# CONSUMER ACCEPTANCE OF GENETICALLY MODIFIED RAPESEED-OIL
## - A DISCRETE-CHOICE-EXPERIMENT -

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**Abstract**

This paper deals with consumer acceptance of genetically modified rapeseed-oil in Germany and analyzes under which conditions consumers would buy such products. To investigate this subject a Discrete-Choice-Experiment was performed within the framework of a cross-European consumer survey in spring 2007. The results show that consumers' utility is increased by an organically produced product and decreased by a GM product. Thereby the association with individual advantages (health benefits) decreases consumers' utility less compared to the association with environmental benefits. Additionally, it could be shown that German consumers prefer locally produced rapeseed-oil compared to imported. If GM products exhibit a considerable price discount compared to conventional products, a certain market potential for GM rapeseed-oil exists in Germany. But the granting of discounts must be carefully balanced especially against the background of profitability for producers and processors.

**Keywords**

Consumer behavior, GM food, rapeseed-oil, Discrete-Choice-Experiment.


## 1    Introduction

In the fields of agriculture and food production the use of genetically modified organisms (GMOs) has been continuously increased since years (CLIVE, 2008). But although testing procedures in the USA have not found food safety problems deriving from GMOs and GM materials in food products, the acceptance towards applying genetic engineering approaches and derived food products is still low among European and especially among German consumers. In the opinion of most consumers there is nothing to gain by GMOs in the agro-food sector but instead serious disadvantages could occur. Some of the most often mentioned concerns of EU consumers are negative long-term health and/or environmental impacts, the extreme difficulties of reversing GM technology as soon as it is released and widely-used, an increasing monopolization of seed and food processing companies resulting in a larger dependence of farmers as well as ethical concerns (FRANK, 2004; DIRECTORATE-GENERAL FOR AGRICULTURE EUROPEAN COMMISSION, 2002; GASKELL ET AL., 2006; WISNER, 2002).

In order to ensure consumers` and users` freedom of choice as well as to avoid environmental and health risks associated with the commercial use of GM products, the EU adopted specific regulations (in particular regulations (EC) No 1829/2003 and (EC) No 1830/2003) which regulate the market approval, labeling and traceability of GMOs in the food and feed chain. Accordingly, food and feed products have to be labeled if containing more than a defined proportion of GMOs. This threshold has been set to 0.9 % adventitious presence of GMOs in the final food product if the GMO is approved in the EU and to 0.5 % if the GMO is not yet authorized but has already received a favorable EU risk assessment. In order to comply with

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these rules a strict documentation system along the entire supply chain is also needed as the GMO content cannot be measured by analytical tests in highly processed food products (JANY and SCHUH, 2006; GASKELL ET AL., 2006; EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, 2003a/b).

However, each country - independently whether it is a net importer or exporter for agricultural products and food - is influenced by the restrictive attitude towards GM food in the European Union, which already supported the restructuring of the world-wide food market (EVENSON and SANTANIELLO, 2004). Therefore, for producers and for the trade it is especially interesting to know under which conditions consumers would choose a GM food product. This question is analyzed in this study using the example of rapeseed-oil.

The paper starts with a deeper analysis of consumer behavior towards GM food which is so far known from scientific literature. Furthermore, some facts concerning (GM) rapeseed are given. This is followed by a description of the theoretical background and the experimental design set up to investigate the subject. Afterwards the results of the conducted consumer survey are portrayed and discussed.

## 2   Consumer behavior towards GM food

As already presented in the introduction, consumers` acceptance is in particular a determining variable for the profitability and the development potential of GM food (EVENSON and SANTANIELLO, 2004).

It was analyzed in several studies which variables influence consumers` acceptance towards GM food. These studies show that primarily the perceived utility and the perceived risk affect the acceptance of genetic engineering. In particular, a distinct perception of the risk associated with GM technology decreases the acceptance of GM food and the probability that these products are consumed (SPARKS ET AL., 1994; FREWER ET AL., 1998; LUSK and COBLE, 2005). In contrast the perceived utility of a product is the factor which mainly causes the acceptance of GM food whereas the acceptance is larger, the larger the GM product`s utility for the consumer is (GASKELL ET AL., 2004, 2006; KNIGHT, 2006; BROWN and PING, 2003). Thus, consumers rather reject such GM plants and derived foods which have no direct advantage for them. For example herbicide tolerance caused by GM technology only simplifies the cultivation process and saves costs for the farmer but consumers have no benefits from herbicide tolerant GMOs. However, consumers react less negative on GM plants with which the application of pesticides and thus the environmental impact can be reduced. The by far highest acceptance enjoy GM plants which provide a clear personal advantage for consumers as e. g. products with health beneficial effects and improved ingredients (BROWN ET AL., 2003; MENRAD, 2000; HAMPEL ET AL., 1997; O'CONNOR ET AL., 2006; HU ET AL., 2004).

