Ordered probit regression analysis of the effect of brand name on beer acceptance by consumers

Suzana Maria DELLA LUCIA[1*], Valéria Paula Rodrigues MINIM[2], Carlos Henrique Osório SILVA[3], Luis Antonio MINIM[2], Paula de Aguiar CIPRIANO[2]

Abstract

Ordered probit regression was used to analyze data of sensory acceptance tests designed to study the effect of brand name on the acceptability of beer samples. Eight different brands of Pilsen beer were evaluated by 101 consumers in two sessions of acceptance tests: blind evaluation and brand information test. Ordered probit regression, although a relatively sophisticated technique compared to others used to analyze sensory data, was chosen to enable the observation of consumers' behavior using graphical interpretations of estimated probabilities plotted against hedonic scales. It can be concluded that brands B, C, and D had a positive effect on the sensory acceptance of the product, whereas brands A, F, G, and H had a negative influence on consumers' evaluation of the samples. On the other hand, brand E had little influence on consumers' assessment.

Keywords: non-sensory characteristics; ordered probit regression; sensory acceptance.

1 Introduction

Results of sensory acceptance tests are traditionally analyzed by examining the frequency distribution of hedonic ratings obtained for each sample or by means of analysis of variance (REIS; MINIM, 2010; VARELA et al., 2010; VASCONCELOS et al., 2013; NG; CHAYA; HORT, 2013). Another way to analyze this type of data is using multivariate internal preference maps (MDPREF) of the samples (MACFIE; THOMSON, 1988; SALES et al., 2008; REIS et al., 2010; SILVA et al., 2012). However, many alternative methods can be used to study important relationships between sensory acceptance and the influence on consumers' behavior of non-sensory characteristics of food such as brand, price, and origin. Among those methods is ordered probit regression, which was originally proposed by Aitchison and Silvey (1957) to model categorical response data. This analysis allows the estimation of $P\ (Y = K \mid X\beta)$ the probability of obtaining category K of the hedonic response Y in terms of the predictor or independent variables of interest.

While ordered probit regression is typically used in food science and technology research (DURY et al., 2002; LIN; JENSEN; YEN, 2005; VALLI; TRAILL, 2005; VERBEKE, 2005; VERBEKE; WARD, 2006; ANGULO; GIL, 2007; AKBAY; TIRYAKI; GUL, 2007; LOBB; MAZZOCCHI; TRAILL, 2007; NAES et al., 2013) to analyze questionnaires and surveys containing questions with categorized and sorted answers, relatively few studies have used ordered probit regression to analyze data obtained of sensory affective tests (SCHECHTER, 2010; XUE et al., 2010) or, as in the current study, data of sensory acceptance tests. Ordered probit regression analysis appears to have an important application in sensory and behavioral studies, and it is a promising alternative to help elucidating and interpreting the influence of non-sensory characteristics on consumer acceptance. In this analysis, the results are presented in a clear way, and their interpretation is more direct than that of other methods used for this type of data. Therefore, this technique was used to study the influence of brand name of eight different commercial brands of beer on sensory acceptance by consumers.

2 Materials and methods

2.1 Brands of beer

Eight Brazilian Pilsen beer brands were used in this experiment. Rather than using the real names of the brands in this study, their names were coded using the first eight letters of the alphabet, A through H. The choice of the brands was made based on three criteria:

1) According to *DataFolha* Institute of Statistical Survey: concerning the brands with the highest and lowest rates of responses when consumers were ranking brands of beer;
2) Inclusion of a brand recently launched in the national market, brand H, which has been an interesting object of research to determine the influence of an unfamiliar brand on consumers' acceptance of beers; and
3) The availability of brands in the market of Viçosa, Minas Gerais State, Brazil since the experiment was conducted with consumers residing in this city.

