Original

Consumer preferences of genetically modified foods of vegetal and animal origin in Chile

Preferências dos consumidores aos alimentos geneticamente modificados de origem animal e vegetal no Chile

Berta SCHNETTLER[1]*, Horacio MIRANDA[1], José SEPÚLVEDA[2], Marianela DENEGRI[2]

Abstract

Given the debate generated by Genetically Modified (GM) foods in developed and developing countries, the aim was to evaluate the importance of determining factors in the preference of consumers in Temuco and Talca in central-southern Chile for GM foods using conjoint analysis and to determine the existence of different market segments using a survey of 800 people. Using conjoint analysis, it was established that, in general, genetic modification was a more important factor than either brand or price in the consumer's decision to purchase either food. Cluster analysis identified three segments: the largest (51.4%) assigned greatest importance to brand and preferred genetically modified milk and tomato sauce; the second group (41.0%) gave greatest importance to the existence of genetic manipulation and preferred non-genetically modified foods; the smallest segment (7.6%) mainly valued price and preferred milk and tomato sauce with no genetic manipulation. The three segments rejected the store brand and preferred to pay less for both foods. The results are discussed based on studies conducted in developed and developing countries.

Keywords: *genetically modified foods; milk; tomato sauce; conjoint analysis; cluster analysis.*

Resumo

Com base no debate gerado pelos alimentos geneticamente modificados (GM), tanto em países desenvolvidos como em países em desenvolvimento, a partir do uso da *conjoint analysis*, o objetivo foi avaliar a importância dos fatores determinantes na preferência de alimentos GM pelos consumidores das cidades de Temuco e Talca, zona Centro-Sul do Chile, e a existência de diferentes segmentos de mercado, mediante uma enquete a 800 pessoas. Utilizando *conjoint analysis*, se determinou, em geral, que a existência de modificação genética foi mais importante que a marca e o preço na decisão de compra de ambos os alimentos. Mediante análise *cluster*, se distinguiram três segmentos, o mais numeroso (51,4%) deu leve maior importância à marca e preferiu leite e molho de tomate geneticamente modificado. O segundo grupo (41,0%) deu maior importância à existência de manipulação genética e mostrou preferência por ambos os alimentos sem manipulação genética. O segmento minoritário (7,6%) valorou em maior medida o preço e preferiu leite e molho de tomate sem manipulação genética. Os três segmentos rejeitam o produto com marca própria e preferem pagar o menor preço em ambos os alimentos. Os resultados são discutidos em relação a estudos realizados em países desenvolvidos e em desenvolvimento.

Palavras-chave: *alimentos geneticamente modificados; leite; molho de tomates; análise conjunto; análise cluster.*

1 Introduction

Agriculturally applied biotechnology is strategically important for underdeveloped countries whose economy is based on their agricultural resources. Research, development, and commercialisation of biotechnological products have usually been based on the offer of these products. More recently, there have been some issues related to their acceptance by the general public (MUCCI; HOUGH; ZILIANI, 2004). Several studies report a predominant consumer preference for non-genetically modified foods (KOIVISTO HURSTI; MAGNUSSON, 2003; LUSK; ROOSEN; FOX, 2003; HO; VERMEER; ZHAO, 2006; COSTA-FONT; GIL; TRAILL, 2008). Those consumers are willing to pay a premium for non-genetically modified foods (COSTA-FONT; GIL; TRAILL, 2008). However, there is evidence that some consumers may be indifferent to this situation (SPENCE; TOWNSED, 2006; TOWNSEND, 2006). Attitudes towards biotechnology depend on the organism in which it is applied and the type of modification; genetic modifications of plants or microorganisms are better accepted than modifications of animals (FREWER et al., 2004; NAYGA JUNIOR; FISHER; ONYANGO, 2006). Some authors even suggest that the effects of genetic modification differ between product categories because it is a feature that affects product evaluation (TENBÜLT et al., 2005; TENBÜLT et al., 2008).

The perceived benefits and risks of biotechnology are the main reason for certain attitudes towards genetic manipulation, which are determined by the knowledge of Genetically Modified (GM) foods (HOSSAIN et al., 2003; VERDUME; VIAENE, 2003; TOWNSEND, 2006). Substantial advantages such as a lower price (LUSK et al., 2002; HOSSAIN et al., 2003; NOUSSAIR; ROBIN; RUFFIEUX, 2004; KAYE-BLAKE; BICKNELL; SAUNDERS, 2005), environmental benefits (TAIT, 2001; BLAINE; KAMALDEEN; POWELL, 2002;

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[1] *Departamento de Producción Agropecuaria, Facultad de Ciencias Agropecuarias y Forestales, Universidad de La Frontera, Av. Francisco Salazar 01145, Casilla, 54-D, Temuco, Chile, e-mail: bschnett@ufro.cl*
[2] *Departamento de Psicología, Facultad de Educación y Humanidades, Universidad de La Frontera*
**Corresponding author*

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NAPIER et al., 2004; KAYE-BLAKE; BICKNELL; SAUNDERS, 2005; GANIERE; CHERN; HAHN, 2006), and benefits to the region's economy (VERDUME; VIAENE, 2003) among others should compensate for the perceived risk, thus resulting in a positive attitude towards GM foods. However, other studies have reported a negative attitude towards GM foods that is not compensated by added benefits, as is the case in Scandinavian countries (GRUNERT et al., 2001). Along the same line, Burton et al. (2001) in the UK and McCluskey et al. (2003) in Japan determined that consumers required a discount between 26 and 50% for foods made with GM ingredients.

The level of confidence is very relevant to the acceptance of GM foods: high levels of mistrust increase the perception of risk, thereby decreasing consumer acceptance (GASKELL et al., 1999). Hence it has been reported that consumers are more willing to purchase GM foods from well known and trustworthy brands (DA COSTA et al., 2000; BAKER; BURNHAM, 2002; VERDUME; VIAENE, 2003; MUCCI; HOUGH; ZILIANI, 2004; FINUCANE; HOLUP, 2005) because they generate confidence (FINUCANE; HOLUP, 2005).