Information is another important factor affecting the acceptance of GM food, but already existing studies reveal different results. On the one hand emphasizing a GM product`s utility leads rather to rejection, on the other hand information makes consumers more confident regarding GM food. Some studies also found that information seems rather to strengthen than to change already existing positive or negative attitudes (BOCCALETTI and MORO, 2000; LUSK ET AL., 2004; FREWER ET AL., 1998; SCHOLDERER and FREWER, 2003). Furthermore, ethical, religious and political values have an influence on the acceptance of GM food – although a smaller one than perceived utility and risk (ANDERSON ET AL., 2006; KOIVISTO HURSTI and MAGNUSSON, 2003; COSTA-FONT and MOSSIALOS, 2005; GASKELL ET AL., 2003)

Regarding the influence of socio-demographic variables various studies show different results. Some studies reveal that mainly women as well as elderly and less educated persons are more likely to reject GM food. But there are also studies which demonstrate that higher educated respondents rather reject GM food products in contrast to women. Other studies however show that age as well as gender have no impact on the acceptance of GM food

(BURTON ET AL., 2001; GASKELL ET AL., 2003; COSTA-FONT ET AL., 2005; CHRISTOPH ET AL., 2008; HARTL, 2007).

## 3 GM rapeseed and rapeseed-oil

For a long time the cultivation of rapeseed was not attractive for agriculture, as there was hardly any possibility to use the seeds. The glucosinolates caused digesting problems, making the use as feed stuff almost impossible. Rapeseed-oil tasted bitter because of the high content of erucic acid. But the cultivation of rapeseed experienced a world-wide dissemination, since it is possible to breed new varieties with conventional methods, which hardly contain these ingredients anymore (TRANSGEN, 2009).

In recent years, especially the application of genetic engineering in the field of rape breeding was in the focus of public interest. Thereby the seed industry pursues different objectives. On the one hand resistances against herbicides, pathogens, parasites, weeds and drought were developed, on the other hand a change of the composition of ingredients or an enrichment with special health beneficial ingredients is possible. While in the European Union no commercial cultivation of genetically modified (GM) rapeseed takes place, in the USA and in particular in Canada over 80 % of the area cultivated with rapeseed is planted with GM varieties (TRANSGEN, 2009).

Rapeseed is predominantly processed to rapeseed-oil, which mainly provides the basis for the production of cooking fat and oil. Rapeseed-oil which is produced from EU-grown rapeseed is always a conventional product due to the missing cultivation of GM rapeseed. However, oils made from GM rapeseed as well as approved GM rapeseed varieties (which will be further processed in the EU) can be imported without any restrictions but must be labeled as such (see chapter 1) (TRANSGEN, 2006).

The example rapeseed-oil is suitable for the analysis of consumer preferences towards GM food for several reasons. It is a less processed product, thus it might be relatively easy for the respondents to establish a relationship to the raw commodity rapeseed (HARTL, 2007). As described above, rapeseed can be genetically modified in terms of environmental as well as health benefits. Therefore, GM rapeseed-oil is suitable to analyze consumer preferences towards GM food with associated environmental benefits and with associated health benefits at the same product. Moreover, the number of purchase-relevant characteristics is limited, which reduces the survey requirements on the respondents (HARTL, 2007). Several studies (HARTL, 2007; BANIK and SIMONS, 2008) revealed origin as one of these crucial attributes for the purchase decision regarding rapeseed-oil. Thus, this aspect is additionally included in the study on hand.

## 4 Description of the theoretical background and of the survey

To analyze under which conditions consumers would choose a GM food product a Discrete-Choice-Experiment (DCE) was performed. The following section deals with the theoretical background of discrete choice models and the experimental design which was set up in the survey.