Received 30/4/2013
Accepted 22/6/2013 (006084)

[1] *Departamento de Engenharia de Alimentos, Centro de Ciências Agrárias, Universidade Federal do Espírito Santo – UFES, CP 16, CEP 29500-000, Alegre, ES, Brasil, e-mail: smdlucia@yahoo.com.br*
[2] *Departamento de Tecnologia de Alimentos, Universidade Federal de Viçosa – UFV, CEP 36570-000, Viçosa, MG, Brasil*
[3] *Departamento de Estatística, Universidade Federal de Viçosa – UFV, CEP 36570-000, Viçosa, MG, Brasil*
**Corresponding author*

DOI: http://dx.doi.org/10.1590/S0101-20612013005000068

2.2 Acceptance tests

This study was registered under number 50703155996 – Research Committee - Federal University of Viçosa, and it was conducted according to technical and ethical standards.

The sensory analysis team of panelists was composed of 101 recruited volunteers including students and staff members of the Federal University of Viçosa (UFV), along with residents of the city of Viçosa, Minas Gerais State, Brazil. The prerequisites for participating in the study were that the individual habitually consumed beer and showed an interest in participating in all test sessions. It is important to mention that the selected sample did not necessarily represent the population of Brazilian consumers of beer, but rather aided in the study of non-sensory characteristics which influence consumer acceptance and enabled us to demonstrate the use of ordered probit regression to analyze data of studies such as this.

The acceptance tests were carried out in two sessions in the Laboratory of Sensory Analysis of the UFV with intervals of at least eight hours between sessions to avoid sensory fatigue of the consumers. In the first session (blind test), the consumers tasted 40 mL beer samples served in acrylic cups, without prior knowledge regarding the brand of the beer being evaluated. In the second session (test with information), the acceptance of the beer samples was evaluated, and their respective containers, 350 mL aluminum cans, were showed to the panelists. The consumers were asked to judge the sample with particular attention to the fact that each drink was taken from the package presented to them (DELLA LUCIA et al., 2010a, b).

Evaluations were carried out in individual cabins under white light, and in each session, the beer samples were served in a random and monadic way at refrigeration temperature ranging from 6 °C to 8 °C (CAPORALE; MONTELEONE, 2004). A sensory evaluation form was provided for each sample, on which the consumers were required to indicate their acceptance of the product on a nine-point hedonic scale, in which "extremely liked" corresponded to score 9 and "extremely disliked" corresponded to score 1 (REIS; MINIM, 2010).

The results were evaluated by means of ordered probit regression analysis, as described below.

2.3 Ordered probit regression

The objective of this analysis was to estimate the probability of each score attributed by the consumers as a function of the brand for the two types of tests (blind test and test with brand information).

Let Y_{mct} be the score attributed to the m-*th* brand of beer by the c-*th* consumer in the t-*th* test.

Considering m = 1, 2,..., 8 brands of beer, c = 1, 2, ..., 101 consumers, and t = 1, 2 for the blind test and the test with information.

In order to simplify, let us consider $Y_{mct} = Y_n$, with n= 1, 2, ..., 1616 and let us also consider Y_n^*, a continuous latent variable so that the dependent variable Y_n is related to Y_n^* as follows:

$$y_n = 1 \Leftrightarrow y_n^* \le \mu_1, \quad y_n = k, \textit{ for } k = 2,\dots,8 \Leftrightarrow \mu_{k-1} < y_n^* \le \mu_k, \quad y_n = 9 \Leftrightarrow \mu_8 < y_n^*$$

The values of m_k, for k = 1, 2,.., K-1 (K = 9 categories) are denominated threshold parameters.

The ordered probit regression model used in this study is (DELLA LUCIA et al., 2010a):

$$Y_n^* = \sum_{i=1}^{8} \beta_{1i} I_{1i} + \sum_{i=1}^{8} \beta_{2i} I_{2i} + \varepsilon_n \quad (1)$$

where, I_{1i} and I_{2i} are indicator variables (dummy variables) for the i-*th* brand of beer and the test with information for the i-*th* brand, respectively, that is:

$I_{1i} = 1$ if brand = i and $I_{1i} = 0$, otherwise;

$I_{2i} = 1$ if brand = i and test = with information and $I_{2i} = 0$, otherwise.