The controversy regarding GM foods has mainly been confined to Europe; however, it has also become a topic of concern in North America (BAKER; BURNHAM, 2002) and more recently in developing countries. Food availability and nutritional intake are of much greater concern in less developed countries than in the United States, Europe, and Japan. The increased crop yields and dietary supplements provided by genetically altered foods could bring great benefits to developing countries in terms of food availability and nutrition, while the potential drawbacks are similar. These potential benefits, along with lower perceived risks, have contributed to generally more positive attitudes towards GM foods in developing nations (CURTIS; McCLUSKEY; WAHL, 2004). Surveys conducted in China, Indonesia, and the Philippines suggest that most Asian consumers have a positive attitude towards GM foods (ZHONG et al., 2002). Li et al. (2002) found that consumers in Beijing, China, view GM rice and soybean oil favourably, two staples of their diet. Curtis (2003) found that Chinese consumers, on average, are willing to pay a 35% premium for genetically modified processed potato products. In Africa, Kimenju and De Groote (2008) found that a large majority of consumers in Kenya would be willing to buy GM maize meal at the same price as their favourite brand. Da Costa et al. (2000) reported that Brazilian consumers appear to be less concerned than their British counterparts about the use of genetic modification in food production. Pachico and Wolf (2002) found that 66% of survey respondents in Colombia were willing to try genetically modified foods. Nevertheless, there is evidence to suggest that the reception of GM foods differs among developing countries. Curtis and Moeltner (2006) noted that in Romania and China, despite demographic and psychographic similarities, consumer willingness to purchase GM foods is quite different between the two samples. Consumer preferences depend principally on risk perceptions, which are high in the Romanian sample, but low in the Chinese sample. Mucci and Hough (2003) reported greater acceptance in Argentina towards GM foods that benefit health or the environment. Mucci, Hough and Ziliani (2004) subsequently found that purchase intent was low unless a nutritional benefit was promised, and perceptions were generally more negative than positive. Gil et al. (2001) observed a negative public perception towards the use of GM foods in Santiago de Chile.

Several studies report that the attitude towards GM foods depends on the consumer's gender (ZHONG et al., 2002; KOIVISTO HURSTI; MAGNUSSON, 2003; HOSSAIN et al., 2003; NAPIER et al., 2004; GANIERE; CHERN; HAHN, 2006; NAYGA JUNIOR; FISHER; ONYANGO, 2006; CHRISTOPH, BRUHN; ROOSEN, 2008), age (LI et al., 2002; ZHONG et al., 2002; HOSSAIN et al., 2003; MUCCI; HOUGH; ZILIANI, 2004; NAPIER et al., 2004; GANIERE; CHERN; HAHN, 2006; NAYGA JUNIOR; FISHER; ONYANGO, 2006; KIMENJU; DE GROOTE, 2008), income (ODA; SOARES, 2000; KIMENJU; DE GROOTE, 2008), and education (BAKER; BURNHAM, 2002; LUSK; SULLIVAN, 2002; ZHONG et al., 2002; KOIVISTO HURSTI; MAGNUSSON, 2003; MUCCI; HOUGH; ZILIANI, 2004; GANIERE; CHERN; HAHN, 2006; KIMENJU; DE GROOTE, 2008). Some studies have identified different consumer segments based on their attitudes towards GM foods (DA COSTA et al., 2000; BAKER; BURNHAM, 2002; GANIERE; CHERN; HAHN, 2006; CHRISTOPH; BRUHN; ROOSEN, 2008; COSTA-FONT; GIL; TRAILL, 2008).

The general aim of this study was to evaluate the relative importance of relevant product attributes (price and brand) and the presence of genetic modification in the decision to purchase food of vegetal and animal origin in the south-central area of Chile. The specific aims were: to determine differences in the consumer preferences regarding GM food according to its origin; to determine differences associated with the consumer's area of residence; and to distinguish different consumer segments. In order to identify a possible positive effect on those consumers associated with economic benefits for the region of residence derived from the use of biotechnology in agriculture, this study was conducted in Talca and Temuco, capitals of the Region of Maule and the Region of the Araucanía, respectively. Both regions are important in terms of domestic agriculture, but they differ in their respective predominant activities. Therefore, milk was chosen for case study in food of animal origin given that the Araucanía Region has the second highest milk production in the country. At the same time, tomato sauce was chosen as the food of vegetal origin because the greatest tomato production for industry is concentrated in Maule.

2 Materials and methods

A personal interview was conducted with a sampling of 400 consumers in Talca (35° 25' S and 71° 40' W) and 400 in Temuco (38° 45' S and 73° 03' W), who are responsible for purchasing food in their home and normally shop in supermarkets. The number of surveys was obtained using the formula for simple random sampling for non-finite populations (N > 100,000; Talca: 201.797 inhabitants, Temuco: 245.347 inhabitants as per the 2002 Census) taking into account a 95% confidence and 5% estimation error with p and q of 0.5 (FERNÁNDEZ, 2002). The survey was conducted in two supermarkets located in residential areas in each city between April and June 2007 following validation of the questionnaire through a pre-test with 10% of the sampling

from Temuco. A questionnaire with closed questions was used as an instrument for collecting information. Two questions regarding knowledge of GM food were included. The first question, "Have you ever heard, seen or read anything about GM food?", verifies respondents' general awareness about the topic. The second question, "Do you know what it means when a food has been genetically modified?", verified respondents' general understanding of the issue. Independently of whether those being surveyed indicated knowledge of transgenic food or not, the following definition was read to them: "GM foods are those to which a foreign gene is artificially introduced at embryo level so that when reproducing they maintain this new characteristic, for example, eliminating the use of pesticides, fungicides, and herbicides during their cultivation". They were subsequently asked if they considered it necessary for the label to indicate whether a food contains GM ingredients. Classification questions about those being interviewed were included: gender, age, number of family members, presence of children and their age, level of education of the head of the household, and the possession of 10 household goods. These last two variables were meant to determine the socioeconomic group according to Adimark (2004): ABC1 (upper and middle-upper), C2 (middle-middle), C3 (middle-lower), D (lower) and E (very low).

Conjoint analysis was used to determine the importance of the existence of genetic modification in the decision to purchase food of vegetal and animal origin (HAIR et al., 1999). This analysis established the importance of the attributes presence or absence of genetic manipulation, brand, and price in the purchase of liquid milk and tomato sauce. For the first attribute, the levels were defined as genetically modified and not genetically modified. For brand, the levels were defined as national and store brands. Store brand or private labels are generally brands created for, controlled by, and/or sold by retailers, while a brand product sold by the manufacturer through retailers is a national brand (SETHURAMAN; COLE, 1999). Well known brands were used for the national brands named: "Lactea" in milk and "Tomata" in tomato sauce for the purpose of this study. As a store brand, "supermarket brand" was indicated without specifying a particular distributor. The price levels were established on the basis of the average price of the Temuco market at the time of the survey (US$ 0.77/L milk and US$ 0.32/200 g package tomato sauce), to which 10% was added and subtracted, giving the levels of US$ 0.69/L and US$ 0.84/L in milk. Likewise, in tomato sauce the levels were US$ 0.29/200 g and US$ 0.35/200 g. The national currency values (Chilean pesos) were converted to dollars using the average 2007 value ($522.47/US$) (OFICINA..., 2008). A full factorial design was used resulting in 8 hypothetical products ($2 \times 2 \times 2$) for each food. The total profile procedure was used for data collection, for which eight cards were drawn up with a specification for each attribute for milk (Table 1) and for tomato sauce (Table 2). The interviewees were asked to order the cards from the most to the least preferred using a scale of 1 to 8 (1 = most preferred; 8 = least preferred). To estimate the partial utility scores, an additive conjoint model was used (HAIR et al., 1999). For price, a linear relation was established given that, at a higher price, the utility or preference is generally weaker. The remaining attributes were considered discrete variables. Pearson's correlation coefficient was used to determine the goodness-of-fit for the model, and Kendall's Tau was used to determine whether the order of the stimuli estimated according to the order function corresponds to the respondent's real order (HAIR et al., 1999).