### 4.1 Theoretical background

**Discrete-Choice-Experiments**

Choice experiments are based on the random utility theory (LOUVIERE ET AL., 2000), which was established by Thurston in 1927 and advanced inter alia by Luce and McFadden. The random utility theory assumes that an individual $q$ maximizes his utility when choosing between $J$ alternatives. Since the researcher is not fully informed about the decision of the individual it is necessary to partition the utility $U_{iq}$ of the $i$th alternative for the $q$th individual

into a systematic component (representative utility) $V_{iq}$ and a random or unobserved component $\varepsilon_{iq}$:

$$U_{iq} = V_{iq} + \varepsilon_{iq} \tag{1}$$

$\varepsilon_{iq}$ is the part of the utility, which cannot be observed by the researcher and includes unobserved attributes, unobserved peculiarities of individual tastes and measurement errors. In contrast $V_{iq}$ is the part of the utility, which can be observed by the researcher (LOUVIERE ET AL., 2000; MAIER and WEISS, 1990). It is a function of $Xiq$ and a coefficient $\beta i$ and an unknown parameter vector to be estimated. $Xiq$ defines a matrix which may contain attributes belonging to choice options, characteristics belonging to individuals or interactions between individual characteristics and attributes. In most practical applications it is assumed that $V_{iq}$ is a linear, additive function (ENNEKING, 2004).

If $A$ is defined as the universal choice set of discrete alternatives of products and $J$ the number of elements in $A$ then the key assumption in the choice model is, that individual $q$ will choose alternative $i$ if and only if

$$U_{iq} > U_{jq} \tag{2}$$

or $\quad V_{iq} + \varepsilon_{iq} > V_{jq} + \varepsilon_{jq} \qquad$ for all j unequal i $\tag{3}$

Taking (1) into account the probability that individual $q$ chooses $i$ from set $A$ is given by

$$P_{iq} = P(\varepsilon_{iq} - \varepsilon_{iq} \leq V_{iq} - V_{jq}) \tag{4}$$

According to equation (4) an individual $q$ will choose alternative $i$ if the observable utility of this alternative is larger than the utility of every other alternative and if this utility difference is not larger than the utility difference of the stochastic component $\varepsilon_{iq} - \varepsilon_{iq}$ (LOUVIERE ET AL., 2000; PROFETA, 2006).

To specify the choice probabilities of (4) it is necessary to make assumptions concerning the distribution of the random components. A popular distribution assumed in Discrete-Choice-Analysis is the extreme value type 1 (EV1) distribution, which enables the researcher to treat the random elements $\varepsilon_{iq}$ as independent and identically distributed (HENSHER ET AL., 2005). Underlying this distribution one can calculate the probability of an individual $q$ choosing option $i$ out of the set of $J$ alternatives as[2]:

$$P = \frac{e^{Viq}}{\sum_{j=1}^{J} e^{Vjq}} \; ; j \neq i, j = 1, ...J; \; q=1,...Q \tag{5}$$

or

$$P = \frac{1}{\sum_{j=1}^{J} e^{-(Vi-Vj)}} \; j \neq i, j= 1, ...J; \; q=1,...Q \tag{6}$$

To estimate the parameter of the choice model normally the maximum likelihood estimation (MLE) procedure is used. Therefore, the following log likelihood function L* has to be maximized with respect to the utility parameter $\beta$s:

$$L* = \sum_{q=1}^{Q} \sum_{j=1}^{J} f_{iq} \ln P_{iq} \tag{7}$$

where $f_{iq} = 1$ if alternative $j$ is chosen and $f_{iq} = 0$ otherwise (LOUVIERE ET AL., 2000).

**Willingness-to-pay**

Besides other methods (e. g. contingent evaluation) the willingness to pay can be estimated with a discrete choice model: The ratio of two ß-coefficients describes in a linear conditional logit model the willingness of a respondent to trade off one attribute against another. This

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[2] A detailed derivation of the conditional multinomial logit model can be found by LOUVIERE ET AL. 2000, p. 45 ff.

ratio corresponds to the willingness-to-pay (WTP) for a quality changed attribute, if the attribute in the denominator is a monetary variable:

$$WTP_{\text{quality changed attribute}} = \beta_{\text{quality changed attribute}} / (-\beta_{\text{monetary attribute}}) \qquad (8)$$

(ENNEKING, 2004).