The intercept was set equal to zero ($\beta_0 = 0$), $\mu_1 = 0$ (threshold parameter), and σ = 1 (standard deviation), as implemented on SAS (Statistical Analysis System) program and explained in Jackman (2000): restrictions in order to make the model identifiable.

Therefore, for the i-*th* brand of beer, $\hat{Y}_n^* = \hat{\beta}_{1i}$ is the estimated response for the blind test and $\hat{Y}_n^* = \hat{\beta}_{1i} + \hat{\beta}_{2i}$ is the estimated response for the test with information. Hence, testing $H_0 = \beta_{2i} = 0$ is equivalent to testing the effect of the i-th informed brand in the acceptance test.

The estimation of the regression coefficients β_{1i} and β_{2i} and the values of μ_k, which are achieved by maximum likelihood (L) (as discussed below), must be done in order to adjust the model (1) that allows estimation of probabilities associated to each hedonic score, as follows (DELLA LUCIA et al., 2010a):

$$P(y_i = 1) = P\left(y_i^* \le \mu_1\right) = P\left(\varepsilon_i \le \mu_1 - X_i\beta\right) = \Phi\left(\mu_1 - X_i\beta\right) = \Phi_{i1},$$

$$P(y_i = m) = P\left(\mu_{m-1} \le y_i^*\right) = P\left(\varepsilon_i \ge \mu_{m-1} - X_i\beta\right) = 1 - \Phi\left(\mu_{m-1} - X_i\beta\right) = 1 - \Phi_{i,m-1},$$

where, Φ represents the accumulated probability in the standardized normal distribution. For all the other categories ($j = 2,3,\dots,m-1$), there is:

$$P(y_i = j) = P\left(\mu_{j-1} < y_i^* \le \mu_j\right) = P\left(\mu_{j-1} - X_i\beta < \varepsilon_i \le \mu_j - X_i\beta\right) = \Phi_{ij} - \Phi_{i,j-1} \quad (2)$$

The estimation of the threshold parameters (μ) and the regression coefficients (β) are done by means of iterative numerical methods. If we admit y_i observations as independent and define $\Phi_{i0} = 0$ and $\Phi_{im} = 1$, thus (2) defines a general expression which allows us to write the joint probability function of the sample, or the likelihood (L) function, $L = \prod_{i=1}^{N} P(y_i = j) = \prod_{i=1}^{N} (\Phi_{ij} - \Phi_{i,j-1})$, for which the log-likelihood function is, $\ln L = \sum_{i=1}^{N} \ln(\Phi_{ij} - \Phi_{i,j-1})$, or according to Jackman (2000), $\ln L = \sum_{i=1}^{N}\sum_{j=1}^{m} Z_{ij} \ln(\Phi_{ij} - \Phi_{i,j-1})$, where $Z_{ij} = 1 \Leftrightarrow y_i = j$ is an indicator variable.

The maximization is conducted through iterative numerical methods such as the modified Newton-Raphson algorithm implemented in the Statistical Analysis System (SAS), system version 9.1 (SAS Institute Inc., Cary, NC, USA).

Therefore, the ordered probit regression method enables the estimation of probabilities for all nine categories of hedonic scores, both for the blind test and for the brand information test. The effect of the brand names on consumers' acceptance can therefore be directly inferred.

The statistical analyses were implemented with the SAS, licensed for usage at UFV.

3 Results

The null hypotheses $H_0 : \beta_{1i} = 0$ and $H_0 : \beta_{2i} = 0$ for each brand were tested using the Wald test. The quality of the adjusted model was evaluated by the likelihood ratio test. The result was not significant (p = 1.0), indicating that the model was appropriate to represent the data. The estimated regression coefficient and its significance are shown in Table 1.

