

The environmental feature in consumer purchasing preferences: The case of Genetically Modified foods

Rodriguez-Entrena Macario, Sayadi Samir



**Paper prepared for presentation at the 12th EAAE Congress
'People, Food and Environments: Global Trends and European Strategies',
Gent (Belgium), 26-29 August 2008**

*Copyright 2008 by [Rodriguez-Entrena Macario, Sayadi Samir] All rights reserved.
Readers may make verbatim copies of this document for non-commercial purposes by any
means, provided that this copyright notice appears on all such copies.*

The environmental feature in consumer purchasing preferences: The case of Genetically Modified foods

Rodríguez-Entrena Macario, Sayadi Samir.

IFAPA , Dpt. Agricultural Economics and Rural Studies, Granada (Spain)

ABSTRACT

Progress in Biotechnology (Gene Revolution) tends to be compared with that of the Green Revolution in the sixties and seventies. This process is developing in a context of increasing concern by the consumers for food safety and environmental conservation, stirring controversy in the scientific community and society about the potential benefits and possible risks of genetically modified organisms (GMOs). In this context, the purpose of the present study is to estimate consumer preferences in relation to genetically modified (GM) foods, emphasizing the relative importance of environmental attribute, to develop an understanding of the factors influencing consumer purchasing decisions.

Key words: Genetically Modified Foods, Consumers' Preferences, Conjoint Analysis.

JEL Codes: Q13; Q18; D12.

I. INTRODUCTION

Like any technological innovation in agriculture, GM crops exert socio-economic impact for farmers, consumers and, in short, the society as a whole. The International Service for the Acquisition of Agri-Biotech Applications (ISAA) reports on the boom of GM crops in the agricultural sector. This report shows that the total area of GM crops has increased from 1.7 million hectares to more than 102 million between 1996 and 2006 (soy 57%, corn 25%, cotton 13%, and canola 5%; James, 2006). In Spain, the area occupied by GM maize varieties has increased from 22,317 hectares in 1998 to over 75,148 in 2007 [1]. The development of GM farming and the consumer awareness regarding food produced by genetic engineering augments the interest in analysing consumers' preferences for GM food. Also, it is worth in identifying sociodemographic, lifestyle, attitude, and opinion traits that influence the perception of the environmental issue related to this type of food

(specifically reducing the water and pesticide consumption by genetic manipulation).

II. METHODOLOGY

The information has been compiled by means of face-to-face surveys, focusing on a representative sample of 442 Andalusian consumers (sampling error of 5%). The sample has been a random stratified proportional methodology, using the following variables: urban or rural, sex and age [2]. The surveys were carried out between March and June 2007.

For the analysis of the consumer's preference structure for GM food, the Conjoint Analysis technique was used [3]. The most representative attributes of GM product, in consumer purchasing preferences, and their respective levels were selected by means of interviews with agri-biotech experts and focus-group discussions (Table 1). The product designed was a package of ½ kg cornflakes.

Table 1: Attributes and levels used in the experiment design.

* Conventional corn indicates that the corn was grown from seeds developed through traditional breeding techniques.

ATTRIBUTES	LEVELS
PRICE	Three levels: 1.50 € 2.00 € 2.50€
HEALTH	Two levels: GM Corn enriched in Omega-3; Conventional Corn* without Omega-3
ENVIRONMENT	Three levels: GM Corn - Pesticide reduction; GM Corn - Water reduction; Conventional Corn - Without pesticide and water reduction
QUALITY	Three levels: Soft Texture; Crispy Texture; Crunchy Texture

It is necessary for the number of attributes required to represent the product realistically to be balanced with the need to simplify the representation so as not

to unnecessarily complicate the respondent's task. Thus, the use of an orthogonal design enable a reduced set of profiles to estimate consumer's preferences [4] (Table 2).





Table 2. Hypothetical cornflakes' profiles finally selected.





↓ (Pesticide or Water reduction); □ (Without Pesticides or Water reduction)
 P[†] (Pesticides); W[‡] (Water); N° GM (Number of genetic modifications); Conv (Conventional corn).