Conjoint analysis of the sampling corresponding to both regions (n = 800), with subsequently separation by region, was performed. To determine difference in the importance assigned to each attribute and the utility scores for each level, between food of vegetal and animal origin, a student-*t* test was applied to the related samples (paired). An independent samples t-test was applied to investigate potential significant differences in the mean responses for both regions. The normal distribution of the variables had previously been proven using the Kolmogrov-Smirnov test, given that the sample exceeded 300 cases (HAIR et al., 1999). A hierarchical cluster analysis was chosen to determine consumer segments according to the importance and utility of the existence of genetic modification in food, brand, and price. Ward's procedure, which calculates the squared Euclidean distance, was carried out. The number of clusters was taken on the basis of the R^2 obtained and on the strong increase produced in the Cubic Criterion of Clustering and Pseudo-F values. In order to describe the segments, a Chi-square test was applied for the discrete variables and a one-factor analysis of variance for the continuous variables, with a 99% confidence level. The variables whose analysis of variance resulted in significant differences ($p \leq 0.001$) were subjected to the Tukey Multiple Comparisons Test. The SPSS program version 14.0 for Windows was used (SPSS Inc., Chicago IL, USA).

3 Results and discussion

The total sample of consumers surveyed (n = 800) contained a similar number of men and women; consumers between 35 and 54 years of age predominate and belonged to families

Table 1. Design of the conjoint experiment in milk.

A	Genetically modified Lactea US$ 0.84/L	**E**	Non-genetically modified Lactea US$ 0.84/L
B	Genetically modified Lactea US$ 0.69/L	**F**	Non-genetically modified Lactea US$ 0.69/L
C	Genetically modified Store brand US$ 0.84/L	**G**	Non-genetically modified Store brand US$ 0.84/L
D	Genetically modified Store brand US$ 0.69/L	**H**	Non-genetically modified Store brand US$ 0.69/L

Table 2. Design of the conjoint experiment in tomato sauce.

A	Genetically modified Tomata US$ 0.35/200 g	**E**	Non- genetically modified Tomata US$ 0.35/200 g
B	Genetically modified Tomata US$ 0.29/200 g	**F**	Non-genetically modified Tomata US$ 0.29/200 g
C	Genetically modified Store brand US$ 0.35/200 g	**G**	Non- genetically modified Store brand US$ 0.35/200 g
D	Genetically modified Store brand US$ 0.29/200 g	**H**	Non- genetically modified Store brand US$ 0.29/200 g

with three to four members with no children or with children between 13 and 17, had complete secondary school and higher education, were from middle and high socioeconomic groups, and resided in urban areas. Approximately 50% of respondents indicated having received information about GM foods, but only 19.5% knew its meaning. The majority agreed that the label should indicate the use of GM ingredients in food production (Table 3). The sample obtained was representative of the country's population distribution according to gender (49.3% men and 50.7% women) and area of residence (86.6% urban and 13.4% rural) Instituto Nacional de Estadísticas (2003). The sample is not representative of the country's population distribution for age or socioeconomic group. But the consumer distribution in this survey was similar to the sample obtained by Schnettler et al. (2008) in supermarket consumer studies previously conducted in Talca and Temuco. Therefore, although the results and conclusions in this study may not be applicable to the total population, they might be for those consumers that purchase foods in supermarkets.

Table 3. Description of the sample Chile, June 2007 (in percentage).

Sample	Characteristics	Frequency (%)
City	Talca	50.0
	Temuco	50.0
Gender	Female	48.9
	Male	51.1
Age	<35 years	33.5
	35-54 years	47.5
	55 years or more	19.0
Family size	1-2 family members	7.9
	3-4 family members	64.6
	5 or more	27.5
Presence and age of the children	Without children	24.6
	Children <5 years	10.9
	Children 5-12 years	12.6
	Children 13-17 years	29.7
	Children ≥18 years	22.2
Education	Without studies	0.4
	Elementary incomplete	1.6
	Elementary complete	5.6
	Secondary incomplete	10.5
	Secondary complete	31.5
	Technical college incomplete	10.9
	Technical college complete or university incomplete	14.0
	University complete or higher	25.5
Socioeconomic group	ABC1	25.5
	C2	36.0
	C3	23.1
	D	14.2
	E	1.2
Residence	Urban	86.9
	Rural	13.1
Have received information regarding GM foods	Yes	50.6
	No	49.4
Know the meaning of GM foods	Yes	19.5
	No	80.5
The label must indicate the use of GM ingredients in food	Yes	99.3
	No	0.7

3.1 Importance of genetic manipulation when purchasing food

Using a conjoint analysis (Table 4), the total sample revealed that the factor of greatest relevance when purchasing either food was the presence or absence of genetic manipulation, followed by the brand and the price, which is clearly contrary to the results found in a similar study conducted in the USA (BAKER; BURNHAM, 2002). The consumers experienced positive utility or preference towards the milk and tomato sauce produced without genetic modification and lower preference with respect to the presence of genetic modification. National brands were preferred over store brands. The consumers preferred the lowest price for both foods. The results of the student-t test for related samples indicate that no significant differences were observed regarding the importance assigned to the presence of genetic manipulation when selecting milk and tomato sauce ($p > 0.1$). On the contrary, a few studies indicate that, although people have a generally negative attitude towards genetic manipulation, evaluations are product-specific and not unconditionally associated with the technology overall (TENBÜLT et al., 2005, 2008). The attribute brand was more relevant for tomato sauce ($p \leq 0.05$) and price was more relevant for milk ($p \leq 0.05$). The rejection of genetic modification was greater for tomato sauce, and furthermore, tomato sauce without genetic modification was more preferred ($p \leq 0.05$), in contrast to previous reports from developed countries (FREWER et al., 2004; NAYGA JUNIOR; FISHER; ONYANGO, 2006) which indicated an increased rejection of food of animal origin with genetic manipulation. No statistical differences were observed in the partial utility scores for national and store brands and price levels ($p > 0.1$).