Of all estimated coefficients, only $\hat{\beta}_2$, representing brand E, was not significant, which shows that this brand name did not influence the evaluation of the sample during the information test. The negative sign for the $\hat{\beta}_2$ coefficients of the brands A, F, G, and H indicate the negative effect of these brand names in the information test. An opposite pattern was observed for brands B, C, and D, with positive estimated values for β_2 thus showing a positive influence on consumers' acceptance in brand information test.

For the eight brands of beer, the probabilities of obtaining the nine hedonic scores for the blind and information tests were also estimated. The graphs of estimated probabilities and the observed frequencies of the hedonic scores on both types of tests, for the eight evaluated brands, are shown in Figure 1.

Table 1. Summary of the ordered probit regression analysis: estimative of the coefficients of regression and summary of the Wald tests (p-values)[a].

Coefficient	Estimative	P-value[a]
$\hat{\beta}_{1i}$		
$\hat{\beta}_{1A}$	2.57	<0.0001
$\hat{\beta}_{1B}$	2.02	<0.0001
$\hat{\beta}_{1C}$	2.31	<0.0001
$\hat{\beta}_{1D}$	2.29	<0.0001
$\hat{\beta}_{1E}$	2.39	<0.0001
$\hat{\beta}_{1F}$	2.32	<0.0001
$\hat{\beta}_{1G}$	2.39	<0.0001
$\hat{\beta}_{1H}$	2.44	<0.0001
$\hat{\beta}_{2i}$		
$\hat{\beta}_{2A}$	−0.43	0.0050
$\hat{\beta}_{2B}$	0.72	<0.0001
$\hat{\beta}_{2C}$	0.65	<0.0001
$\hat{\beta}_{2D}$	0.50	0.0010
$\hat{\beta}_{2E}$	−0.23	0.1323[ns]
$\hat{\beta}_{2F}$	−0.45	0.0027
$\hat{\beta}_{2G}$	−0.62	<0.0001
$\hat{\beta}_{2H}$	−0.51	0.0008
$\hat{\mu}_i$		
$\hat{\mu}_2$	0.64	
$\hat{\mu}_3$	0.98	
$\hat{\mu}_4$	1.49	
$\hat{\mu}_5$	1.78	
$\hat{\mu}_6$	2.24	
$\hat{\mu}_7$	2.90	
$\hat{\mu}_8$	3.91	
Intercept	0.00	

[a] $p\left[\left(\frac{estimative}{standard\ error}\right)^2 \geq \chi_1^2\right]$ ns = not significant (p-value>0.05)

4 Discussion

According to Figure 1, it is interesting to notice the point at which the inversion between the two trend lines occurs, representing the probabilities of the hedonic scores for the blind tests and the tests with information (DELLA LUCIA et al., 2010a). The line shown on the upper position of the graph corresponds to the highest probabilities. Therefore, to interpret these graphs, it is necessary to verify the region in which the scores (lowest ones: 1 to 5 or highest ones: 6 to 9) occur with the greatest probabilities for both the blind test and the test with information. For beer C, for example, when considering the hedonic terms "extremely disliked" to "liked moderately", the estimated probabilities of obtaining hedonic scores in the blind test overcame the probability of the scores in the test with information. In other words, in the blind test, the probability of these scores appear in consumers' evaluation was always higher than in the tests with information. The highest estimated probability achieved by brand C, in the blind test, was for the hedonic term "liked moderately" (P = 0.250). For more extreme hedonic terms ("liked a lot" and "extremely liked"), however, the response was the opposite. The probability of occurrence of these scores was higher in the test with the brand information, proving that this beer received greater frequency of acceptance score (higher probability) when the brand name was known. The term "liked a lot", for instance, reached its greatest probability of occurrence in the test with information (P = 0.352).

