged between 18 and 60 years were recruited for an interview study on GM by newspaper advertising and bill posting. Subjects all lived in the Uppsala area and had varying professional backgrounds (e.g. hospital staff, researchers, blue-collars, students). Interviews were conducted according to the repertory grid method (RGM; Kelly, 1955) in a manner similar to that employed by Frewer and co-workers (1997a). Much of the previous research regarding public attitudes towards GE has used researcher defined constructs (Zechendorf, 1994). Since the public generally lack familiarity with the terminology used in relation to GE this may result in responses with only a limited degree of validity (Frewer et al., 1997a). The RGM allows the respondents to express their concerns and acceptance using their own words. Further, the RGM includes forced choice urging the respondent to try to take up definite a position. The respondents were asked about fifteen possible applications of GM in the areas of food production, agriculture and medicine. Half of the sample was interviewed
about applications phrased in general terms and the other half about fifteen more specific applications (Appendix 2). At the outset of the interview, all subjects were shown a standardised definition of GE. They were then presented with a set of three applications of GE in a randomised order. Each application was presented twice during the interview, resulting in ten different combinations. For each set of three applications, respondents were asked “Which of these applications gives you the most concern, and why?” “Which of these applications is the easiest for you to accept, and why?” and “Which of these applications is the most difficult for you to accept, and why?” The interviews lasted between 20 and 60 minutes, were tape recorded and transcribed verbatim.

**Study IV – Attitudes towards GM foods**

Two thousand subjects randomly selected from the national population register (Sema InfoData, Sweden), ages between 18 and 65 years, received a postal questionnaire and those not responding were sent one reminder. More detailed information and demographic characteristics of the sample are presented in Table 1. The proportions of men and women, and number of subjects in the different age groups correspond fairly well with those of the Swedish population (Statistics Sweden, 2003; Table 1). However, there is an over-representation of subjects with two or three years of upper secondary school education and university or university college education (Table 1).

The questionnaire was based on results obtained from the interviews in Study III. Thirteen constructs (Appendix 3) that were frequently used by the interviewees (Study III) in their description of concerns and acceptance related to GE were employed in the questionnaire. Respondents rated nine food applications of GE in food production on the basis of these thirteen constructs on six point unipolar scales (Appendix 3). The questionnaire also contained questions regarding attitudes towards GM foods in general, and willingness to purchase GM foods with tangible benefits (taste, cheaper price, health, environmental benefits, seven-point bipolar scales ranging from “disagree strongly” to “agree strongly”), knowledge about biology and genetics (true/false/do not know), and attitudes towards food and health (the Health Scales from the Health and Taste Attitude Scales; Roininen, 2001; Roininen et al., 1999). The first page of the questionnaire contained a definition of GE (the same as in Study III).

A Swedish version of the Health Scales (Roininen et al., 1999) was employed. This scale includes three subscales: General Health Interest (GHI) scale, Light Product Interest (LPI) scale, and Natural Product Interest (NPI)
scale. Examples of items in the subscales are “I always follow a healthy and balanced diet” (GHI), “In my opinion, by eating light products one can eat more without getting too many calories” (LPI), and “I try to eat foods that do not contain additives” (NPI). Respondents rated their agreement with each statement on seven-point bipolar scales (endpoints: disagree strongly, agree strongly). The Health and Taste Attitude Scales have been cross-nationally validated (Roininen, Tuorila, Zandstra, de Graaf, Vehkalahti, Stubenitsky & Mela, 2001).

Considering that the response rate was less than 50%, it was decided to take a closer look at the group of subjects who did not return the questionnaire. A short questionnaire (SQ) containing questions on demographic variables, attitudes towards GM foods in general and interest in purchasing GM foods with tangible benefits was sent to half (n=618) of those who did not respond to the original questionnaire (OQ) and 17% responded. Among the other half of those who did not fill out the OQ, 10% of the subjects (n=61) were randomly selected and their telephone numbers were located in telephone directories. Seventeen subjects were not reachable (10 had secret numbers and 7 did not answer when they were called). Twenty-four of the subjects were interviewed. The interview questions were the same as those in the SQ. There were no significant differences in demographic variables between those who returned the OQ and those who filled out the SQ or were telephone interviewed. The most frequently given reasons for not responding to the OQ was “did not have the time” (37%) and “a difficult topic” (15%).

No statistically significant differences were found between those who replied to the SQ/were telephone interviewed and those who filled out the OQ with respect to their attitudes to GM foods with and without tangible benefits.

Data analyses

Statistical analyses
Descriptive statistics (Studies I, II and IV), two-tailed t-test (unpaired; Studies I, II and IV), one-way analysis of variance (Studies I and IV), the Pearson product moment correlation coefficient (Study II), the Chi-square test (Study IV), exploratory factor analysis (Study II), principal component factor analysis (Study IV) and multiple regression analysis (Study II) were used for the statistical analyses. Fisher’s PLSD-test was used for post hoc comparisons. The level of significance was set to p<0.05 in Study I and
p<0.01 in Study II. In Study IV, Bonferroni correction was utilised to adjust the level of significance for all t-tests and ANOVAs. To obtain an overall alpha level of 0.05, the alpha for each t-test/ANOVA had to be 0.00017 (SISA). Thus, the level of significance was set to p<0.0001.

**Factor analyses**

The responses to the 17 environmental, human health and animal welfare consequences (Appendix 1) in Study II were subjected to principal component analysis (PCA, oblique rotation). The PCA resulted in three interpretable factors with eigenvalues >1. The first factor (Environment) reflected environmental pollution, the second (Transportation/Waste) mirrored transportation and waste handling, and the third (Health) perceived health aspects. Cronbach α-coefficients varied between 0.88 and 0.90 which indicates good homogeneity of these factors.

The data on self-reported environmentally friendly behaviours and recycling (Study II) were also subjected to PCA (oblique rotation) and resulted in three factors (all had eigenvalues >1). The first factor, Environmentally Friendly Behaviour (EF Behaviour) included performance of environmentally friendly behaviours (e.g. refrain from car driving to spare the environment, save electricity). The Easy Recycling factor included recycling of items disposable at easily available collection points (e.g. glass and batteries), and Advanced Recycling was based on recycling of items that require more effort on the part of the consumer (e.g. fewer collection points, metal packages, and composting/leaving domestic refuse for composting). Cronbach α-coefficients for the factors were between 0.69 and 0.75, indicating good homogeneity.

**Content analysis**

Content analysis is a method that can be used for data reduction by dividing pieces of text volumes into categories. This can be accomplished in different ways and Weber (1990) argues that there is no simple correct way to do content analysis. The researcher has to decide which is the most appropriate method for his/her data. The basic principle is that pieces of text (e.g. words, sentences, paragraphs), presumed to have a similar meaning or that share similar connotations are classified in the same category (Weber, 1990). To make valid inferences, it is important that the reliability of the categorisation is high. The text should be coded in the same way by different people, i.e. the classification process should be consistent (Weber, 1990). It is also crucial that the classification process produces valid variables. The
interviews in Study III were transcribed verbatim and analysed using content analysis (Weber, 1990).