When comparing Talca and Temuco (Table 5), the results of the t-test for independent samples do not indicate any differences between the cities regarding the importance assigned to the existence of genetic manipulation for either food ($p > 0.1$). Consequently, it was not possible to confirm the existence of a more positive attitude towards GM foods , in which the use of biotechnology in agriculture benefits the economy of the region where the consumers live (VERDUME; VIAENE, 2003). The attribute brand was more relevant in Talca than in Temuco for milk ($p \leq 0.05$) and tomato sauce ($p \leq 0.001$), while the opposite was found for the attribute price for milk ($p \leq 0.05$) and tomato sauce ($p \leq 0.001$). No significant differences were observed in the utility scores for the alternatives with and without genetic manipulation in either food ($p > 0.05$). The preference for national brands over store brands was greater in Talca for both foods ($p \leq 0.001$). Despite significant differences in the utilities towards both price levels for milk and tomato sauce ($p \leq 0.001$), the consumers in Talca and Temuco preferred lower prices. The Pearson correlation coefficients and Kendall's Tau corresponding to the total sample (Table 4) and to each city (Table 5) were values very close or equal to 1, indicating the

Table 4. Importance of genetic manipulation, brand, and price in the decision to purchase milk and tomato sauce and utilities of the attribute levels in the total sample. Chile, June 2007.

	Fluid milk	Tomato sauce	*t*-Student[1]	P value
Importance of the attributes (%)				
Presence/absence genetic manipulation	44.6	44.1	0.888	0.375
Brand	31.5	32.6	–2.307	0.021
Price	23.9	22.6	2.401	0.017
Partial utility of each attribute level				
With genetic modification	–0.465	–0.529	2.117	0.035
Without genetic modification	0.465	0.529	2.117	0.035
National brand	0.877	0.872	0.221	0.825
Store brand	–0.877	–0.872	0.221	0.825
Smaller price	1.394	1.386	0.094	0.925
Greater price	0.701	0.693	0.220	0.826
Correlations conjoint model				
Pearson's R	0.997	0.994	-	
Significance	0.000	0.000	-	
Tau Kendall	1.000	0.929	-	
Significance	0.000	0.001	-	

Utility numbers in the different levels from an attribute with a negative sign indicate utility loss for the consumer. Higher negative numbers indicate higher utility loss. [1]Student-*t* test to related samples (paired)

Table 5. Importance of genetic manipulation, brand, and price in the decision to purchase milk and tomato sauce and utilities of the attribute levels in the cities of Talca and Temuco. Chile, June 2007.

	Talca	Temuco	*t*-Student[1]	P value
Fluid milk				
Importance of the attributes (%)				
Presence/absence genetic manipulation	44.5	44.7	0.164[a]	0.870
Brand	33.3	29.8	–2.823[a]	0.005
Price	22.2	25.5	2.918[a]	0.004
Partial utility of each attribute level				
With genetic modification	–0.361	–0.569	–1.919[a]	0.055
Without genetic modification	0.361	0.569	1.919[a]	0.055
National brand (Lactea)	0.977	0.777	–3.901[b]	0.000
Store brand	–0.977	–0.777	–3.901[b]	0.000
US$ 0.69/L	0.860	1.928	4.622[a]	0.000
US$ 0.84/L	0.440	0.964	4.519[a]	0.000
Correlations				
Pearson's R	0.991	0.999	-	
Significance	0.000	0.000	-	
Tau Kendall	1.000	1.000	-	
Significance	0.000	0.000	-	
Tomato sauce				
Importance of the attributes (%)				
Presence/absence genetic manipulation	43.7	44.6	0.558[a]	0.577
Brand	35.3	30.0	–4.069[b]	0.000
Price	21.0	25.4	3.539[a]	0.000
Partial utility of each attribute level				
With genetic modification	–0.425	–0.633	–1.965[a]	0.051
Without genetic modification	0.425	0.633	1.965[a]	0.051
National brand (Tomata)	0.997	0.748	–4.653[b]	0.000
Store brand	–0.997	–0.748	–2.825[b]	0.005
US$ 0.29/200 g	0.830	1.942	4.913[a]	0.000
US$ 0.35/200 g	0.415	0.971	4.913[a]	0.000
Correlations				
Pearson's R	0.986	0.998	-	
Significance	0.000	0.000	-	
Tau Kendall	0.929	1.000	-	
Significance	0.001	0.000	-	

Utility numbers in the different levels from an attribute with a negative sign indicate utility loss for the consumer. Higher negative numbers indicate higher utility loss. [1]Independent sample *t*-test. [a]Equal variances assumed. [b]Equal variances not assumed.

adequacy of the conjoint model and that the order of the stimuli presented on the cards corresponds to the overall order of the survey, with both being statistically significant ($p \leq 0.001$).

If only the partial utility scores obtained using the conjoint analysis are examined from the total sample and from each city in the study with respect to the presence or absence of genetic modification, the results of this investigation coincide with the majority negative attitude towards GM foods reported in developed countries (KOIVISTO HURSTI; MAGNUSSON, 2003; LUSK; ROOSEN; FOX, 2003; GANIERE; CHERN; HAHN, 2006; HO; VERMEER; ZHAO, 2006) and in two developing countries (GIL et al., 2001; MUCCI; HOUGH; ZILIANI, 2004). Therefore, although some studies report a more positive attitude towards GM foods in developing nations (DA COSTA et al., 2000; LI et al., 2002; PACHICO; WOLF, 2002; ZHONG et al., 2002; CURTIS, 2003; CURTIS; MCCLUSKEY; WAHL, 2004; KIMENJU; DE GROOTE, 2008), it is not possible to generalise about the acceptance of GM products based on the level of development of a country.

3.2 Consumer segments according to genetically modified foods of vegetal and animal origin

Cluster analysis allowed the distinction of three consumer groups with statistically significant differences ($p \leq 0.001$) regarding the importance and preference of the presence or absence of genetic modification, brand, and price in the purchase of liquid milk and tomato sauce, except for the preference for store-brand tomato sauce ($p > 0.1$) (Table 6). Table 7 presents the characteristics with significant differences between groups: gender ($p \leq 0.05$), city, age, size of family, presence and age of children, level of education, and socioeconomic group ($p \leq 0.001$).

- **Group 1** (41.0% of the sample, n = 328) assigned significantly greater importance to the presence of genetic manipulation than the remaining groups ($p \leq 0.001$). This segment preferred non-genetically modified foods (positive utility scores) significantly more than Groups 2 and 3 ($p \leq 0.001$) and rejected GM foods (negative utility scores). Hence, this group can be called **"Consumers sensitive to genetic modification in foods, who reject GM foods"** (Table 6). Within the total sampling, this group presented the highest proportion of women under 35 belonging to small and large families and without children. In addition, this group had the highest proportion of people from the lowest socioeconomic group with an incomplete basic education or complete basic and incomplete secondary education (Table 7).
- **Group 2** (7.6% of the sample, n = 61) assigned the greatest importance to the attribute price ($p \leq 0.001$). The existence of genetic modification was slightly more important than

Table 6. Importance (%) of genetic manipulation (GM), brand, and price in the decision to purchase milk and tomato sauce, and partial utilities of the attribute levels in in the groups obtained using cluster analysis in in the cities of Talca and Temuco. Chile, June 2007.