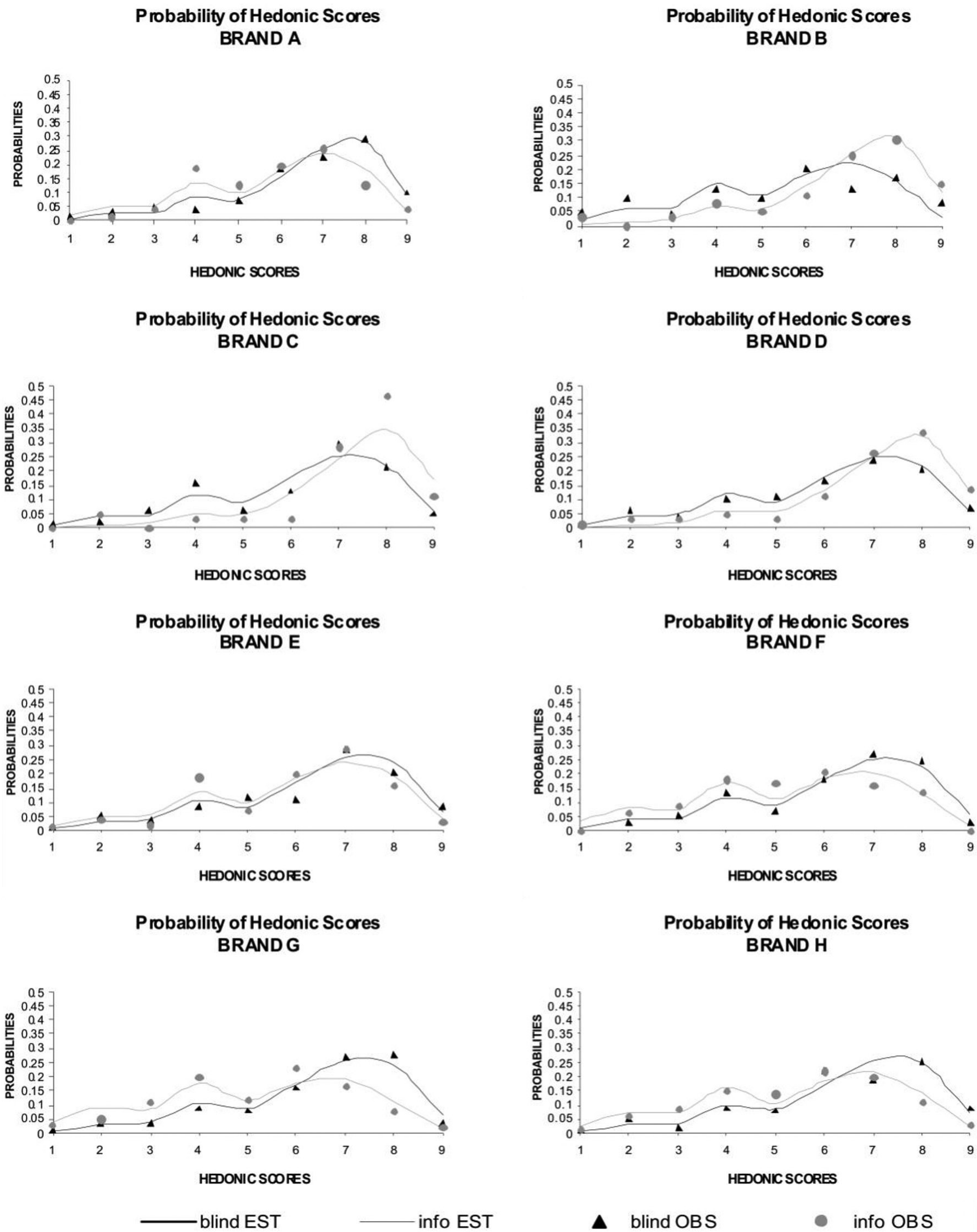

Figure 1. Summary of the ordered probit regression analyses for the eight brands of beer. EST: estimate probability and OBS: observed frequency, both in the blind test and test with the brand information (info).