The interview data were analysed in the following steps: 1) Careful reading of the interviews was performed several times, and notes were made in the margin during the reading process, resulting in definition and identification of recording units (sentences); 2) preliminary themes (categories) and central characteristics for each theme were identified; 3) the themes were then critically tested regarding coherence and distinctiveness in relation to remaining themes; and 4) ten themes were crystallised (Appendix 2). The author performed all four steps. Another person, familiar with the topic of research but who had not performed any of the interviews, read 20 percent of the interviews to scrutinise if she could identify the same themes as suggested by the author (she had access to the same ten themes). Her classification confirmed that the themes reflected the central messages of the interviews.
Results

Summaries of Studies I-IV

Study I – Attitudes towards organic foods
The purpose was to gain knowledge about Swedish consumers’ perceptions of organic foods. To that end, attitudes, purchase criteria, purchase frequency, and beliefs about organic foods were studied. Three main issues were approached: possible gender, age and other demographic differences, the extent to which attitudes are related to purchase behaviour, and interpretations of possible attitude-behaviour concordance or discrepancies.

The majority (46-67%) of the respondents demonstrated positive general attitudes towards buying organic milk, meat, potatoes and bread. However, the positive attitudes were reflected neither in the intention to purchase the investigated organic foods, nor in the purchase frequency of the organic products. Only between 4 and 10 percent declared that it is very likely that they will choose the organic alternative the next time, and only between 8 and 16 percent stated that they often or always buy the four investigated target foods (Table 2). Thus, there appears to be a discrepancy between attitudes and self-reported behaviour. One factor that may help to explain the attitude-behaviour discrepancy is the relative importance of the criterion “organically produced” in comparison to other purchase criteria. In general, the most important purchase criterion for all the foods was that they should taste good, and the least important that they were organically produced (Table 3). Long shelf-life and healthiness were also rated to be important or very important by the majority of the respondents (Table 3). Another candidate for explaining the discrepancy is that consumers did not perceive organic foods to be any better than conventional foods. The most common beliefs about organic foods were that they are “more expensive” and “healthier” than conventional foods (Table 4). Respondents did not think that
the organic counterparts would taste better or have a longer shelf-life (Table 4).

Table 2. Percentage of respondents who reported different purchase frequency of organic milk, meat, potatoes and bread.

<table>
<thead>
<tr>
<th></th>
<th>Milk</th>
<th>Meat</th>
<th>Potatoes</th>
<th>Bread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>49</td>
<td>26</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>Very seldom</td>
<td>21</td>
<td>25</td>
<td>25</td>
<td>31</td>
</tr>
<tr>
<td>Rather seldom</td>
<td>6</td>
<td>15</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Sometimes</td>
<td>11</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Rather often</td>
<td>5</td>
<td>6</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Very often</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Always</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3. Percentage of respondents who agreed that the listed purchase criteria are important or very important when they buy milk, meat, potatoes and bread.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Milk</th>
<th>Meat</th>
<th>Potatoes</th>
<th>Bread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good taste</td>
<td>86</td>
<td>97</td>
<td>93</td>
<td>97</td>
</tr>
<tr>
<td>Long shelf-life</td>
<td>75</td>
<td>72</td>
<td>68</td>
<td>55</td>
</tr>
<tr>
<td>Healthy</td>
<td>71</td>
<td>62</td>
<td>68</td>
<td>70</td>
</tr>
<tr>
<td>Cheap</td>
<td>35</td>
<td>39</td>
<td>31</td>
<td>28</td>
</tr>
<tr>
<td>Organically produced</td>
<td>22</td>
<td>30</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Low-fat</td>
<td>34</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lean</td>
<td>-</td>
<td>41</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Contains no medical residues</td>
<td>-</td>
<td>91</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Produced in Sweden</td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Unsprayed</td>
<td>-</td>
<td>-</td>
<td>48</td>
<td>-</td>
</tr>
<tr>
<td>Locally produced</td>
<td>-</td>
<td>-</td>
<td>31</td>
<td>-</td>
</tr>
<tr>
<td>Undamaged</td>
<td>-</td>
<td>-</td>
<td>90</td>
<td>-</td>
</tr>
<tr>
<td>Contains no additives</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>61</td>
</tr>
<tr>
<td>Contains plenty of fibre</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>Fresh</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>94</td>
</tr>
</tbody>
</table>

Note: - = not investigated
Table 4. Percentage of respondents who stated degrees of likelihood that organic milk, meat, potatoes and bread possess more of the listed characteristics than their conventional counterparts.

<table>
<thead>
<tr>
<th></th>
<th>Not likely</th>
<th>Hardly likely</th>
<th>Somewhat likely</th>
<th>Rather likely</th>
<th>Very likely</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organic milk</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contains less fat</td>
<td>29</td>
<td>48</td>
<td>15</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Healthier</td>
<td>8</td>
<td>20</td>
<td>22</td>
<td>29</td>
<td>21</td>
</tr>
<tr>
<td>Tastes better</td>
<td>16</td>
<td>40</td>
<td>24</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Longer shelf-life</td>
<td>23</td>
<td>52</td>
<td>16</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>More expensive</td>
<td>3</td>
<td>2</td>
<td>7</td>
<td>27</td>
<td>61</td>
</tr>
<tr>
<td><strong>Organic meat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaner</td>
<td>19</td>
<td>43</td>
<td>24</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Healthier</td>
<td>5</td>
<td>12</td>
<td>22</td>
<td>35</td>
<td>26</td>
</tr>
<tr>
<td>Tastes better</td>
<td>10</td>
<td>25</td>
<td>26</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>Longer shelf-life</td>
<td>17</td>
<td>49</td>
<td>22</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>More expensive</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>27</td>
<td>64</td>
</tr>
<tr>
<td>More likely produced</td>
<td>2</td>
<td>6</td>
<td>18</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>in Sweden</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Organic potatoes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More likely unsprayed</td>
<td>4</td>
<td>6</td>
<td>13</td>
<td>32</td>
<td>45</td>
</tr>
<tr>
<td>Healthier</td>
<td>6</td>
<td>17</td>
<td>25</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td>Tastes better</td>
<td>9</td>
<td>35</td>
<td>29</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Longer shelf-life</td>
<td>17</td>
<td>50</td>
<td>21</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>More expensive</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>31</td>
<td>60</td>
</tr>
<tr>
<td>More likely locally</td>
<td>6</td>
<td>24</td>
<td>30</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td>produced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More likely undamaged</td>
<td>9</td>
<td>39</td>
<td>31</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td><strong>Organic bread</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contains fewer additives</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td>40</td>
<td>38</td>
</tr>
<tr>
<td>Healthier</td>
<td>4</td>
<td>16</td>
<td>23</td>
<td>33</td>
<td>24</td>
</tr>
<tr>
<td>Tastes better</td>
<td>9</td>
<td>37</td>
<td>31</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>Longer shelf-life</td>
<td>20</td>
<td>52</td>
<td>19</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>More expensive</td>
<td>1</td>
<td>3</td>
<td>7</td>
<td>31</td>
<td>58</td>
</tr>
<tr>
<td>Contains more fibre</td>
<td>9</td>
<td>28</td>
<td>29</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>Fresher</td>
<td>18</td>
<td>41</td>
<td>21</td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

A third influential factor that may help to account for the attitude-behaviour discrepancy is the fact that nearly half (49%) of the respondents stated that they often or always refrain from buying organic foods because they
perceive them to be too expensive. Further, a majority (63%) reported that it is important or very important that organic foods do not cost more than conventional foods.

