

# Non conventional technologies and impact on consumer behavior

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Consumers are becoming more conscious about the potentially negative impact of food processing on human health and the environment. In particular, there is increased public concern about the application of emerging technologies such as genetic modification to food production, particularly with respect to consumer perceptions of potential for negative impact of genetically modified organisms on ecology. However, less is understood about consumer acceptance of potentially controversial technologies where such technological innovation replaces traditional manufacturing methods, which themselves have the potential for environmental harm. In the present study, consumer acceptance of a genetically modified product was examined. In this research, the process of genetic modification had the

potential for reducing the environmental impact caused by the alternative, traditional method of production. The analysis took account of the effects of other factors such as reduced price and brand in consumer decision making, as well as the provision of information about manufacturing process. The product investigated was vegetable oil. One hundred and sixty five consumers evaluated the relative importance of different combinations of manufacturing process (traditional process, *versus* genetic modification) as well as the commercial brand (familiar *versus* unknown), price (low *versus* high) and label image (sunflower *versus* an image of a green globe indicating environmental friendliness), on purchase intentions. The data were analysed using conjoint and cluster analyses. Three clusters of consumers were identified. The first cluster (11% of the sample) based the purchase intention decisions on the label the image. The second one (25% of the sample) preferred environmentally friendly oil, highly priced and branded as Mazola. The third cluster (19% of the sample) considered mainly information about manufacturing process as of importance to their decision about purchases. In particular, these consumers preferred products associated with information about “environmentally friendly processing methods”. The results are compared with a similar sample of British respondents, and the implications of cross-cultural differences discussed.

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Consumers are becoming increasingly concerned about both the quality of the food they eat, and about food safety. These quality and risk-related perceptions mean that, for consumers, it is essential that they associate products with adequate (and technologically appropriate) hygiene practices, for example, food irradiation has been rejected by European consumers, despite reductions in micro-biological risk to those consuming irradiated products [1]. Consumers are also concerned about nutrition and sensory aspects of foods. A food, which meets nutritional requirements, is unlikely to be accepted by consumers if they do not like the flavour or other quality attributes. Finally, the method of production is also of increasing concern to many consumers. Pesticide application, genetic modification of plants, animals and micro-organisms, and other technological innovations have all resulted in an extremely volatile

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public debate about the merits and disadvantages of many food production technologies in many parts of the world. The growth market in “organic” or “ecological” foods is the result of many consumers becoming increasingly concerned about agrochemical residues, environmental impacts, and the possible negative impacts of human health [2]. Reassurances of technical safety from representatives of the scientific and regulatory communities have failed to convince consumers that their real concerns about food security are being addressed by those institutions designed to promote the security of the food supply. One result of this concern is that many non-government organisations are calling for the adoption of the precautionary principal as the standard approach to regulatory practice, which mitigates against the development and assessment of new technologies in field trials outside of controlled laboratory settings. Many consumers are seeking foods with reduced technological inputs into processing. However, genetic modification of food, for example, might be more acceptable to consumers if the technology resulted in *reduced* environmental impact relative to traditional manufacturing processes, or result in some other desirable and tangible benefit, such as reduced price. In other words, directing technological innovations towards outcomes that consumers *actually want* may mitigate against negative perceptions associated with the process itself [3]. Other factors may also be important in the acceptance of emerging food technologies. For example, it has been demonstrated that packaging plays an important role in consumer food choice [4], and the features of the label are likely to influence consumer food perception, mainly to novel foods, obtained through the application of new technologies. Finally, it is important to understand that consumers are not homogenous; consumer reactions to a particular product are prone to intra-individual [5] and cross-cultural variations [6].

The present study aimed to investigate the impact of different manufacturing processes, brand, price and label image on Brazilian consumers intention to purchase food quality vegetable oils. Traditional manufacturing processes involve the use of solvents, which have the potential for negatively impacting on the environment. Alternative production processes, which do not involve the use of solvents, may require the application of new technologies such as genetic modification to the plants from which the oil is derived. It is of interest to examine whether the potential for reduced environmental impact increases acceptance of genetic modification used in food production. Decisions regarding the acceptance or rejection of genetically modified foods was interpreted in terms other attitudinal variables and values held by respondents. These were the Need for Cognition (NFC), attitude towards genetic modification, and concern about the environmental impact of technology. In addition,

demographic data were used to understand consumer decision making with respect to genetically modified vegetable oil. The design of the study replicated research conducted in the United Kingdom in 1996, enabling the results to be directly compared, and conclusions to be made regarding cross-cultural differences in responses to genetically modified foods [7]. The vegetable oil was used as an example of a food product because it is widely consumed by both Brazilian and British consumers, increasing the validity of cross-cultural comparison.