	PRICE	HEALTH	ENVIROMENT	QUALITY	N°
	1/2 kg	Effect on health	Effect on the environment	Texture	GM
CORNFLAKES 1	2.00 €	Conv-Corn / Non Omega-3	GM Corn / ↓ 30% P [†]	Crunchy	1
CORNFLAKES 2	2.00 €	Conv-Corn / Non Omega-3	GM Corn / ↓ 30% W [‡]	Crispy	1
CORNFLAKES 3	1.50 €	Conv-Corn / Non Omega-3	Conv-Corn / □ P [†] -W [‡]	Crispy	0
CORNFLAKES 4	2.50 €	Conv-Corn / Non Omega-3	GM Corn / ↓ 30% W [‡]	Soft	1
CORNFLAKES 5	2.50 €	Conv-Corn / Non Omega-3	Conv-Corn / □ P [†] -W [‡]	Crunchy	0
CORNFLAKES 6	2.00 €	GM Corn / Omega-3	Conv-Corn / □ P [†] -W [‡]	Soft	1
CORNFLAKES 7	1.50 €	Conv-Corn / Non Omega-3	GM Corn / ↓ 30% P [†]	Soft	1
CORNFLAKES 8	2.50 €	GM Corn / Omega-3	GM Corn / ↓ 30% P [†]	Crispy	2
CORNFLAKES 9	1.50 €	GM Corn / Omega-3	GM Corn / ↓ 30% W [‡]	Crunchy	2

The consumer's preferences for GM food were quantified using a rating scale from 1: cornflakes, strongly dislikes, to 10: cornflakes, likes a great deal. Figure 1 includes examples of stimulus cards shown to respondents.

Figure 1. Example of cards displayed to consumers.

CORNFLAKE 1		
PRICE	2.00 €	
HEALTH	Corn isn't GENETICALLY MODIFIED to contain OMEGA-3	
ENVIRONMENT	Corn is GENETICALLY MODIFIED to reduce PESTICIDE consumption by 30%	
QUALITY	Crunchy Texture	
Corn is GENETICALLY MODIFIED with "1" manipulation		

CORNFLAKE 3		
PRICE	1.50 €	
HEALTH	Corn isn't GENETICALLY MODIFIED to contain OMEGA-3	
ENVIRONMENT	Corn isn't GENETICALLY MODIFIED to reduce WATER and PESTICIDE consumption	
QUALITY	Crispy Texture	
Corn isn't GENETICALLY MODIFIED with "0" manipulation		

Moreover, the sociodemographic, lifestyle, attitudes and opinions factors that influence on the consumer perception of the environmental attribute from GM food (specifically on reducing the water and pesticide consumption) were identified using a multiple-regression model. Table 3 illustrates the independent variables included in the final model.

The dependent variable was defined as follows:

$$U_{rwp\ i} = u_{rw\ i} + u_{rp\ i} \quad (1)$$

Where:

U_{rwp i}: Utility by the individual i associated with the levels "reducing water's consumption" + "reducing pesticide consumption" of environmental attribute from genetic manipulations of the food.

U_{rw i}: Part-worth utility by the individual i associated with the level "reducing water consumption" from genetic manipulations of the food.

U_{rp i}: Part-worth utility by the individual i associated with the level "reducing pesticide consumption" by means genetic manipulations of the food.

Table 3: Independent variables of the regression model "utility of reducing the water and pesticide consumption by means genetic modifications".

Independent Variables	Description	Values
<i>Constant</i>	<i>Constant</i>	
<i>AGE</i>	<i>Age</i>	<i>Continuous variable (years)</i>
<i>RISK</i>	<i>Risk perception concerning GM food compared to the conventional food</i>	<i>From 1: very low to 5: very high.</i>
<i>BCISL</i>	<i>Degree of agreement with the idea that biotechnology will improve the standard of living</i>	<i>From 1: strongly disagree to 5: strongly agree.</i>
<i>QUALITY</i>	<i>Opinion about the current quality food compared to the one some years ago</i>	<i>1: inferior quality, 2: similar y 3: superior quality</i>
<i>LABEL</i>	<i>Degree of agreement with the non-labelled food derived from animals fed with GM feed</i>	<i>From 1: strongly disagree to 5: strongly agree.</i>
<i>ENVIRON</i>	<i>Membership of any environmental organizations</i>	<i>1: yes, 0: no</i>
<i>KNOW</i>	<i>Knowledge about GM food</i>	<i>1: yes, 0: no</i>
<i>FRINNO</i>	<i>Frequency of new food consumption</i>	<i>From 1: never to 5: always</i>
<i>WELFARE</i>	<i>Degree of concern for animal welfare as a food-safety problem</i>	<i>1: high, 0: low</i>

III. RESULTS

Consumer's preference structure for GM cornflakes.

The preferences model was fitted through ordinary least squares (OLS), obtaining the aggregate results shown below (Table 4):

Table 4. Relative importance of attributes and part-worth utility.