	Group 1 n = 328	Group 2 n = 61	Group 3 n = 411	Levene's statistic	F
Fluid milk					
Importance of the attributes (%)					
Presence/absence GM	58.3[a]	20.3[c]	37.2[b]	2.646	196.968*
Brand	22.9[b]	23.4[b]	39.5[a]	2.588	108.210 *
Price	18.8[c]	56.3[a]	23.3[b]	2.529	202.134 *
Partial utility of each attribute level					
With genetic modification	−1.9878[c]	−0.0328[b]	0.6861[a]	1.037	941.295*
Without genetic modification	1.9878[a]	0.0328[b]	−0.6861[c]	1.037	941.295*
National brand (Lactea)	0.6784[b]	0.6598[b]	1.0681[a]	2.125	30.772*
Store brand	−0.6784[a]	−0.6598[a]	−1.0681[b]	2.125	30.772*
US$ 0.69/L	2.2500[b]	7.1311[a]	−0.1411[c]	1.009	227.595*
US$ 0.84/L	1.1265[b]	3.5656[a]	−0.2620[c]	1.058	231.957*
Tomato sauce					
Importance of the attributes (%)					
Presence/absence GM	57.9[a]	21.5[c]	36.8[b]	2.636	182.581*
Brand	23.3[b]	18.4[b]	42.4[a]	2.789	163.585*
Price	18.8[b]	57.1[a]	20.8[b]	2.624	271.336*
Partial utility of each attribute level					
With genetic modification	−1.9787[c]	−0.0902[b]	0.5620[a]	1.042	765.946*
Without genetic modification	1.9787[a]	0.0902[b]	−0.5620[c]	1.042	765.946*
National brand (Tomata)	0.6540[b]	0.5123[b]	1.1010[a]	2.136	42.618*
Store brand	−0.6540[a]	−0.5123[b]	−1.1010[c]	2.136	42.618*
US$ 0.29/200 g	2.2927[b]	7.6721[a]	−0.2701[c]	1.011	328.089*
US$ 0.35/200 g	1.1463[b]	3.8361[a]	−0.3350[c]	1.059	328.089*

Utility numbers in the different levels from an attribute with a negative sign indicate utility loss for the consumer. Higher negative numbers indicate higher utility loss. *Significance (0.001). Different letters[a,b,c] in a row indicate statistical difference according to Tukey's multiple comparison test ($p \leq 0.001$). **Group 1:** Consumers sensitive to genetic modification in foods, who reject GM foods, "opponents". **Group 2:** Consumers sensitive to price, who reject GM foods. **Group 3:** Consumers sensitive to brand and GM, who prefer GM foods, "supporters".

Table 7. Characteristics (frequencies in %) of the groups of supermarket buyers identified using cluster analysis in the cities of Talca and Temuco. Chile, June 2007.

Characteristic	Group 1 n = 328	Group 2 n = 61	Group 3 n = 411	Pearson Chi-Sq.	P value
City					
Talca	46.0	32.8	55.7	14.665	0.001
Temuco	54.0	67.2	44.3		
Gender					
Female	55.2	41.0	45.0	9.198	0.010
Male	44.8	59.0	55.0		
Age					
<35 years	49.4	37.7	20.2	70.605	0.000
35-54 years	35.4	44.3	57.7		
55 years or more	15.2	18.0	22.1		
Family size					
1-2 family members	14.6	4.9	2.9	57.184	0.000
3-4 family members	51.5	65.6	74.9		
5 or more	33.8	29.5	22.1		
Presence and age of the children					
Without children	40.2	39.3	10.0	139.432	0.000
Children <5 years	13.1	4.9	10.0		
Children 5-12 years	11.0	14.8	13.6		
Children 13-17 years	13.4	19.7	44.3		
Children ≥18 years	22.3	21.3	22.1		
Education					
Without studies	0.3	0	0.5	71.158	0.000
Elementary incomplete	3.0	0	0.7		
Elementary complete	8.2	3.3	3.9		
Secondary incomplete	15.2	13.1	6.3		
Secondary complete	37.5	42.6	25.1		
Technical college incomplete	7.6	9.8	13.6		
Technical college complete or university incomplete	11.3	13.1	16.3		
University complete or higher	16.8	18.0	33.6		
Socioeconomic group					
ABC1	20.5	21.3	30.2	37.725	0.000
C2	31.5	36.1	39.5		
C3	24.5	29.5	21.0		
D	21.7	13.1	8.3		
E	1.8	0.0	1.0		
Residence					
Urban	89.9	80.3	85.4	5.776	0.056
Rural	10.1	19.7	14.6		
Have received information regarding GM Foods					
Yes	50.9	55.7	49.6	0.810	0.667
No	49.1	44.3	50.4		
Know the meaning of GM Foods					
Yes	21.0	27.9	17.0	4.810	0.090
No	79.0	72.1	83.0		
The label must indicate the use of GM ingredients in food					
Yes	98.8	98.4	99.8	3.037	0.219
No	1.2	1.6	0.2		

P value, is the asymptotic significance (bilateral) obtained in Pearson Chi-Square Test. **Group 1:** Consumers sensitive to genetic modification in foods, who reject GM foods, "opponents". **Group 2:** Consumers sensitive to price, who reject GM foods. **Group 3:** Consumers sensitive to brand and GM, who prefer GM foods, "supporters".

brand for tomato sauce and the opposite for milk. Like Group 1, this segment preferred milk and tomato sauce without genetic manipulation and rejected both GM foods (Table 6). Hence, this segment can be called **"Consumers sensitive to price, who reject GM foods"**. This group presented the greatest proportion of residents of Temuco, without children (Table 7).

- **Group 3** (51.4% of the sample, n = 411) gave slightly greater importance to brand for both foods, significantly more than Groups 1 and 2 ($p \leq 0.001$). The second most important attribute for both foods was the existence of genetic manipulation. The positive utility score for GM milk and tomato sauce obtained for this group indicates a significantly greater preference for this condition than that for the other groups ($p \leq 0.001$). The negative utility scores for both non-GM foods was significantly lower than that in the other groups ($p \leq 0.001$), demonstrate a lower preference or rejection of these foods. Accordingly, this group can be called **"Consumers sensitive to brand and genetic modification, who prefer GM foods"** (Table 6). Within the total sample, this group had the highest proportion of residents of Talca, men, between 35 and 54, families with three or four members, consumers with children between 13 and 17, from the upper, upper-middle, and middle-middle socioeconomic groups, people with higher education or with incomplete technical studies (Table 7).