To estimate standard errors and confidence intervals of estimated WTPs it is possible to apply the bootstrap method (EFRON and TIBISHIRANI, 1998). Thereby a simulated distribution is generated for the variable under consideration (e. g. WTP). This method makes no assumptions about the distribution of the coefficients in the model. To simulate the distribution of the variable of interest (e. g. WTP) a large number of samples of size N (with replacement) is drawn from the estimation sample. With each of these samples the specified model is estimated and the WTP is measured according to equation (8). After that the WTP values are ranked (smallest to largest) to identify the 2.5th and 97.5th percentile and to achieve the 95 % confidence interval, when applying the percentile confidence interval. The bootstrap method suits well for the estimation of confidence intervals if the sample size is small (ENNEKING, 2004; HOLE, 2007; SHIKANO, 2005).

## 4.2    Design of the survey

To estimate consumer preferences of genetically modified rapeseed-oil which is either locally grown or imported a choice experiment was conducted within the framework of a cross-European project. The data were collected by means of personal interviews. The sample was stratified according to age and income. Additionally, only people who are mainly responsible for buying food in a household and who buy rapeseed-oil were requested to participate. 319 interviews were conducted in Germany from March to April 2007. Besides the interviews in Germany, further 1,259 interviews were conducted in Great Britain, Spain, Poland and Denmark.

Within the choice experiments the respondents had to make their choice in each case between three alternative rapeseed-oil products. Table 1 shows which attributes and attribute levels were used to construct the products. Every product (alternative) is composed of three attributes: price, production technology and location of origin. These attributes were derived by means of a literature study, a pilot questionnaire and discussion by the project partners in the run-up of the main survey. To map the price margin occurring on the German market the price was presented in four levels and varied between 1.25 and 5 € per 750 ml rapeseed-oil. The attribute "location of origin" was defined as a dichotomous variable with the levels imported and locally produced. The attribute "production technology" exhibits four levels, which are conventional, organic, genetically modified with associated health benefits (enhancement of levels of beneficial anti-oxidants) and genetically modified with associated environmental benefits (resistance to the damaging effects of certain herbicides). For the model estimation the price variable is considered as linear, continuous, while all the other variables are defined discrete. The discrete variables were integrated as dummy coded variables.

With the specified attributes and attribute levels a 100 % efficient main effect design with three choices for each choice set was constructed by the Spanish project partner of the EU project (for details see COSTA-FONT ET AL., 2008a; COSTA-FONT ET AL. 2008b; JONES ET AL., 2008). The dataset for Germany was analyzed according to this general framework. The

decision to consider only main effects and no interaction effects was a compromise between simplicity and efficiency[3].

**Table 1: Attributes and attribute levels used in the Discrete-Choice-Experiment**

| Attribute | Attribute Levels | Variable name |
|---|---|---|
| Production technology | Conventional | conventional |
| | Organic | bio |
| | GM health benefits | GM_health |
| | GM environmental benefits | GM_envir |
| Origin | Locally produced | inland |
| | Imported | import |
| Price | 1.25 € | price |
| | 2.50 € | |
| | 4.00 € | |
| | 5.00 € | |

Source: Co-Extra consumer survey, 2007

To construct the main effect model a fractional factorial design was generated using the SPSS statistical package for orthogonal main effect designs. The final fractional factorial design for the choice experiment consisted of 16 choice sets, which were split into two groups (blocking). Thus, each interviewee had to complete 8 randomly selected choices. Besides the choice experiment interviewees had to answer questions dealing with their general food purchasing behavior, their knowledge/trust in GM and their attitudes towards organic and GM products as well as their socio-demographic characteristics. Table 2 provides an overview concerning questions dealing with attitudes towards GM as well as risk evaluation of GM, which are relevant for the estimation of the final model.

**Table 2: Exogenous variables included in the estimation**

| Question wording | Variable name | Mean (n) |
|---|---|---|
| Please rank the following technologies in terms of risk to human health: GM technology (where 1=Very high risk; 5=Very low risk) | risk_GM | 2.33 (n=282) |
| Growing genetically modified crops will be harmful to the environment (where 1 = strongly agree; 5 = strongly disagree) | harm_envir | 3.49 (n=263) |

Source: Co-Extra consumer survey, 2007

## 5 Results of the survey

Overall, 319 people participated in the survey. Since all 319 questionnaires were fully completed 2,522 choice sets (= 7,656 choices) could be used for the estimation of the model. The estimation was done with the software STATA 10. Additionally, table 3 summarizes some key data of the socio-demographic characteristics in the sample. It shows that women are overrepresented in the sample compared to the distribution in the German population (2007: 49 % women, 51 % men)[4] (STATISTISCHES BUNDESAMT, 2009). This is mainly due to the fact that the interviewees should be persons, who are mainly responsible for buying food in the household.