Nevertheless, in the blind test, its probability was 0.221, a value lower than the hedonic score previously mentioned.

The same pattern was observed for beer D. The maximum value of probability was for the term "liked a lot", in the test with the brand information (P = 0.325), which was higher than the value obtained for the same term in the blind test (P = 0.218). The least achieved probability was reached for the term "extremely disliked" (P = 0.003) in the test with information; the same term in the blind test, had a probability value of 0.011; that is, the probability of obtaining a minimum score in the hedonic scale was greater in the blind test.

Similar data were obtained for brand B. The difference in this case was that there was a greater discrepancy between the probability of occurrence of the higher scores than "like moderately" between the tests with information and the blind one, i.e., the probability of obtaining high hedonic scores for brand B in the test with information was much greater than in the blind test. For the term "liked a lot", the probability of occurrence was 0.314 for the test with information, against 0.158 in the blind test, i.e. the probability of consumers that liked beer B a lot was approximately twice greater than that when its brand name was provided in the sensory analysis, demonstrating the considerable influence that this brand name has over consumers' acceptance.

In conclusion, beers B, C, and D had a positive effect on acceptance of the drink.

For brand E, the probability of occurrence of the hedonic scores was similar on both tests. The estimate of probability for terms more extreme than "slightly liked" was the opposite between the two tests. In this case, however, the probability of obtaining high scores was slightly lower in the test with information, suggesting a negative influence of the brand name in the sensory evaluation. For the term "extremely liked", for example, the estimated probability in the blind test was 0.064, against the value 0.040 obtained in the test with information. Since the probabilities of obtaining the hedonic scores were close in both situations during the evaluation of the samples, it could be concluded that although there was some negative influence on acceptance of the beverage, brand name should not be considered a factor of great influence in the evaluation of consumers of the beer E.

Brands A, F, G, and H had graphs with a similar pattern among themselves and opposite to those observed for brands B, C, and D. The estimated probabilities of obtaining the hedonic scores in the test with information overcame the probabilities in the blind test with regard to the hedonic terms "extremely disliked" and "slightly liked".

The probability of occurrence of the minimum hedonic scale score, although presenting low absolute values, was always higher in the test with information, ranging from 0.005, for brand A, to 0.009, for brand G. In the case of more extreme hedonic terms ("moderately liked" to extremely liked"), however, the response was the opposite. The probability of occurrence of such scores was higher in the blind test. The maximum estimated probability for brands F, G, and H in the blind test was for the hedonic term "liked moderately", ranging from 0.251 (brand F) to 0.257 (brand H). Beer brand A showed the maximum estimated probability for the term "like a lot" in the blind session (P = 0.279), compared to a value of P = 0.185, for the same term, in the test with information. This corroborates the fact that such brands achieved greater acceptance less frequently during their evaluations when the brands were informed, i.e., the brand names had a negative effect on consumers' acceptance.

Della Lucia et al. (2010b) conducted a study under the same conditions of those used in the present study and involving the same eight brands of beer. They used descriptive statistics with frequency distributions and paired comparison t-test as data analysis methods, which have already been established in the literature as adequate methods to analyze the influence of non-sensory characteristics on consumer acceptance. The results found by those authors were similar to the results of the present study: samples corresponding to brands B, C, and D positively influenced consumer evaluation; brands A, F, G, and H had a negative effect on the participants. For brand E, the results suggested that the brand itself did not influence consumers' evaluation, but other factors associated with it must have caused an increase in its acceptance.

Resano, Sanjuán and Albisu (2007) carried out similar sensory tests to those conducted in this research in order to investigate the influence of the brand, the origin, and the quality certificate on the acceptance of Spanish ham. Their results indicated that brand was not a factor which affected the acceptance of consumers. While the results in the Spanish study contradicted those obtained in the evaluation of beer, other studies confirm our findings of the influence of brand names on the consumers' evaluation (VARELA et al., 2010; DI MONACO et al., 2003, 2004; DELLA LUCIA et al., 2006).