Overall, women and younger respondents had the most positive attitudes towards the organic target foods. However, there were no demographic differences with respect to the purchase frequency of organic foods or the perceived importance of the purchase criterion “organically produced”.

The results indicate that there is a discrepancy between attitudes and behaviour regarding organic foods. This discrepancy seems to be explained by the facts that consumers do not consider “organically produced” to be an important purchase criterion, that organic foods are not perceived to surpass conventional foods regarding taste and shelf-life (two qualities rated to be of great importance), and because of the perceived premium prices of organic foods.

**Study II – Choice of organic foods**

The objective was to predict consumer attitudes to purchase and purchase behaviour in relation to organic foods on the basis of a) consumer perceptions of the likelihood of occurrence of environmental and human health consequences as a result of their choice of organic foods and, b) on the basis of the frequency of self-reported recycling and other environmentally friendly behaviours.

A majority of the respondents thought it was quite or very likely and important that their choice of organic foods would result in positive environmental, human health and animal well-being consequences (Appendix 1). Only a small proportion (1-11%) stated that it was not at all likely or important that the given consequences would be influenced by their choice of organic foods.

The factor-analytically derived factors (Environment, Transportation/Waste, Health, EFB behaviour, Easy recycling, Advanced recycling) and demographic variables (age, gender, education) were used as independent variables in the multiple regression analysis to investigate the predictability of the dependent variables: attitudes to purchase, the importance of the criterion organically produced, purchase intention, and purchase frequency. Each of the four organic foods were analysed separately and the main findings were the same for them all. Health was the most important factor for predicting attitudes to purchase, the importance of the purchase criterion
“organically produced” and purchase intention. Age contributed to the prediction of attitudes. The relationship between age and attitude was negative suggesting that younger consumers are more likely to have positive attitudes towards purchasing organic milk, meat, potatoes and bread. Health was also an important predictor of purchase frequency. However, EF Behaviour appeared to be an equally important predictor of purchase frequency. In the regression analyses including only the likelihood ratings of positive health and environmental outcomes as a result of organic food purchase (Environment, Transportation/Waste, Health), it was clear that positive health consequences were most important for predicting attitudes towards and purchase frequency of organic foods. Thus, positive health benefits appear to be a stronger motive for purchase than are environmental benefits. The finding that the frequency of performance of environmentally friendly behaviours contributed equally to the prediction of purchase frequency indicates that in the context of environmental concerns, behaviour-behaviour correlations seem to be stronger than “belief”-behaviour correlations.

**Study III – Acceptance of genetic modification**

The purpose was to investigate consumer acceptance of applications within three areas of genetic modification: food production, agriculture and medicine, and attitudes towards modifying humans, animals, plants and microorganisms. A further purpose was to investigate motives/reasons for acceptance or rejection of employing genetic engineering in these areas and with different categories of organisms.

The analysis resulted in ten themes: control, hierarchy, beneficial, unnecessary, tampering with nature, consequences of tampering with nature, information to consumers, health, risk of misuse, and distribution/size of the field of application (see Appendix 2 for further details). Overall, many consumers appeared to have a balanced view of GE and had not taken a definite position either strongly for or against the technology.

Medical applications were generally easily accepted because they were perceived to be beneficial and have a lawful aim. Many food/agricultural applications were perceived to be less beneficial than medical applications for reasons such as being less necessary and executed mainly to generate more money for the producers. However, the crop applications (higher yields or with built in resistance) and the herbicide resistant soy were perceived to be beneficial. This was because the crops would provide a possibility to produce more food for the world’s growing population and the soy to reduce
the need for chemicals in agriculture. Modifications that involved human DNA/humans and animals were generally more difficult to accept than GM of microorganisms and plants. This opinion was to a large extent based on a hierarchical thinking in terms of the organism’s capacity of having an emotional life and its ability to feel pain, but also on the perceived distance between the application and humans. The low-fat meat and the application suggesting transference of human DNA to other organisms for food production purposes were associated with cannibalism. Genetic screening (for hereditary diseases, medical and non-medical purposes) was perceived to have the possibility to be both positive and negative, depending on how the obtained information would be used and by whom.

Some applications were rejected because they were perceived to tamper with nature (e.g. mixing genes from two species, playing God) and the respondents feared that tampering with nature might lead to other unpleasant consequences, e.g. for the ecological system/food chain. Perceived risk of misuse and the perception of an application as unnecessary also contributed to rejection. The purpose of executing a modification appeared to be crucial for the interviewees and many thought it was difficult to take a position when they did not know why the modification was done. This was particularly common among those who were interviewed about the general applications for which no aim was specified. The possibility to control the modified organisms was also of importance and microorganisms and plants were perceived to be more difficult to control (may easily spread/cross breed in nature) in comparison to animals (kept in stables). Issues regarding GM and its potential effect on human health, particularly regarding GM foods, were also raised. Some subjects were of the opinion that we need to gain more knowledge about if and how GM foods affect our bodies.

The results indicate that consumers accept/reject applications on a case by case basis. Acceptance/rejection is based on several factors, among which the most salient appear to be the specific organism being modified, for what purpose, and in what it may result.

**Study IV – Attitudes towards GM foods**

The general aim was to gain further understanding about consumers’ perceptions of GM foods. More specifically, the study investigated attitudes to nine food applications of GE, to what extent consumers are interested in buying foods with tangible benefits, and possible demographic differences. In addition, possible relationships between consumers’ interest in natural foods, healthy eating, and attitudes to GM foods were studied.
Most consumers were generally rather negative towards the use of genetic engineering (GE) within the food production area. Nevertheless, there was a group of respondents who were more positive towards the use of GE in food production. Males, younger respondents and those with three years of upper secondary school education demonstrated more positive attitudes than did women, older respondents and those with lower levels of education. The modified salmon and pork meat received the overall most negative ratings (most concern, most unethical, highest risk etc.) while the rice application was perceived as most positive (least unethical, most healthy, highest benefit etc.). A large proportion of the respondents appeared to have moral and ethical doubts about eating GM foods. Tangible benefits like better taste and lower price were not perceived to be sufficiently good arguments for purchasing GM foods. However, if GM foods were healthier and better for the environment, a substantially larger proportion of the respondents declared that they would buy such foods.