Independently of the acceptance or rejection of GM foods, the three segments preferred the national brands and rejected store brands (negative utility scores). Group 3's preference for national brands was significantly higher than that of the rest of the groups ($p \leq 0.001$). The three groups preferred the lowest prices suggesting that there is no connection between higher price and superior quality.

The use of the cluster analysis made it possible to distinguish three consumer segments regarding the importance assigned to genetic manipulation, brand, and price for milk and tomato sauce. **"Consumers sensitive to brand and genetic modification, who prefer GM foods"** (Group 3) gave slightly greater relevance to brand over the existence of genetic manipulation, which, according to Baker and Burnham (2002), indicates that none of these attributes dominates consumer preferences. This group preferred both genetically modified foods. For the **"Consumers sensitive to genetic modification in foods, who reject GM foods"** (Group 1), the existence of genetic manipulation dominates consumer preferences, with a rejection of milk and tomato sauce with genetic manipulation and a preference for these foods free of genetic manipulation. **"Consumers sensitive to price, who reject GM foods"** (Group 2) saw price as the attribute of greatest importance to purchasing decision and showed preference for non-GM foods. However, it was decided not to discuss the results referring to Group 2 (n = 61) because it is risky to draw conclusions based on segments with such a low number of consumers (McEWAN, 1997). Accordingly, there is one large group of consumers who preferred genetically modified milk and tomato sauce, who can be considered **"supporters"**, and a second large group that rejected both GM foods, who can be considered **"opponents"**. Therefore, these results partially agree with previous studies conducted in developed countries on the existence of consumer segments for and against these products (GANIERE; CHERN; HAHN, 2006; CHRISTOPH; BRUHN; ROOSEN, 2008; COSTA-FONT; GIL; TRAILL, 2008).

The percentage of people in the total sample that had received information about GM food (50.6%, Table 3) was similar to that reported by Oda and Soares (2000) in Brazil (53%). Nevertheless, it was higher than that obtained by Blaine, Kamaldeen and Powell (2002) in the same country (39%) and by Gil et al. (2001) in Chile (42%). However, it is far below than that reported by Mucci, Hough and Ziliani (2004) in Argentina (76%) and by Blaine, Kamaldeen and Powell (2002) in Germany, the UK, Japan, the US, and Canada (between 66-95%). However, if one considers that only 19.5% of respondents previously knew the meaning of GM food, then it is feasible to attribute the positive attitude towards the GM milk and tomato sauce of the group of **"supporters"** to the information given prior to the introduction of the stimuli developed for the conjoint analysis. In effect, benefits for the environment (TAIT, 2001; MUCCI; HOUGH, 2003; NAPIER et al., 2004; KAYE-BLAKE; BICKNELL; SAUNDERS, 2005; GANIERE; CHERN; HAHN, 2006), such as a reduction in pesticide use (BLAINE; KAMALDEEN; POWELL, 2002; KAYE-BLAKE; BICKNELL; SAUNDERS, 2005), results in a positive consumer attitude towards GM foods. In this sense, the generalised approval of the total sample (99.3%) regarding the inclusion of food information about the use of GM ingredients on the label represents the option of making an informed choice (COSTA-FONT; GIL; TRAILL, 2008). Similarly, various studies have shown that most consumers want GM foods to be labelled (MUCCI; HOUGH, 2003; NAPIER et al., 2004).

This study illustrates that there is no one demographic profile of consumers who approve or reject GM foods in developed or developing countries. The greater presence of men in the group of **"supporters"** and women in the group of **"opponents"** concurs with the different attitude towards GM foods associated with gender in developed countries (KOIVISTO HURSTI; MAGNUSSON, 2003; HOSSAIN et al., 2003; GANIERE; CHERN; HAHN, 2006; NAYGA JUNIOR; FISHER; ONYANGO, 2006; CHRISTOPH; BRUHN; ROOSEN, 2008). In this respect, however, the results of this study contradict those found by Oda and Soares (2000) in Brazil, Zhong et al. (2002) in China and Mucci and Hough (2003) in Argentina. Accordingly, the greatest presence of those with technical college or university education in the group of **"supporters"** agrees with the greater acceptance of GM food by people with higher education (LUSK; SULLIVAN, 2002; KOIVISTO HURSTI; MAGNUSSON, 2003). Likewise, the highest proportion of consumers with basic and secondary education in the group of **"opponents"** confirm the greatest rejection by those with less education (BAKER; BURNHAM, 2002; GANIERE; CHERN; HAHN, 2006; KIMENJU; DE GROOTE, 2008) in both developed and in developing countries. Yet, the results obtained in the present study go against those determined by Mucci, Hough and Ziliani (2004) and Zhong et al. (2002) in two developing countries, in which the consumers with higher

education tended to be more reluctant to accept GM foods. The stronger presence of people between 35 and 54 years of age in the group of **"supporters"** and the higher number of people under 35 in the group of **"opponents"** contradict the results found by several authors who have reported a greater acceptance of GM food among young people (LI et al., 2002; HOSSAIN et al., 2003; MUCCI; HOUGH; ZILIANI, 2004; NAPIER et al., 2004; NAYGA JUNIOR; FISHER; ONYANGO, 2006) and greater rejection among older people (BAKER; BURNHAM, 2002; GANIERE; CHERN; HAHN, 2006; KIMENJU; DE GROOTE, 2008) in studies conducted in developed and developing countries. However, our results in relation to age agree with the greater rejection found among young consumers in China (ZHONG et al., 2002). With regard to the socioeconomic group, however, the greater percentage of upper-income people (ABC1 and C2) in the **"supporters"** group and the greater presence of consumers from the lower level (D) in the **"opponents"** group confirm the greater acceptance of GM foods by higher income people in developing countries (ODA; SOARES, 2000; KIMENJU; DE GROOTE, 2008).

With respect to the make-up of the family, in addition to the differences recorded in the number of members, the relationship between the presence and age of children and the attitude towards GM foods is worthy of note. Thus, while **"supporters"** had the larger proportion of homes with children between 13 and 17, "**opponents"** presented the greatest proportion of people without children. It is therefore possible to suggest that those potential parents will be cautious about purchasing GM-free food for their children. If one considers that the latter segment also has the greatest proportion of under 35s, one may expect that future generations in Chile will tend to reject GM foods. This offers differentiation opportunities for the food industry in the short term and, in particular the range of food products for children in the medium and long term.