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[3] Main effects explain up to 80 % of the model variance. Interaction effects explain further 2-3 % of the model variance, whereby this addition is accompanied by an increase in the number of choice sets, when an efficient design should be reached (LOUVIERE ET AL. 2000).

[4] In case of age and income a comparison of the sample with the distribution in the German population is not possible due to the use of different categories.

**Table 3: Key data of socio-demographic characteristics in the sample**

| | | % of sample (n=319) | | % of sample (n=319) |
|---|---|---|---|---|
| Gender | male | 22.26 | female | 77.74 |
| Age | 18-25 years | 24.45 | 26-40 years | 23.51 |
| | 41-65 years | 27.27 | > 65 year | 24.76 |
| Household income | < 833 € | 16.93 | 833-1,666 € | 42.32 |
| | 1,667-2,499 € | 21.94 | 2,500-3,333 € | 12.23 |
| | > 3,334 € | 6.58 | | |

Source: Co-Extra consumer survey, 2007

## 5.1 Description of the final choice model

The results of the estimated conditional logit model are shown in table 4. The LR test confirms that the model is statistical significant, since the null hypothesis that the ß parameters are equal to zero can be rejected (LOUVIERE ET AL., 2000). Additionally, the iia-assumption, which states "that the ratio of the probabilities of choosing any two alternatives is independent of the attributes of any other alternative in the choice set" could be verified with the Hausman test of independence of irrelevant alternatives (HAUSMAN and MCFADDEN, 1984). With 0.2709 the pseudo R² reaches an acceptable level.

**Table 4: Final model estimation results**

| Variable | ß-Coefficient | Standard Error | z | P>z | Odds Ratio |
|---|---|---|---|---|---|
| price | -.434489 | .0196255 | -22.14 | 0.000 | .6475955 |
| inland | .6689595 | .0500539 | 13.36 | 0.000 | 1.952205 |
| bio | .7668194 | .0652772 | 11.75 | 0.000 | 2.152908 |
| GM_health | -.5012956 | .0729722 | -6.87 | 0.000 | .6057453 |
| GM_envir | -.8194933 | .0762379 | -10.75 | 0.000 | .4406549 |
| GM_envirXrisk_GM | .5043283 | .0789321 | 6.39 | 0.000 | 1.655873 |
| GM_healthXrisk_GM | .6511501 | .0733014 | 8.88 | 0.000 | 1.917745 |
| GM_envirXharm_envir | -.4301102 | .0845019 | -5.09 | 0.000 | .6504374 |
| GM_healthXharm_envir | -.5940937 | .0785078 | -7.57 | 0.000 | .5520627 |

No. of obsv = 7,656; LR Chi² = 1,519.24; (p = 0.0000); Log likelihood = -2,044.039; pseudo R² = 0.2709

Source: Co-Extra consumer survey, 2007

All ß-coefficients of the variables are highly significant, exhibit the expected sign and thus have a significant influence on German consumers' utility of rapeseed-oil.

As expected, the coefficient for the price variable is negative, indicating that the higher the price the less likely interviewees are choosing the product.

The ß-coefficient for the inland variable shows that consumers prefer domestically produced rapeseed-oil compared to imported products. This is consistent with the results of other studies dealing with consumer behavior towards rapeseed-oil products (HARTL, 2007; BANIK and SIMONS, 2008).

Looking at the coefficients for the attribute "production technology" it is obvious, that organically produced rapeseed-oil increases consumers' utility, whereas a genetic modification decreases consumers' utility compared to a conventionally produced rapeseed-oil. The coefficient for a genetic modification with associated environmental benefits is more negative than the coefficient for a genetic modification with associated health benefits, thus

the first decreasing consumers' utility more than a GM rapeseed-oil offering health benefits. But both alternatives are estimated clearly negative by the consumers.