### Material and methods

One hundred and sixty five respondents took part in this study. Their ages varied from 16 to 58 years (mean age 37 years). Respondents were selected from a wide range of occupations and educational backgrounds to reflect the structure of the Brazilian population as a whole. Inclusion in the study was voluntary, and respondents were not paid following their participation in the experiment.

#### Package manipulation

Manipulating the four features of interest in the current research involved altering the label design on the product created the sunflower oil labels. These features were:

1. The provision of information about how the product was produced, (genetically modified to enable an “environmentally friendly” solvent free production process to be used, OR “traditional” using “environmentally unfriendly” solvent extraction processes, OR simply using “environmentally friendly” production methods with no mention of genetic modification)
2. Price, (cheap OR expensive)
3. Brand name (established OR unknown)
4. Label imagery (traditional, sunflower OR “green” globe, which conveyed symbolically that the product was manufactured in a way that minimised environmental impact) (Table 1). In all other ways, the product appeared identical for across all experimental conditions.

“Mazola” is a well-known brand but “Pétala” is not a recognised brand. The prices realistically reflect Brazilian retail price ranges for food vegetable oils at the time of data collection.

The features used to design the labels were obtained either from commercial products available in the market place or created specially for the study using Adobe PhotoShop software<sup>TM</sup> for Macintosh<sup>®</sup>. Features such as brand name were photographed with colour slide film and then scanned into a photographic image-retouching programme. A factorial design was used in order to get a reasonable number of design combinations [8].

Feature	Levels	Description of levels
Brand name	2	Familiar name: Mazola Unfamiliar name: Pétala
Information	3	Environmentally friendly process Genetic engineering Traditional process
Picture	2	Product: sunflower Environment: green globe
Price	2	Low: R\$ 1.05 High: R\$ 1.80

### Experimental design

A 3×2×3 design was applied in order to investigate both main effects and interactions between the 2 level factors (price, image and brand) and the 3 level factor (information about different production methods).

### Image display

The eighteen images were transformed into slides and projected on a screen placed in a non-illuminated room. The first slide projected was identical for all the experimental sessions, aimed at removing the “first sample effect” (representing the “19th” slide in the design). This slide was a image of an oil package without brand name and information, but with sunflower illustration. Subsequent presentations were presented in different sequences to remove order effects.

### Data collection

The respondents (seated around the table) looked at each image for a standard time (15 seconds) [9]. After presentation of each slide, the image was replaced by a blank slide. Each sunflower oil portrayed in the photographic image was then assessed on the rating scale provided. “Purchase intention” was assessed using a non-structured horizontal nine-centimetre line scale, with the left side anchored as “definitely would not buy” and the right anchored as “definitely would buy”.

After 15 seconds, the next image was projected on the screen and consumers repeated their evaluations for the next product. This process was repeated until the 19 products images had been shown to respondents and rated sequentially. Eight consumers took part in each session.

Following the collection of purchase intention data, the respondents completed a range of attitudinal questionnaires designed to elicit information about salient attitudes (attitudes to genetic modification, and the environment) and cognitive styles. These were the;

1. “Need for Cognition” scale, or NFC, [10], which assesses the tendency for individuals to engage in and enjoy thinking and effortful information processing

2. Consumer attitudes towards the use of genetic modification in food production (with items focused on vegetable oils) [11]
3. Attitudes towards the environment [12]
4. Demographic data were collected from each respondent. Information was collected about the gender, age, occupation, level of education and household income for each respondent, to enable individual differences in attitudes and decision-making behaviour to be analysed, and to facilitate interpretation of the clusters obtained in the analysis.

### Analysis

The data were analysed using Cluster and Conjoint Analysis [13,14]. Each consumer’s results were analysed individually. Part-worths for each individual for the main effects of the different factors were calculated, together with interactions of interest. As the variance in the consumers ratings was very large, a standardisation with the subject scores was applied to the results. This standardisation was made by dividing subject’s mean by the standard deviation (SD), as follows:  $STD_{score} = (\text{subj. score} - \text{mean score}) / SD$ . The consumers whose conjoint model did not significantly fit the model were excluded from further analysis ( $P = 0.20$ ).