The interviews in Study III indicated that a number of consumers had the perception that GM foods may have a negative effect on the body and on health. Previous research has implied that GM foods are associated with unnaturalness (e.g. Bredahl, 1999) and unhealthiness (e.g. Grunert et al., 2001). Therefore, we were interested in studying possible relationships between consumer attitudes to GM foods, and their interest in healthy eating [General Health Interest (GHI) scale], in light food products [Light product interest (LPI) scale] and in natural foods [Natural Product Interest (NPI) scale]. The scales were used for categorising the consumers into two groups, those with high vs. low GHI/LPI/NPI scores. The results showed that those who had a high score on the NPI scale were more negative towards the GM food applications than were those with low NPI scores. Likewise, those who scored high on the GHI scale viewed the applications more negatively than did those who had low GHI scores. Thus, consumers who thought it was more important that foods are healthy and natural had more negative attitudes to GM foods than those who attached less importance to the healthiness and naturalness of foods. No statistically significant differences were found for those who had low/high LPI scores.

To conclude, although most consumers demonstrated a rather negative attitude to GM foods, some were more positive (particularly males, younger respondents and those with three years of upper secondary school education). Benefits to health and/or the environment seem to have the best potential for influencing consumer willingness to purchase GM foods. The finding that those who scored high on the NPI and GHI scales were more
negative towards the GM foods may be interpreted to reflect that GM foods are either perceived as natural or healthy by a large number of consumers.
Discussion

General discussion

The main findings are the following. The attitudes to organic foods were mainly positive but the reported purchase frequency was relatively low (Study I). “Health concerns” appear to be a more important predictor of attitudes and purchase of organic foods than “environmental concerns”. However, the performance of “environmentally friendly behaviours” was also an important predictor of the purchase of organic foods (Study II). GM applications involving human DNA and animals caused more concerns than those involving plants and microorganisms. Medical applications were generally easier to accept than were applications within the food and agricultural area (Study III). In concordance with that, Study IV demonstrated that attitudes to GM foods were predominantly negative, and that food applications involving animals were viewed more negatively than those concerning plants and microorganisms. Positive consequences for human health and the environment were tangible benefits that may increase consumer willingness to purchase GM foods (Study IV).

Perception of organic foods

A majority of the consumers had positive attitudes towards purchasing organic foods but the proportion of regular buyers was relatively low (Study I). This finding corresponds well with those of previous research (e.g. Wandel & Bugge, 1997). Thus, there appeared to be a discrepancy between attitudes and behaviour (Study I). This incongruity may have several explanations and Study I indicated three reasons: 1) organic foods are perceived as expensive, 2) lack of beliefs that organic foods have a superior quality in comparison to conventional foods, and 3) low importance ratings of the criterion “organically produced”.

The most common belief about organic foods was that they were more expensive, and almost half of the respondents stated that they refrain from...
buying organic foods for this reason (Study I). Premium prices have been stated to be a major obstacle to the purchase of organic foods in other studies (Grunert & Kristensen, 1995; Mathisson & Schollin, 1994; Roddy et al., 1996; Tregear et al., 1994). At the start of the selling of organic foods in Sweden, the price difference between them and conventional foods was rather high. With an increasing consumer interest in and more farmers switching over to organic agriculture, price differences have been reduced. A recent study by the National Board for Consumer Policies (2003) demonstrated that replacing some of the conventional foods with organic foods does not affect the food expenses dramatically. As an example, for an additional cost of 100 Swedish kronor a month, a family (2 adults and 2 children) could change to organic milk, soured milk and hard cheese (National Board for Consumer Policies, 2003). However, if many consumers have the belief that organic foods are more expensive, this may prevent them from buying organic foods. In Study I, a majority of the consumers stated that it is important that organic foods are not more expensive than conventional foods. Thus, consumers demonstrated an interest in buying organic foods but they did not seem to be willing to pay premium prices. This finding is in line with conclusions of previous research (Wandel & Bugge, 1997).

Some studies indicate that consumers believe that organic foods have sensory attributes that are superior to conventional foods (e.g. Williams, 2002). However, in the present thesis, the proportion of consumers who believed that organic foods taste better than conventional foods was (except for meat) only between 20 and 27 percent (Study I). Generally, the most important purchase criteria (taste, shelf-life, health), irrespective of whether the product was conventionally or organically produced, did not correspond very well with the most common beliefs about organic foods (more expensive, healthier), except for health (Study I). Health as a purchase motive will be discussed further in the section “Health and environmental concerns as motives for food purchase”.

A somewhat surprising result was that although the majority of the consumers had positive attitudes to purchasing organic foods, only between 17 and 30 percent stated that “organically produced” was an important purchase criterion (Study I). Further, “organically produced” was the criterion that overall was perceived to be least important for the investigated foods. It seems that society’s overall perception of organic agriculture is rather positive. Many consumers associate organic agriculture/foods with positive characteristics such as natural products and animal welfare. The Swedish Government supports the conversion of conventional farms to organic, and has set goals concerning the proportion of arable land to be cultivated organically and that of animals in organic production. Thus, the
positive attitudes towards buying organic foods in Study I may be a reflection of a positive image of organic agriculture. Also, consumers may think that it is not “socially correct” to have a negative attitude towards buying organic foods. A further explanation of the inconsistency between positive attitudes and the low importance rating of the criterion “organic” concerns the perceived benefits of organic foods. One of the most common beliefs about organic foods is that they are healthier than conventional foods (Study I) and this seems to be the major motive for the purchase of organic foods (Study II). It may be that the benefit (health) is perceived as a more important quality than the characteristic “organic”. This suggestion is supported by results in Study I, where it was demonstrated that “health” was one of the most important purchase criteria while “organic” was the least important criterion for food purchase.

**Demographic differences**

Study I confirms the findings from earlier studies suggesting that organic foods to a greater extent appeal to females than to males (Mathisson & Schollin, 1994; Wandel & Bugge, 1997). Age also played a part, the younger respondents being more positive than the older (Studies I and II). However, there were no differences between the demographic groups regarding the purchase frequency (Study I). The differences between demographic groups should be interpreted with caution since the mean differences between the groups generally were small and no Bonferroni correction was employed to adjust the level of signification. Thus, it is possible that some of the differences are due to mass significance.

**Perception of GM and GM foods**

Study III suggests that medical applications are generally more easily accepted than applications in the agricultural and food areas. However, Study III also demonstrates that the acceptance of GM has a more complex basis. One important factor for the acceptance was what kind of organism was involved and between which organisms the gene transfer occurred. In general, modification or transfer of genes from humans to other organisms and modifications involving animals were most difficult to accept, while modifications of microorganisms and plants were the easiest. The hierarchy seemed to be founded on the organism’s ability to feel pain and having “an emotional life” (Study III). This hierarchical thinking of different organisms in relation to GM has been demonstrated earlier (Wibeck, 1999). Acceptance of and attitudes to GM also seem to a rather great extent to depend on the specific purpose of the modification. Many of the consumers who were asked about the specific applications in Study III began with identifying the
purpose and used it as a starting-point in their judgement of the application. Few of those who were interviewed in Study III were categorically for or against GM. Most consumers appeared to accept/reject the applications on a case by case basis. This finding is similar to that demonstrated in earlier research (Frewer et al., 1997a).