The effect of a genetic modification decreases consumers' utility the less, the lower respondents evaluate the risk of GM technology for human health (interaction GM_envir*risk_GM, interaction GM_health*risk_GM). But the higher respondents estimate the harm of growing GM crops for the environment, the more decreases consumers' utility for a genetically modified product. Thereby, the effect is biggest, when the genetic modification aims at human health benefits (interaction GM_health*harm_envir, interaction GM_envir*harm_envir). Other studies point out similar results concerning risk perception and environmental attitudes (see chapter 1).

The influence of socio-demographic characteristics as well as information given to consumers on the acceptance of GM products is not clear, since different studies provide different results. As already mentioned some studies show that women, elderly and less educated persons are most likely to reject GM food, some studies reveal that - in contrast to women - higher educated respondents refuse GM products. Other research results show that age as well as gender have no impact on the acceptance of GM food (BURTON ET AL., 2001; GASKELL ET AL., 2003; COSTA-FONT ET AL., 2005; CHRISTOPH ET AL., 2008; HARTL, 2007). In case of information studies show on the one hand that emphasizing a GM product`s utility rather leads to rejection, and on the other hand that information makes consumers more confident regarding GM food (BOCCALETTI and MORO, 2000; LUSK ET AL., 2004; FREWER ET AL., 1998; SCHOLDERER and FREWER, 2003). In this survey however no significant effects of socio-demographic variables (gender, age, income etc.) as well as information could be estimated. Thus, such variables were not included in the final model.

## 5.2 Willingness-to-pay for genetically modified rapeseed-oil

With the estimated ß-coefficients it is possible to estimate consumers' willingness-to-pay for the varying rapeseed-oil-products following equation (8). The WTP for the different production technologies can be derived by taking the ratio of the coefficient of the production-technology (e. g. bio) to the coefficient of the monetary attribute (price). Additionally, bootstrap method is applied to estimate confidence intervals of the WTP.

Therefore, 1,000 samples were taken from the observed data with replacement to estimate ß-coefficients for each of these samples and calculate the respective WTP. On the basis of these replications the distribution of WTP for rapeseed-oil was computed and the 95 % confidence interval of the WTP was obtained with the percentile method (see chapter 3.1). Table 5 summarizes the estimated WTP (€/750 ml) to change from a conventional production to another technology and respectively from an imported to a locally produced product as well as the bootstrap percentile confidence intervals.

German consumers are willing to pay a premium for organically produced as well as locally produced rapeseed-oil. On average they are prepared to pay 1.77 €/750 ml more compared to a conventional produced one and respectively 1.54 €/750 ml more for a locally produced one compared to an imported rapeseed-oil. In contrast a genetically modified product results in a decreased WTP. German consumers are only willing to switch from a conventional product to a genetically modified if it exhibits a discount of 1.15 €/750 ml rapeseed-oil (GM with associated health benefits) and 1.88 €/750 ml rapeseed-oil (GM with associated environmental benefits) respectively.

**Table 5:Estimated WTP (€/750 ml rapeseed-oil) and bootstrap percentile confidence intervals**

| Attribute | bio | GM_health | GM_envir | inland |
|---|---|---|---|---|
| WTP | 1.765 | -1.154 | -1.886 | 1.540 |
| Bootstrap 95 % confidence interval | (1.298; 2.050) | (-1.554; -0.747) | (-2.311; -1.460) | (1.249; 1.853) |

Source: Co-Extra consumer survey, 2007

Additionally market shares of hypothetical GM rapeseed-oil products were simulated on the basis of the estimated conditional logit model. Therefore individual participant's probability of choosing each of the alternatives under different scenarios was predicted and summed up to achieve the simulated share of each alternative in the market. Table 6 summarizes the results for two hypothetical scenarios. In scenario 1 three different products exist on the market: two which are GM modified with associated health benefits and either locally produced or imported and a conventional, locally produced reference product. In scenario 2 the two genetically modified products exhibit environmental benefits. If all products cost 2.50 €/750 ml the conventional product reaches the biggest market share in both scenarios (52 % and 60 % respectively). In accordance with the estimated ß-coefficients the market share of the reference product is bigger in scenario 2 compared to scenario 1, since a genetic modification with associated environmental benefits decreases consumers' utility more than a GM rapeseed-oil with health benefits. If prices for GM products are decreased and the price for the conventional product is hold constant at 2.50 €/750 ml market shares for the GM products grow. At a price of 1.35 €/750 ml (scenario 1) or 0.62 €/750 ml (scenario 2) respectively the market shares for the locally produced GM product and the locally produced conventional product are the same. In this case the price difference to the conventional product (1.15 €/750 ml in scenario 1; 1.88 €/750 ml in scenario 2) reflects the discount, which is necessary in order that consumers switch from the conventional to the GM rapeseed-oil (see table 5).