A hierarchical cluster analysis was performed on the part-worths, with the aim of identifying groups of respondents with similar responses to variations in the experimental manipulations with respect to “purchase intention”. Groups with similar decision making criteria were identified using dendrograms. Once clusters had been identified, mean part-worths for each factor within each cluster were identified. Analysis of variance was carried out to check for differences between clusters in terms of demographic and attitudinal measures.

### Results

Fifty-seven respondents were excluded from the analysis because the conjoint model did not fit their responses at the  $P = 0.20$  level. Following deletion of these data, three clusters of respondents were identified from the dendrogram produced by the cluster analysis (Table 2). Eighteen respondents did not fit into the clusters and their results will not be discussed further.

Cluster 1 comprised 11% of respondents who made purchase decisions based on the label illustration. These respondents expressed greater intention to purchase products with the sunflower image on the label. However, information provision and brand name influenced decision making for these respondents ( $P < 0.05$ ). The familiar brand “Mazola” and the provision of information about genetic modification used in production of the vegetable oil increased the likelihood of purchase for respondents in cluster 1.

The second cluster (25% of respondents), based their purchase intention on information, price and brand

**Table 2. Purchase intention standardisation and relative importance of sunflower oil label aspects for three cluster of consumers<sup>a</sup>**

	Cluster 1 (n = 18)	Cluster 2 (n = 41)	Cluster 3 (n = 31)
<b>Information</b>			
● Traditional	0.00 <sup>a</sup>	0.00 <sup>b</sup>	0.00 <sup>a</sup>
● Genetic engineering	0.11 <sup>b</sup>	-0.81 <sup>a</sup>	1.02 <sup>b</sup>
● Environmentally friendly	0.00 <sup>a</sup>	0.34 <sup>c</sup>	1.80 <sup>c</sup>
Relative importance	8%	42%	87%
<b>Price</b>			
● High	0.00	0.00 <sup>b</sup>	0.00 <sup>b</sup>
● Low	0.19	-0.82 <sup>a</sup>	-0.17 <sup>a</sup>
Relative importance	13%	30%	5%
<b>Illustration</b>			
● Sunflower	0.00 <sup>b</sup>	0.00	0.00 <sup>b</sup>
● Green globe	-1.09 <sup>a</sup>	-0.09	-0.14 <sup>a</sup>
Relative importance	76%	3%	4%
<b>Brand</b>			
● Mazola	0.00 <sup>b</sup>	0.00 <sup>b</sup>	0.00 <sup>b</sup>
● Pétala	-0.04 <sup>a</sup>	-0.69 <sup>a</sup>	-0.10 <sup>a</sup>
Relative importance	3%	25%	3%

<sup>a</sup> Different letters denote significant differences ( $P < 0.05$ ). The sign- (minus) before the scores means that the feature had a negative impact on consumer's purchase likelihood evaluation.

name. These respondents were more likely to purchase vegetable oils associated with "environmentally friendliness," and were also prepared to pay a higher retail price for the product. These respondents also appeared to prefer a familiar brand to the novel brand ( $P < 0.05$ ).

Cluster 3, which comprised 19% of respondents, reacted most strongly to information as the most important contributor to purchase decisions. These respondents expressed higher purchase intentions for the environmentally friendly oil. The Mazola brand name, high price and sunflower illustration also increased purchase intention for respondents within cluster 3 ( $P < 0.05$ ).

Analysis of variance indicated that there were no differences between the three clusters in term of respondents need for cognition, nor attitudes of respondents towards genetic modification used in food production. However, there is some evidence that respondents in cluster 3 had a slightly higher NFC. Respondents in this cluster were also more affected by information provision, which is consistent with other research, although the effect did not reach significance. For example Haugtvedt [15] proposed in their studies that consumers with high NFC were more influenced by information, as they preferred to process in depth and internalise information about a product rather than to make assumptions based on labels and other external cues.