***, ** significance levels 1% and 5%, respectively.

Attribute	Relative Importance	Levels	Part-Worth
ENVIRONMENT	34.58%	Without water and pesticides reduction – Conventional	1.042
		Pesticides reduction – GM	-0.593
		Water reduction – GM	-0.449
HEALTH	25.26%	Without Omega 3 – Conventional	0.353
		Omega 3 – GM	-0.353
QUALITY	21.75%	Soft texture	-0.540
		Crispy texture	0.364
		Crunchy texture	0.175
PRICE	18.41%	Coefficient	-1.013
		1.50€	-1.520
		2.00€	-2.027
		2.50€	-2.533
Pearson's R: 0.968*** Tau-Kendall: 0.667**			Constant 7.065

The attribute "Environment" had the highest importance score in respondents' utility function, 34.58%, "Health" ranked second in significance, 25.26% followed by "Quality" and "Price", with

21.75% and 29%, respectively. Based on the part-worth utilities (Table 4), the surveyed most preferred the *conventional* cornflakes, without genetic modification, neither to reduce pesticide and

water consumption nor to enrich for Omega-3 content, with *crispy texture* and a price of 1.50 €.

Utility of reducing the water and pesticides consumption by means genetic modification: Regression Analysis.

Table 5 illustrates the model results.

Table 5. Results of multiple regression model

Model	Non-Std. coefficient		Std. coefficient	t	Sig.	VIF
	B	Std. Err.	Beta			
(Constant)	-0.093	0.531		-0.175	0.861	
AGE	-0.015	0.004	-0.144	-3.710	0.000	1.111
RISK	-0.725	0.084	-0.349	-8.631	0.000	1.210
BCISL	0.269	0.054	0.192	5.024	0.000	1.083
QUALITY	0.143	0.071	0.077	2.021	0.044	1.065
LABEL	0.224	0.088	0.098	2.553	0.011	1.092
ENVIRON	-0.900	0.327	-0.105	-2.751	0.006	1.084
KNOW	0.481	0.141	0.128	3.419	0.001	1.028
FRINNO	0.177	0.066	0.103	2.667	0.008	1.095
WELFARE	-0.441	0.195	-0.087	-2.258	0.024	1.106
Source	SS	DF	MS	F	Sig.	
Regression	494.527	9	54.947	34.089	0.000	
Residual	696.329	432	1.612			
Total	1190.856	441				
R ²	41.53					
Adjusted R ²	40.31					
Standard Error of Estimate	1.26960					
Durbin-Watson	1.915					

The model shows that sociodemographic, lifestyle, attitude, and opinion variables influence the respondents' perception of GM cornflakes' environmental utility (reducing water and pesticide consumption). Thus, the AGE and RISK variables had an inverse relationship with the GMO's environmental perceived utility. On the contrary, this utility was directly correlated with the BCISL, QUALITY, LABEL, FRINNO variables. The above-mentioned environmental improvements were greater when the respondents knew about GM foods. Finally, consumers, who belonged to an environmental organization and often regarded the animal welfare as a threat for food, to a lesser extent, appreciated the environmental advantage of genetic manipulation.

IV. CONCLUSIONS

The study of social attitudes and preferences for GM foods indicates that consumers, despite the advantages offered by this kind of food, prefer the conventional ones. The attributes "Environment" and "Health", which determine the type and the degree of a food's genetic modification, are the most important in consumer's preferences for evaluated cornflakes. It bears noting that the price is the least important factor for consumers' preference, a finding that is logical taking into account the peculiarities of such foods.

Nowadays, the greater preference for conventional foods does not prevent the presence of a pioneer consumer segment who, in an innovative way, accepts GM foods, which are expected to

become generalized in their supply over medium-term.

The customer profile most prone to appraise the GM food's environmental utility is a young person who relies on current food quality and shows an innovative attitude to consume new-generation foods, does not belong to environmental organizations, is not deeply concerned about animal welfare, knows this kind of food, states that these foods in relation to the conventional ones do not pose special health or environmental risks, and agrees that biotechnology will improve the standard of living for future generations.

Based on the previously conclusions, the environmental improvements could be a way to enhance GM food, especially over the medium-long term, in which the current controversy over such production becomes resolved. On the other hand, more knowledge and information, together with greater market transparency, are fundamental in order to allow consumers to make the right decisions on this matter.

REFERENCES

1. Hair J F, Anderson R E, Tathan R L, Black W C, (1999) *Análisis multivariante*. Prentice-Hall, Madrid.
2. Instituto Nacional de Estadística at <http://www.ine.es>
3. James C (2006) Global Status of Commercialized Biotech/GM Crops: 2006. (Brief N°35). International Service for the Acquisition of Agri-Biotech Applications, Ithaca NY.
4. Ministerio de Agricultura, Pesca y Alimentación (2007). Superficie en hectáreas de variedades de maíz GM que se encuentran incluidas en el registro de variedades. MAPA, Madrid.
5. Steenkamp J B (1987). Conjoint measurement in ham quality evaluation. *Journal of Agricultural Economics* 38(3): 473-481.