Studies III and IV demonstrated that the consumers generally have a rather negative attitude to GM foods. This corresponds with findings from the Eurobarometer surveys (Gaskell et al., 1998; 2000). The fourth survey showed an increase of negative attitudes towards GM foods among consumers from 1996 to 1999 (Gaskell et al., 2000). The finding that modifications involving microorganisms and plants are more easily accepted than those involving animals was confirmed in Study IV. In several cases, the modified salmon and pigs were rated most negatively (e.g. most concern, highest risk, most unethical etc.). The rice application was perceived as most positive (most healthy, highest benefit, least unethical etc.), while other GM foods (soy, tomatoes, yoghurt, beer, strawberries, wheat) were rated in between (Study IV).

In Study IV, the vast majority of the consumers indicated that they have no or very little control over the consumption of GM foods. This may strengthen the negative attitudes. Previous research has shown that most consumers want GM foods to be labelled (e.g. Fjæstad et al., 1998; Gaskell et al., 1998; Hill, Stanisstreet, Boyes & O’Sullivan, 1998; Koivisto Hursti et al., 2002). Thus, consumers want to have control over the foods they buy and eat, and a prerequisite of making informed choices is labelling.

Demographic differences
Generally, males and younger respondents had more positive attitudes to the GM food applications than did females and older respondents (Study IV). Also earlier studies have indicated that males are more positive than females (Gaskell et al., 1998; Hill et al., 1998; Hoban, 1996; Koivisto Hursti et al., 2002; Olofsson & Olsson, 1996; Sparks et al., 1994). Regarding age, some studies have demonstrated that older people are more positive than younger (Fjæstad et al., 1998; Olofsson & Olsson, 1996) while others report that the support is greater among the younger (Gaskell et al., 1998; Koivisto Hursti et al., 2002). On a closer examination, older consumers appear to be more supportive of GM within the medical area (Fjæstad et al., 1998; Olofsson & Olsson, 1996), and younger consumers seem to be more positive towards food applications (Gaskell et al., 1998; Koivisto Hursti et al., 2002). Thus, the demonstrated age differences may be dependent on the application area. Respondents with three years of upper secondary school education were more positive towards the food applications than were respondents in other educational groups (Study IV). This corresponds with previous research
indicating that people with higher education hold more positive attitudes to GM (Fjæstad et al., 1998; Gaskell et al., 1998). However, a study by Koivisto Hursti and co-workers (2002) demonstrated no educational differences.

**Health and environmental concerns as motives for food purchase**

**Health concerns**

Many consumers believed that organic foods are healthier than conventional foods (Study I). This belief appears to be rather common among consumers (Grankvist & Biel, 2001; Torjusen et al., 1999). However, there is no unambiguous evidence that organic foods are healthier than conventionally produced foods (Torjusen et al., 1999). It is rather difficult to compare the quality of organic and conventional foods, because there may be variations between foods within each production method as well. Some of these differences may be due to the sort (e.g. sort of carrots), variations in the characteristics of soil, and climate. Such conditions influence the quality of both organic and conventional foods (Lindeskog & Bruce, 2003). However, the cultivation condition may also influence the nutritional contents of food (Lindeskog & Bruce, 2003). The protein content of wheat is dependent on the nitrogen supply. Organic agriculture uses less nitrogen why organic wheat contains less protein than conventional wheat (Lindeskog & Bruce, 2003). A few studies indicate that the content of organic acids, e.g. vitamin C is higher in organic foods (Lindeskog & Bruce, 2003). This is likely to be due to a lower growth as a result of less use of nitrogen fertiliser. Some studies also show that the amount of beta-carotene is higher in conventional plants as a consequence of using more fertilisers (Lindeskog & Bruce, 2003).

Study II clearly demonstrated that “positive health beliefs” is the strongest predictor of attitudes to and purchase of organic foods. Thus, health concerns seem to be the major motive for buying organic foods. This purchase motive is under the present conditions based on vague assumptions. If no substantial health benefits can be demonstrated, there may be a risk for a setback in purchase frequency among consumers whose primary purchase motive is “health concerns”. Therefore, the promotion of organic foods should not be focused on eventual health benefits until scientific research can provide comprehensive results.

GM foods, on the other hand, were not generally perceived as particularly healthy (Study IV), and some consumers feared that they might influence human health negatively (Study III). These results support earlier research findings (e.g. Bredahl, 1999; Grunert et al., 2001). A study of British,
Danish, German and Italian consumers demonstrated strong beliefs that consumption of GM yoghurt would reduce healthiness (Bredahl, 1999). Further, the consumers did not trust the GM yoghurt because of its perceived unknown long-term consequences on human health (Bredahl, 1999). In their study of Nordic consumers’ perceptions of GM foods, Grunert and co-workers (2001) showed that each of the investigated GM applications were associated with poorer health.

Even though GM foods are not perceived as healthy, almost one third of the consumers in Study IV stated that they would buy GM foods if they were healthier than conventional foods. Thus, health appears to be a tangible benefit that consumers consider relevant. This finding is in accordance with results by Frewer and co-workers (1996; 1997b) who found that the likelihood of purchase of GM tomatoes and GM cheese increased if they were said to be modified to be more nutritious (Frewer et al., 1996; 1997b). However, Lähteenmäki and co-workers (2002) who investigated consumer responses to GM labelled cheese (“real” exposure) found that reduced fat content as a health benefit only marginally influenced the acceptance. Therefore, it should be born in mind that it is not sure that consumers would purchase GM foods with health benefits if they were available. There is often an incongruity between attitudes/opinions and behaviour. Further, the question is rather hypothetical as very few labelled GM foods are for sale and the Swedish consumers have practically no experience of GM foods.

Environmental concerns

One central goal of organic agriculture is to carry on a long-term sustainable agriculture (KRAV, 2004). A main characteristic of organic agriculture is that it does not allow fertilisers. However, some researchers are of the opinion that using organic manure instead of fertilisers offers no environmental advantages (Bergström, 2003). Bergström (2003) argues that in the comparisons of organic and conventional agriculture, light should also be shed on the long term sustainability of the two production-systems regarding fertility and productivity. From his and other research, he concludes that the use of fertilisers contribute to preserve soil fertility and sustainability for future generations (Bergström, 2003). Thus, his opinion is that organic agriculture renounces expedient aid by prohibiting fertilisers (Bergström, 2003).

Most consumers thought it was both likely and important that their choice of organic foods would result in positive environmental consequences (Study II). Nevertheless, the factors Environment and Transportation/Waste were not strong predictors of attitudes or purchase of organic foods (Study II). However, the frequency of performance of environmentally friendly (EF) behaviours was an important factor. EF behaviour was an equally important
factor as health for the purchase of organic foods (Study II). This result may at least partly reflect the fact that both variables concern self-reported behaviour. Further, this implies that behaviour-behaviour correlations are stronger than “belief”-behaviour correlations in the context of environmental concerns.