The preference for national brands and the rejection of store brands in the total sample and the segments identified in this study are related to the influence of the risk perceived in the purchase of store-brand products (SETHURAMAN; COLE, 1999), which concurs with the results of studies conducted in developed (BAKER; BURNHAM, 2002; VERDUME; VIAENE, 2003; FINUCANE; HOLUP, 2005) and developing countries (DA COSTA et al., 2000; MUCCI; HOUGH; ZILIANI, 2004), which indicate that consumers are more willing to purchase GM foods from brands they know. In contrast to the reports from studies indicating that consumers are willing to pay more for foods without genetic modification (TERAWAKI, 2008), in this study the consumers preferred to pay the lowest price for both milk and tomato sauce, regardless of brand or the presence or absence of genetic manipulation.

4 Conclusions

The general results of the conjoint analysis indicate that the existence of genetic modification dominated consumer preferences in the choice of milk and tomato sauce in the total sample of those purchasing in supermarkets in Talca and Temuco, Chile. For both foods, the second most important attribute was brand, followed by price.

In the total sample, there was no difference in the importance assigned to genetic manipulation in milk or tomato sauce. An increased rejection of food of animal origin with genetic manipulation was not observed. Both preference for non-genetically modified food and rejection of GM products were greater in the case of food of vegetal origin.

This study detected no differences in the importance assigned to the existence of genetic modification in milk and tomato sauce among consumers in Talca and Temuco or in the preference or rejection of either food with or without GM. Therefore, in this case, there would not be a more positive attitude towards GM foods if the use of biotechnology in agriculture benefits the economy of the region where the consumers live.

Using cluster analysis, it was possible to distinguish two main consumer segments: the largest (51.4%) assigned greatest importance to brand and preferred genetically modified milk and tomato sauce; and the second group (41.0%) gave greatest importance to the existence of genetic manipulation and preferred neither food with genetic manipulation. The above notwithstanding, the segments rejected the store brand and preferred to pay less for both foods. Consumer groups were distinguished according to place of residence, gender, age, size and composition of family, level of education, and socio-economic level.

The results obtained contribute to the knowledge of the food market, particularly of genetically modified foods, when identifying different consumer segments with different demands. Hence, based on these findings, food companies can develop differentiated marketing mixes according to the needs of the target segment.

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References

ADIMARK. **Mapa socioeconómico de Chile**. Disponível em: <http://www.adimark.cl/medios/estudios/informe_mapa_socioeconomico_de_chile.pdf>. Acesso em: jun. 2004.

BAKER, G.; BURNHAM, T. The market for genetically modified foods: consumer characteristics and policy implications. **International Food Agribusiness Management Review**, v. 4, p. 351-360, 2002. http://dx.doi.org/10.1016/s1096-7508(02)00063-0

BLAINE, K.; KAMALDEEN, S.; POWELL, D. Public perceptions of biotechnology. **Journal of Food Science**, v. 67, n. 9, p. 3200-3208, 2002. http://dx.doi.org/10.1111/j.1365-2621.2002.tb09566.x

BURTON, M. et al. Consumer attitudes to genetically modified organisms in food in the UK. **European Review of Agricultural Econonomics**, v. 28, p. 479-498, 2001. http://dx.doi.org/10.1093/erae/28.4.479

CHRISTOPH, I.; BRUHN, M.; ROOSEN, J. Knowledge, attitudes towards and acceptability of genetic modification in Germany. **Appetite**, v. 51, p. 58-68, 2008. PMid:18243411. http://dx.doi.org/10.1016/j.appet.2007.12.001

COSTA-FONT, M.; GIL, M.; TRAILL, B. Consumer acceptance, valuation of and attitudes towards genetically modified food: Review and implications for food policy. **Food Policy**, v. 33, n. 2, p. 99-111, 2008.

CURTIS, K. R. **The industrialized global market for processed potatoes**: Contracting, westernization in Asia, and biotechnology. 2003. Thesis (Doctoral)-Washington State University, Washington, 2003.

CURTIS, K. R.; MCCLUSKEY, J. J.; WAHL, T. Consumer Acceptance of Genetically Modified Food Products in the Developing World. **AgBioForum**, v. 7, n. 1-2, p. 70-75, 2004.

CURTIS, K. R.; MOELTNER, K. Genetically modified food market participation and consumer risk perceptions: a cross-country comparison. **Canadian Journal of Agricultural Economics**, v. 54, p. 289-310, 2006. http://dx.doi.org/10.1111/j.1744-7976.2006.00050.x

DA COSTA, M. C. et al. Non conventional technologies and impact on consumer behavior. **Trends in Food Science & Technology**, v. 11, p. 188-193, 2000. PMid:21299575. http://dx.doi.org/10.1016/S0924-2244(00)00052-2

FERNÁNDEZ, A. **Investigación y técnicas de mercado**. Madrid: Editorial Esic, 2002.

FINUCANE, M. L.; HOLUP, J. L. Psychological and cultural factors affecting the perceived risk of genetically modified food: an overview of the literature. **Social Science & Medicine**, v. 60, p. 1603-1612, 2005. http://dx.doi.org/10.1016/j.socscimed.2004.08.007

FREWER, L.J. et al. Societal aspects of genetically modified foods. **Food Chemistry and Toxicology**, v. 42, p. 1181-1193, 2004. PMid:15123386. http://dx.doi.org/10.1016/j.fct.2004.02.002

GANIERE, P.; CHERN, W.; HAHN, D. A continuum of consumer attitudes toward genetically modified foods in the United States. **Journal of Agricultural Research Econonomics**, v. 31, n. 1, p. 129-149, 2006.

GASKELL, G. et al. Worlds apart? The reception of genetically modified foods in Europe and the US. **Science**, v. 295, p. 348-387, 1999.

GIL, L. et al. Aceptación pública de la biotecnología y de los alimentos transgénicos. **Ambiente y Desarrollo**, v. 17, n. 4, p. 52-59, 2001.

GRUNERT, K. et al. Consumer perception of food products involving genetic modification: results from a qualitative study in four Nordic countries. **Food Quality and Preference**, v. 12, p. 527-542, 2001. http://dx.doi.org/10.1016/S0950-3293(01)00049-0

HAIR, J. et al. **Análisis multivariante**. 5. ed. Madrid: Prentice Hall Internacional, 1999.

HO, P.; VERMEER, E.; ZHAO, J. Biotechnology and Food safety in China: Consumers' acceptance or resistance? **Development and Change**, v. 37, n. 1, p. 227-253, 2006. http://dx.doi.org/10.1111/j.0012-155X.2006.00476.x

HOSSAIN, F. et al. Product attributes consumer benefits and public approval of genetically modified foods. **International Journal of Consumers Studies**, v. 27, n. 5, p. 353-365, 2003. http://dx.doi.org/10.1046/j.1470-6431.2003.00303.x

INSTITUTO NACIONAL DE ESTADÍSTICAS - INE. **Censo 2002**. Santiago: Instituto Nacional de Estadísticas, Gobierno de Chile, 2003. Resultados Volumen I: Población; País - Región.