**Table 6: Simulated market shares**

| Product | Price [€] | Simulated market share [%] | Price [€] | Simulated market share [%] |
|---|---|---|---|---|
| Scenario 1 | | | | |
| GM health, locally produced | 2.50 | 31.74 | 1.35 | 39.76 |
| GM health, imported | 2.50 | 16.34 | 1.35 | 20.50 |
| Conventional, locally produced | 2.50 | 51.91 | 2.50 | 39.75 |
| Scenario 2 | | | | |
| GM envir, locally produced | 2.50 | 26.65 | 0.62 | 39.74 |
| GM envir, imported | 2.50 | 13.71 | 0.62 | 20.49 |
| Conventional, locally produced | 2.50 | 59.63 | 2.50 | 39.77 |

Source: Consumer survey Co-Extra, 2007

## 6    Discussion

The main results of the conducted survey are consistent with findings of other studies. It could be shown that German consumers prefer organically produced rapeseed-oil and reject a genetically modified one compared to a conventional product. This goes hand in hand with the results of HARTL (2007), who showed that consumers' utility is highest if rapeseed is grown organically, followed by a conventional produced and a GM rapeseed-oil product. Additionally, it can be concluded from the survey results that consumers oppose a GM

product less if the genetic modification leads to advantages for themselves (e. g. health benefits). A similar result was obtained e. g. by HU ET AL. (2004). They showed that two consumer segments exist (value seeking consumers, anti-GM-consumers), of which the marginal attribute values (ratio attribute – price coefficient) are more negative in the case of genetic modification with environmental benefits compared to the one with health benefits (produced environmentally friendly vs. rich in healthy vitamins). Moreover, O'CONNOR ET AL. (2006) demonstrated that in three of four identified consumer segments the utility score for a GM product with a health claim is less negative compared to a genetic modification with no associated claim. Thus, market shares for GM products can be gained if individual advantages like health benefits are associated with them.

Another possibility to increase consumer acceptance towards GM products resulting from this study and being in line with other research (e. g. SPARKS ET AL., 1994; FREWER ET AL., 1998; LUSK and COBLE, 2005) is the reduction of perceived risk regarding GM technology (e. g. by means of risk communication from trusted sources).

The results of this survey show additionally, that an indication of the designation of origin (here locally produced) affects consumer preferences towards the product positively. This is in line with other studies for products like e. g. beef, beer (PROFETA, 2006) and specifically for rapeseed-oil, too. HARTL (2007) could demonstrate that consumers' utility increase significantly, if the utilized rapeseed is grown within Germany. Additionally, BANIK and SIMONS (2008) could confirm that there exists a group of rapeseed-oil consumers holding trust in local food and perceive food labeled with its origin as of higher quality and health-related value than comparable, non-local food. Due to the applied main effect design interaction effects of the origin and the GM production technology cannot be estimated. Therefore, it is not possible to estimate the combined effect of these too variables on consumer acceptance. But the simulated market shares (see table 6) show that the indication of a local production can lead to higher market shares for GM products compared to imported GM products. This is an indicator for the high relevance of origin for the consumers` decision making process and rises the question how and to what extent region-of-origin cues can compensate negative perceptions of GM products. Therefore, further qualitative and quantitative analyzes seem to be necessary to further clarify this question.

Furthermore, the survey results show that there exists market potential for GM food in Germany if the GM products exhibit a considerable discount compared to conventional products. For rapeseed-oil this discount lies between 1.15 €/750 ml for GM rapeseed-oil with associated health benefits and 1.88 €/750 ml for GM rapeseed-oil with associated environmental benefits. However, it should be emphasized that for most food products market shares increase if prices decrease. Therefore, even for GM products with associated health benefits - for which the necessity of price reductions are diminished - the granting of discounts must be carefully balanced especially against the background of profitability for producers and processors.

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