There was a marginal difference ( $P = 0.06$ ) in the relative number of men and women in each of the clusters. Specifically, a greater number of women (67%) were members of cluster 1. This finding is consistent with recent research that has indicated that women tend to be more concerned with environmental and health issues, as well as nutrition information [16–21]. Furthermore, Steenkamp [22] has observed that the design of the package is a more important aspect of purchase intention for women, which may reflect the gender bias observed in cluster 1.

Analysis of variance also indicated that there were differences between the three clusters in terms of respondent attitude towards the environment ( $P < 0.05$ ). Respondents in cluster 3 were more likely to express high levels of environmental concern, and, consistent with this view, were more likely to purchase environmentally friendly vegetable oil.

## Discussion

Comparison with research originally conducted in the UK [7] indicated that there are cross-cultural differences between Brazilian and British consumers in terms of their acceptance of genetically modified vegetable oils, although these differences are not profound. British consumers (about 30% of the sample) were very price sensitive, and tended to make purchases based on lower prices, independent of other factors such as information provision, brand or manufacturing process. The majority of consumers (67%) in the British sample preferred environmentally friendly products and rejected genetically modified equivalents, independent of whether the process of genetic modification resulted in reduced environmental impact.

Many of the Brazilian respondents considered in this study were also concerned about green issues and environmentally advantageous products- but did not appear to believe that the application of genetic modification to food processing mitigated against environmental protection. In the UK, consumer negativity towards genetically modified foods has been a matter of public and media debate for several years [23], which has not been the case in Brazil. However, such cross-cultural differences may not be temporally stable, but are prone to influence by other factors such as media attention to the risks and benefits of genetically modified foods in a given culture. Thus attitudes in Brazil may become more negative in the future if there is saturation level media reporting associated with genetic modification. Such saturation levels of reporting may result in a wider public debate about genetic modification within Brazil, but may also serve to crystallise opinions. Once people have formed an opinion about an issue (for example the acceptability of genetically modified foods), it seems that they filter new information in a way which consistent with these views. That is, people respond to new information in an attitude consistent way [24,25].

In many parts of the world, consumers are prepared to pay a premium for products, which are produced, using environmentally friendly methods [2,26]. Our results confirm that Brazilian consumers who are also concerned about the environment are prepared to pay a premium for products manufactured using low methods with low environmental impact. The results reported here appear to indicate that this proportion of Brazilian consumers is not insubstantial, although more research is needed to determine major demographic differences associated with income exist across the Brazilian population as a whole.

In Brazil, the brand name Mazola, considered as familiar brand oil in the market place, tended to increase consumer acceptance of the different oils, particularly when associated with the sunflower image normally associated with this brand. Trusted brands may be more important for Brazilians compared to British consumers—more research may indicate that new technologies or innovative production techniques are more acceptable to Brazilian consumers if associated with a trusted brand. This is NOT the case in the United Kingdom, where pairing potentially non-acceptable technologies with valuable brands may result in loss of the brand rather than acceptance of the technology.

It is possible that Brazilian consumers in clusters 2 and 3 associated environmental friendliness with higher product quality, and were thus prepared to pay a higher price for the product. This effect was not impaired by acknowledgement of the use of genetic modification in the production process. Other authors [27,28] have observed analogous results, where the consumer has assumed a higher price is indicative of better quality. Of course, the respondents may have also (consciously or otherwise) been attempting to impress the researcher with their appreciation and preference for higher quality products [29,30]. This effect, whereby consumers are prepared to pay more for high quality products has been shown to be prone to age effects in other studies [7,17,31]. This does not appear to be the case for Brazilian consumers, although it is inappropriate to generalise to other product types from the limited experimental design employed in the research reported here.

## Conclusions

At present, Brazilian consumers appear less concerned than their British counterparts about the use of genetic modification in food production, although this situation may, of course, change in the future. Brazilians appear to accept genetic modification in food production, the British appear not to, even if environmental impact is reduced through its application. This may be because the British are concerned about the potential for negative environmental impact associated with genetic modification itself [3].

Cross-cultural differences in acceptance do, of course, have implications for the long-term development of international trade and regulation. European legislation is taking a precautionary approach towards market approvals of genetically modified organisms [32]. How will such precautionary regulation impact upon European confidence in products exported from regulatory environments with less precautionary approaches to regulation of genetically modified food products? The long-term impact of such international diversity of public acceptance of food technologies opinion on the continuing evolution of world trade (and by implication, political structures and international science policy) is surely worthy of empirical research and informed commentary in the future.

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