KAYE-BLAKE, W.; BICKNELL, K.; SAUNDERS, C. Process versus product: wish determines consumer demand for genetically modified apples? **Australian Journal of Agricultural and Resource Economics**, v. 49, p. 413-427, 2005. http://dx.doi.org/10.1111/j.1467-8489.2005.00311.x

KIMENJU, S.; DE GROOTE, H. Consumer willingness to pay for genetically modified food in Kenya. **Agricultural Economics**, v. 38, n. 1, p. 35-46, 2008. http://dx.doi.org/10.1111/j.1574-0862.2007.00279.x

KOIVISTO HURSTY, U-K.; MAGNUSSON, M. K. Consumer perception of genetically modified and organic foods. What kind of knowledge matters? **Appetite**, v. 41, p. 207-209, 2003. http://dx.doi.org/10.1016/S0195-6663(03)00056-4

LI, Q. et al. Consumer attitudes toward genetically modified foods in Beijing, China. **AgBioForum**, v. 5, n. 4, p. 145-152, 2002.

LUSK, J. L. et al. Influence of brand and type of modification on consumer acceptance of genetically engineered corn chips: a preliminary analysis. **International Food Agribusiness Management Review**, v. 4, p. 320-331, 2002.

LUSK, J. L.; SULLIVAN, P. Consumer acceptance of genetically modified foods. **Food Technology**, v. 56, n. 10, p. 32–37, 2002.

LUSK, J. L.; ROOSEN, J.; FOX, J. A. Demand for beef from cattle administered growth hormones or fed genetically modified cord; a comparison of consumers in France, Germany, the United Kingdom and the United States. **American Journal of Agricultural Economics**, v. 85, p. 16-29, 2003. http://dx.doi.org/10.1111/1467-8276.00100

McCLUSKEY, J. J. et al. Consumer response to genetically modified food products in Japan. **Agricultural & Resource Economics Review**, v. 2, p. 222-231, 2003.

McEWAN, J. A. A comparative study of three product acceptability trials. **Food Quality and Preference**, v. 8, p. 183-190, 1997. http://dx.doi.org/10.1016/S0950-3293(96)00047-X

MUCCI, A.; HOUGH, G. x. Perceptions of genetically modified foods by consumers in Argentina. **Food Quality and Preference**, v. 15, p. 43-51, 2003. http://dx.doi.org/10.1016/S0950-3293(03)00021-1

MUCCI, A.; HOUGH, G.; ZILIANI, C. Factors that influence purchase intent and perceptions of genetically modified foods among Argentine consumers. **Food Quality and Preference**, n. 6, p. 559-567, 2004. http://dx.doi.org/10.1016/j.foodqual.2004.02.004

NAPIER, T. et al. Consumer attitudes toward GMOs: the Ohio experience. **Journal of Food Science**, v. 69, n. 3, p. 69-76, 2004.

NAYGA JUNIOR, R.; FISHER, M.; ONYANGO, B. Acceptance of genetically modified food: comparing consumer perspectives in the United States and South Korea. **Agricultural Economics**, v. 34, p. 331-341, 2006. http://dx.doi.org/10.1111/j.1574-0864.2006.00129.x

NOUSSAIR, C.; ROBIN, S.; RUFFIEUX, B. Do consumers really refuse to buy genetically modified food? **Economic Journal**, v. 114, p. 102-120, 2004. http://dx.doi.org/10.1046/j.0013-0133.2003.00179.x

ODA, L. M.; SOARES, B. E. Genetically modified foods: economics aspects and public acceptance in Brazil. **Trends in Biotechnology**, v. 5, p. 188-190, 2000. http://dx.doi.org/10.1016/S0167-7799(00)01436-0

OFICINA DE ESTUDIOS Y POLÍTICAS AGRARIAS - ODEPA. Cifras de indicadores económicos. **Avance mensual**, 2008. Disponível em: <http://www.odepa.gob.cl/odepaweb/servlet/sistemas.precios.indicadores.ServletIndicadoresTrx;jsessionid=C82F4C849E6AE24C081A7C9F38EA228E>. Acesso em: abr. 2008.

PACHICO, D.; WOLF, M. Attitudes toward genetically modified food in Colombia. In: INTERNATIONAL CONSORTIUM ON AGRICULTURAL BIOTECHNOLOGY RESEARCH - ICABR CONFERENCE, 6.; 2002, Ravello, Italy. **Proceedings**… ICABR, 2002.

SCHNETTLER, B. et al. Importance of the country of origin in food consumption in a developing country. **Food Quality and Preference**, v. 19, n. 4, p. 372-382, 2008. http://dx.doi.org/10.1016/j.foodqual.2007.11.005

SETHURAMAN, R.; COLE, C. Factors influencing the price premiums that consumers pay for national brands over store brands. **Journal of Product & Brand Management**, v. 8, n. 4, p. 340-351, 1999. http://dx.doi.org/10.1108/10610429910284319

SPENCE, A.; TOWNSEND, E. Examining consumer behavior toward genetically modified (GM) Food in Britain. **Risk Analysis**, v. 26, n. 3, p. 657-670, 2006. PMid:16834625. http://dx.doi.org/10.1111/j.1539-6924.2006.00777.x

TAIT, J. More Faust than Frankenstein: the European debate about the precautionary principle and risk regulation for genetically modified crops. **Journal of Risk Research**, v. 4, n. 2, p. 175-189, 2001. http://dx.doi.org/10.1080/13669870010027640

TENBÜLT, N. K. et al. Perceived naturalness and acceptance of genetically modified food. **Appetite**, v. 45, p. 47-50, 2005. PMid:15896875. http://dx.doi.org/10.1016/j.appet.2005.03.004

TENBÜLT, N. K. et al. Acceptance of genetically modified foods: the relation between technology and evaluation. **Appetite**, v. 51, p. 129-136, 2008. PMid:18336952. http://dx.doi.org/10.1016/j.appet.2008.01.004

TERAWAKI, T. Can information about genetically modified corn and its oil have significant effects on Japanese consumers' risk perception and their valuation? **AgBioForum**, v. 11, n. 1, p. 39-47, 2008.

TOWNSEND, E. Affective influences on Risk Perceptions of, and attitudes toward genetically modified food. **Journal of Risk Research**, v. 9, n. 2, p. 125-139, 2006. http://dx.doi.org/10.1080/13669870500085130

VERDUME, A.; VIAENE, J. Consumer beliefs and attitude towards genetically modified food: basis for segmentation and implications for communication. **Agribusiness**, v. 219, n. 1, p. 91-113, 2003. http://dx.doi.org/10.1002/agr.10045

ZHONG, F. ET AL. GM foods: A Nanjing case study of Chinese consumers' awareness and potential attitudes. **AgBioForum**, v. 5, n. 4, p. 136-144, 2002.