The possible influence of organic agriculture and GM on the environment differs in one substantial way. The use of GM may cause great and irreversible effects if the technology is not handled with care and if we do not have enough knowledge about potential negative effects before using it. Consumers were concerned that GM organisms may affect other organisms in the ecosystem (Study III). In addition, some subjects in Study III raised issues concerning the risk of spreading GM plant genes with qualities that are not desirable to be spread, and the risk that GM plants with superior characteristics would knock out non-GM plants. The perception that we do not have knowledge about all consequences of the technology and that some organisms (plants, microorganisms) are difficult to control (e.g. plants grown on open fields) had a negative influence on the acceptance of GM (Study III).

It has been suggested that a positive environmental impact as a result of GM is a tangible benefit that is relevant for consumers (Frewer et al., 1996; 1997b). Study IV confirms that positive “environmental outcomes” may be a benefit that can increase consumer willingness to purchase GM foods.

To summarise, health and environmental concerns appear to be important motives for the purchase of organic foods (Study II), as well as GM foods (Study IV). In the case of GM foods, there is both a fear that GM foods may have a negative effect on human health and the environment, but at the same time, if GM foods provide advantages for human health and the environment, this is perceived to be a tangible benefit.

Health and environmental benefits differ in some fundamental respects. Firstly, health is motive founded on a more egoistic basis while environmental concerns more clearly stem from altruism. Further, health is more of a personal “goal”. An individual may obtain good health by him/herself and not be particularly dependent on others to reach this. Eventual sacrifices made are for one-self and the chance that someone else will spoil these for you is small. In addition, the desirable effect can be obtained rather quickly. On the contrary, to obtain a better environment is a collective goal, that is, a large group of people has to work to attain the goal. The individual is dependent on the others and it may take a long time to establish the effects of environmentally friendly behaviour. It is even possible that we may not ever experience the benefit of our own behavioural change during our lifetime.
Study I showed that few consumers are regular buyers of organic foods and that “organically produced” was a purchase criterion of low importance for many. However, Study II demonstrated that a majority of the consumers recycle several fractions (e.g. glass, newspaper/paper, batteries – data not shown) regularly, and that many perform other environmentally friendly behaviours (e.g. purchase environmentally friendly products, save electricity – data not shown). Thus, consumers appear to be more willing to act altruistic in the recycling area than in the area of food choice. This is in accordance with findings from a recent Swedish study (Grankvist, 2001).

There are some obvious differences between the behaviours that may partly explain why consumers are more inclined to recycle than to purchase organic foods. Recycling involves negligible economic and only minor behavioural costs. Not performing recycling (leaving everything in the garbage) can be considered morally unacceptable. In addition, in Sweden, money is refunded at the return of aluminium cans and glass/PET bottles. Organic foods may be more expensive and less available than conventional foods, and alternative behaviours represent established purchase and consumption habits. Further, the criterion “organically produced” was stated to be the least important purchase criterion, and consumers do not seem to think that organic foods have superior qualities (taste better, have longer shelf-life etc.) in comparison to conventional foods. This indicates that it does not seem likely that a majority of the consumers would be interested in paying additional prices for foods that they do not think are of higher quality. Another important factor to bear in mind is that eating involves incorporation of material from the outside world into our bodies and that this is a potentially threatening activity (Rozin, 1990). Also, eating is a highly personal activity and is strongly influenced by affective factors. Birch (1981) proposed that eating behaviour is very resistant to change because it is characterised by powerful affective and apparently non-cognitive components that are not easily influenced by information, not even information about consequences or contingencies. Establishment of “environmental concerns” as a purchase motive in the food sector is made difficult by the fact that food-related behaviours differ in fundamental respects from recycling behaviour.

Naturalness

People appear to have a preference for natural things (Rozin, 2003). But what does the term “natural” mean to consumers? According to results from the OCHA study [Observatoire CIDIL (Centre d’Information et de Documentation des Industries Laitières) des Habitudes Alimentaires; referred in Rozin, 2003], the three most important features of “natural” are:
1) unprocessed/untouched by humans, 2) coming from nature, and 3) having no additives (Rozin, 2003). These features coincide with consumer perceptions of healthy eating (Povey et al., 1998), and are important food characteristics considered in food choice (Torjusen et al., 2001). The three features of “natural” also to some extent coincide with the ideology of organic agriculture. Organic agriculture does not allow the use of industrialised fertilisers or synthetic pesticides, GM organisms are forbidden, and additives are restricted in processed foods (KRAV, 2004). The positive attitudes to organic foods are likely to be partially due to the perceived naturalness of organic foods.

Perceived naturalness also appears to have a central role for acceptance of GM and GM foods. Study III demonstrated that the mixing of genes from different species was perceived as unnatural. In accordance with that, applications that were perceived as being more alike traditional plant and animal breeding were better accepted than the others (Study III). Studies III and IV demonstrated that GM applications involving plants generally were more accepted and that the attitudes were more positive towards them than those involving animals. According to Rozin (2003), plants (i.e. forests, trees, plant foods) often come to mind when people think of natural things. The OCHA study (referred in Rozin, 2003) indicates that plant foods and non-edible plants are more frequently mentioned than animal foods and non-edible animals in consumer associations to the word “natural”. This indicates that from a psychological view, plants are perceived to be closer to “natural” than animals (Frewer, Howard, Hedderly & Shepherd, 1999). Frewer and co-workers (1999) suggest that this may explain why GM products involving animals produce stronger negative reactions than those involving plants.

Several studies demonstrate that GM foods are associated with unnaturalness (Bredahl, 1999; Grove-White et al., 1997; Grunert et al., 2001), and that GM foods are perceived as less natural than conventional foods (Bredahl, 1999; Frewer et al., 1996; Grunert et al., 2001). Frewer and co-workers (1996) found that perceived unnaturalness of GM foods was associated with a decreased likelihood of purchase. Study IV demonstrated that consumers who scored high on the Natural Product Interest (NPI) scale had more negative attitudes to the GM foods than did those who scored low. This is in line with research by Lähteenmäki and co-workers (2002). They demonstrated a negative correlation between attitudes to GE and the Natural Product Interest scale (Lähteenmäki et al., 2002). Study IV also showed that those who scored high on the General Health Interest (GHI) scale were more negative to GM foods than those scoring low on the scale. This suggests that GM foods are not perceived as either natural or healthy. This is in accordance with previous research demonstrating that healthy eating (Povey
et al., 1998) and healthy foods (Santich, 1994) are associated with natural foods.

**Moral and ethics**

Moral and ethical considerations seem to be important components in the perception of and attitudes towards both organic and GM foods. The ideology of organic agriculture is largely founded on moral and ethics. One of the basic commitments of organic agriculture is the thought of global solidarity (KRAV, 2004). Others are to promote animal health and welfare, and to acknowledge animals’ innate behaviour and needs, and to protect and develop the biodiversity (KRAV, 2004). Consumers who attach greater importance to food characteristics such as animal welfare, ethical and political considerations, environmentally sound production and no use of GMOs are more likely to purchase organic food products than those who find these aspects less important for their food choice (Torjusen et al., 2001).

Moral and ethical reflections are also important for the acceptance of and attitudes towards GM (Study III) and GM foods (Study IV). These findings are in accordance with previous studies (e.g. Fjæstad et al., 1998; Gaskell et al., 1998). The majority were of the opinion that it is against their principles, and that it would be morally wrong for them to eat GM foods (Study IV – data not shown). Feelings of guilt were also connected with eating GM foods (Study IV – data not shown). Mixing genes from two different species was not easily accepted particularly if animals or human DNA were involved (Study III). Transfer of human DNA to other organisms for food production purposes was associated with cannibalism (Study III). The emphasis on moral and ethical issues in relation to GM may be due to the notion that GM offers possibilities to do things that would not happen naturally. The possibility to mix genes from different species or to reinforce a certain characteristic in an organism may arouse dislike and fear.

**Methodological considerations**

The questionnaires used in Studies I, II and IV were developed by the research groups and have not been validated. However, both questionnaire surveys were preceded by interviews. The factors derived from the principal component analysis in Study II showed good reliability. The reliability was measured in terms of the factor homogeneity (Cronbach α-coefficients).

The generalizability of the results from Studies I, II and IV are considered high as the samples were randomly selected from the national population register. However, the response rate of Study IV was relatively low (39%).
This may indicate that many consumers are not familiar with GE, do not have a definite opinion on GM foods or do not think that GM foods concern them. It may also reflect the fact that GM foods are practically inaccessible in Sweden and thus, people have limited experience of them. Therefore, they have neither been “confronted” with GM foods, nor have had to take a definite opinion about them. It could be expected that those who responded to the questionnaire are consumers with strong attitudes either for or against GM foods. However, no statistically significant differences were found between those who responded to the original questionnaire and those who answered the short questionnaire/were telephone interviewed either in demographic variables or in their attitudes towards GM foods with and without tangible benefits.

The response rate of the sample in Studies I and II was almost 20 percent higher (58%) but can still be considered rather low. This could be interpreted to reflect that many consumers are unfamiliar with the term organic foods or have a moderate interest in organic foods. Studies I and II contained an over-representation of consumers with higher education, who are likely to be more interested in organic foods. Consequently, the results may be a little more positive than the actual state of the case. Previous research has demonstrated that consumers with a higher education are more likely to buy organic foods (Wandel & Bugge, 1997). Thus, it is possible that even the proportion of organic food purchasers is smaller than what Study I demonstrates. The demographic group comparisons in Study I should be interpreted with caution since some of them may be due to multiple comparisons. Bonferroni correction should have been utilised to adjust the level of significance for all t-tests and analyses of variance.

The participants in Study III were recruited by advertisements and bill-posting in Uppsala, a university town with a large number of inhabitants either being students or with an academic degree. Studies with a more qualitative approach may have problems with “elite bias”, i.e. getting participants who are the most articulate, accessible or high-status members of a group (Sandelowski, 1986). However, the interviewed sample consists of a rather broad range of people regarding profession and age. Their opinions on genetic engineering were divided and they demonstrated a profound picture. However, the generalizability of the data is not as high as for the questionnaire studies with randomly selected samples.

All studies are based on self-reported data. One problem with self-reported measures is distortion on the part of the subjects (Kazdin, 1998). The respondents may in some way respond as a reflection of self-interest or their own motives (Kazdin, 1998). In food research, it is likely that respondents are influenced by social desirability as the society’s general division of healthy or “good” and unhealthy and “bad” foods are fairly
“universal”. In addition, the general attitude towards organic agriculture in society seems rather positive and consumers may think that it is not “socially correct” to demonstrate a negative attitude. Thus, there may be a risk that some respondents have answered according to social desirability in Studies I and II. The figures for the purchase frequency of organic foods (Study I) are likely to be overestimated, especially for meat, as there was not that much organic meat available at the time of the study. However, this overestimation may also be due to that some consumers do not know or are uncertain of how organic meat is labelled. Thus, they may think that they have purchased organic foods although they have not.

The interviews in Study III were performed by two interviewers. One person did all the interviews concerning the general applications and the other all the interviews regarding the specific applications. The interview technique employed in Study III involved posing of fairly structured questions but the respondent could reply freely. Thus, it is likely that the questions were posed in almost the same manner to all the respondents. A risk of an interviewer training effect is possible, i.e. that the interview technique improves with increased experience. However, as the same questions were posed for all triads and for all respondents, the effect of training is likely to have had little effect on the results.

The coding of data into the themes (Study III) was made by the author. To test the reliability of the themes, another researcher read 20 percent of the interviews. The reliability could have been further investigated by letting another researcher repeat the same procedure and scrutinise the context of the themes and the categorised text.

Conclusions

The perception of and attitudes towards organic and GM foods differed in several respects. Organic foods were perceived as healthy and environmentally friendly and the majority of the consumers had positive attitudes towards purchasing them. Choice of organic foods was related to perceived positive consequences for human health and the environment. The attitude to GM foods was generally negative and GM foods were considered not to be healthy. Also, consumers feared that tampering with nature might lead to unpleasant consequences in the ecological system. However, GM resulting in foods with benefits for human health or the environment seemed to increase consumer willingness to purchase GM foods. Thus, although consumer perceptions of organic and GM foods differed in several respects, they had two things in common: positive consequences for human health and the environment were related to both the purchase of organic foods and a
potential purchase willingness of GM foods. This latter finding suggests that for some consumers, the perceived benefits of foods may be of greater interest than how the food was produced.

**Suggestion for future studies**

The present studies and other research demonstrate that organic and GM foods are perceived to differ in several respects. However, they are also perceived to have things in common. Most studies have either studied organic or GM foods. Future studies should compare consumer perceptions of organic and GM foods, and their relation to healthiness, environmental friendliness and naturalness. This will offer a possibility to obtain perceptions of both organic and GM foods from the same respondents. Different types of interview methods (group and individual) should be employed since many such techniques allow the respondents to reply more “freely” than in questionnaires.

On the basis of this thesis and previous studies, there is evidence that the major motive for purchasing organic foods is health-related. However, we know little about how consumers perceive that they can obtain a better health by choosing organic foods. Two outlooks on achieving a better health due to organic foods may be applied by the consumers. The first concerns a belief of a “direct” effect. That is, the health effect will be obtained by consuming organic foods. The second is of a more “indirect” character and regards the link between human health and the environment: if the general state of the environment improves, this will affect the health of all people positively. The knowledge about which outlook the choice of organic foods is based on is limited. Future studies should investigate consumer perceptions of how consuming organic foods may increase their health.

Wise food choices may help the individual to promote good health. A group of foods that is developed and produced with the purpose to promote good health are the functional ones. Thus, their major characteristic is to promote health. Since it has been shown that consumers associate GM with unhealthiness (Bredahl, 1999; Grunert et al., 2001), it would be interesting to investigate how consumers perceive functional foods if they are produced by means of GM.
Appendix 1

Environmentally friendly behaviours (Studies I and II)
1. Avoid purchasing products in environmentally non-friendly packages.
3. Save electricity.
4. Donate money to environmental organisations.
5. Discuss environmental problems with my friends or family.
6. Refrain from car driving to spare the environment.
7. Avoid purchasing new products to spare the environment.
8. Compost or leave domestic refuse for composting.

Environmental, human health and animal welfare consequences (Studies I and II)
1. Improve the general state of the environment
2. Improve circumstances and health of the farm animals
3. Improve my own or my family’s health
4. Give myself a good conscience
5. Avoid risks that may be associated with eating non-organic foods
6. Reduce the use of artificial fertilisers in agriculture
7. Reduce the eutrophication of lakes and watercourses
8. Reduce the pollution of the soil
9. Reduce the transportation of foods
10. Reduce the use of petrol and other non-renewable sources of energy
11. Reduce the amount of waste
12. Reduce the ozone-hole in the atmosphere
13. Preserve biodiversity in Nature
14. Reduce the use of herbicides and pesticides in agriculture
15. Reduce the medication of farm animals
16. Give my children better food
17. Reduce the risk for illness in my family
Appendix 2

Definition of genetic modification given to the subjects (Studies III and IV)

Genetic modification of plants and animals is done by means of genetic engineering by cutting a piece of DNA from one organism and transferring it into another in order to change its properties. For animals this is often done by injecting genes into cells, while for plants genes are usually shot or transferred by means of special bacteria. Classical breeding, e.g. crossing plants or inseminating animals is not considered as genetic modification even if this technique also aims at choosing superior genetic traits.

General and specific applications (Study III)

General applications
1. Genetic engineering of microorganisms (e.g. yeast) for food production purposes.
2. Genetic engineering of plants for food production purposes.
3. Genetic engineering of animals for food production purposes.
4. Transfer of human DNA to other organisms for food production purposes.
5. Genetic engineering of microorganisms (e.g. yeast) for agricultural purposes.
7. Genetic engineering of animals for agricultural purposes.
8. Transfer of human DNA to other organisms for agricultural purposes.
9. Genetic engineering of microorganisms (e.g. yeast) for medical purposes.
11. Genetic engineering of animals for medical purposes.
12. Transfer of human DNA to other organisms for medical purposes.
15. Genetic “screening” of humans for non-medical purposes.
Specific applications
1. Herbicide-resistant soy
2. Bacteria modified with a human gene in order to produce e.g. insulin
3. Tomatoes that stay fresh longer
4. Crops with “built in” pest resistance
5. Animals that are modified to enable their organs to be transplanted to humans
6. Beer brewed with modified yeast
7. Strawberries that can grow in dry conditions
8. Mice that develop cancer used in medical research
9. Salmon that can grow faster
10. Crops with higher yields
11. Genetic “screening” for hereditary illness
12. Salmon with built in resistance to salmon lice (a parasite)
13. Tobacco that grows three times as fast as conventional tobacco
14. Genetically modified bacteria for production of medicine e.g. insulin
15. Low-fat meat produced by inducing human genes to animals
## Themes (Study III)

<table>
<thead>
<tr>
<th>Theme</th>
<th>Central characteristics</th>
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| 1     | Beneficial              | Make man healthier, avoid suffering and illnesses  
        |                         | Screening both beneficial and useless  
        |                         | Increased food production  
        |                         | Less need for chemicals  
        |                         | Praiseworthy/Non praiseworthy aim  
        |                         | The end justifies the means  
| 2     | Hierarchy               | Organisms capacity of feeling pain and having an emotional life  
        |                         | Human material involved  
        |                         | Distance of the GM organism to humans  
        |                         | The size of the organism  
| 3     | Consequences of tampering with nature | Effects on the ecological system  
        |                         | Animal welfare  
| 4     | Risk of misuse          | Multinational companies  
        |                         | Knowledge about GM can be misused  
        |                         | Information obtained by screening/GM of humans can be misused  
| 5     | Tampering with nature    | (No) mixing of species  
        |                         | Cannibalism  
        |                         | We should not play God/Where does the boundary go?  
        |                         | Perceived naturalness  
        |                         | Perceived size of encroachment  
        |                         | Animal welfare  
| 6     | Unnecessary              | Unnecessary  
        |                         | Why should we use GM for this?  
| 7     | Control                 | Application area  
        |                         | A marked off (or not) area  
        |                         | Organism involved  
| 8     | Distribution/Size of the field of application | Perception of that this is something that is already being done  
        |                         | Number of people affected by the application  
| 9     | Health                  | Uncertainty about how eating GM foods effects the human body  
| 10    | Information to consumers | Labelling of foods  

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Appendix 3

Constructs (Study IV)

1. How much benefit do you think that we can have from the following applications of genetic engineering (GE)? (1=“no benefit at all”, 6=“very much benefit”)
2. How unethical do you perceive the following applications of GE? (“not unethical at all”, “very unethical”)
3. How healthy do you think it is to eat the following foods produced by means of GE? (“not healthy at all”, “very healthy”)
4. How great a control (possibility to decide for yourself) over the consumption of the following foods produced by means of GE do you think you have? (“no control at all”, “great control”)
5. How reluctant do you feel for the following applications of GE? (“no reluctance at all”, “very strong reluctance”)
6. How strong a concern do you feel for the following applications of GE? (“no concern at all”, “very strong concern”)
7. To what extent do you think that we tamper with nature in the following applications of GE? (“no tampering with nature at all”, “to a great extent tampering with nature”)
8. How great a risk do you perceive there is with using the following applications of GE? (“no risk at all”, “great risk”)
9. How great a risk for misuse do you think there is with the following applications of GE? (“no risk for misuse at all”, “great risk for misuse”)
10. To what extent do you perceive that the following applications of GE are used for profit alone? (“not used for profit at all”, “to a great extent used for profit alone”)
11. To what extent do you think the following applications of GE serve a good purpose? (“no good purpose at all”, “serves to a great extent a good purpose”)
12. How necessary do you think the following applications of GE are? (“not necessary at all”, “very necessary”)
13. To what extent do you think we have knowledge about the consequences of the use of the following applications of GE? (“no knowledge about the consequences at all”, “very much knowledge about the consequences”)

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Food applications (Study IV)

1. Soy that has been GM to become resistant against pesticides
2. Tomatoes that have been GM to stay fresh longer
3. Fat-free yoghurt that has been produced with GM lactic acid bacteria
4. Beer brewed with GM yeast
5. Strawberries that have been GM so that they can grow under dry conditions
6. Pigs that have been GM in order to produce meat with lower fat content
7. Wheat that has been GM to give higher yields
8. Salmon that has been GM to grow ten times faster than “normal” salmon
9. Rice with a higher iron and β-carotene content which could help people in developing countries to meet their daily needs for those substances.
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Uppsala in March, 2004

Maria
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Editor: The Dean of the Faculty of Social Sciences

A doctoral dissertation from the Faculty of Social Sciences, Uppsala University, is either a monograph or, as in this case, a summary of a number of papers. A few copies of the complete dissertation are kept at major Swedish research libraries, while the summary alone is distributed internationally through the series Ego rtgj gnukg'us o ctkg'gh'Wrrwq: Fkugw kqpuVhtq 'y gIcwnf' ghUqeknUkqpeg(Prior to July 1985, the series was published under the title "Abstracts of Uppsala Dissertations from the Faculty of Social Sciences").