5 Conclusions

Using ordered probit regression, it was found that the estimated probabilities for the highest hedonic scores of the scale were higher for the beer brands B, C, and D in the test with the brand information, indicating a positive effect on acceptance of the participants in the research study. In the case of beers A, F, G, and H, the probability of occurrence of more extreme hedonic terms was greater in the blind test, indicating a negative influence of the brand name on consumer evaluation. As for beer E, based on the estimated probabilities for the hedonic scores in both sensory tests, it did not greatly influence the evaluation by consumers.

The results of this study using ordered probit regression were similar to those reported in the literature in a study with the same eight beer brands. The differences between these two studies indicate small differences caused by the different analysis methods used and their peculiar characteristics. This demonstrates that the use of ordered probit regression analysis was efficient in the analysis of data of the effect of non-sensory characteristics on consumers' evaluation.

Ordered probit regression proved useful in studies that associate sensory evaluation and consumer behavior making it possible to obtain the modeling of probabilities of occurrence of the nine hedonic scores for different beer brands in blind and information tests. This technique is an alternative data analysis that has been only rarely explored in the sensory acceptance field. The results of this technique provide a direct, clear visualization of hedonic scores of sensory acceptance that is easily understood and conclusive, and which provides interesting insights into the effect of non-sensory characteristics on consumers' behavior, thereby justifying its usage in the sensory analysis of food.

Acknowledgments

The authors are grateful to the Foundation for Research Support of Minas Gerais State (FAPEMIG) and the National Council for Scientific and Technological Development (CNPq) for the financial support.

References

AITCHISON, J.; SILVEY, S. The generalization of probit analysis to the case of multiple responses. **Biometrika**, v. 44, n. 1-2, p. 131-140, 1957. http://dx.doi.org/10.1093/biomet/44.1-2.131

AKBAY, C.; TIRYAKI, G. Y.; GUL, A. Consumer characteristics influencing fast food consumption in Turkey. **Food Control**, v. 18, n. 8, p. 904-913, 2007. http://dx.doi.org/10.1016/j.foodcont.2006.05.007

ANGULO, A. M.; GIL, J. M. Risk perception and consumer willingness to pay for certified beef in Spain. **Food Quality and Preference**, v. 18, n. 8, p. 1106-1117, 2007. http://dx.doi.org/10.1016/j.foodqual.2007.05.008

CAPORALE, G.; MONTELEONE, E. Influence about manufacturing process on beer acceptability. **Food Quality and Preference**, v. 15, n. 3, p. 271-278, 2004. http://dx.doi.org/10.1016/S0950-3293(03)00067-3

DELLA LUCIA, S. M. et al. Expectativa gerada pela embalagem na aceitação de iogurte sabor morango. **Revista do Instituto de Laticínios Cândido Tostes**, v. 351, n. 61, p. 148-151, 2006.

DELLA LUCIA, S. M. et al. Características não sensoriais e o comportamento do consumidor: conceitos e métodos estatísticos de avaliação. In: MINIM, V. P. R. (Ed.). **Análise sensorial**: estudos com consumidores. 2nd. ed. Viçosa: Editora UFV, 2010a. cap. 6; p. 125-167.

DELLA LUCIA, S. M. et al. Expectativas geradas pela marca sobre a aceitabilidade de cerveja: estudo da interação entre características não sensoriais e o comportamento do consumidor. **Boletim do CEPPA**, v. 28, n. 1, p. 11-24, 2010b.

DI MONACO, R. et al. The role of the knowledge of color and brand name on the consumer's hedonic ratings of tomato purees. **Journal of Sensory Studies**, v. 18, n. 5, p. 391-408, 2003. http://dx.doi.org/10.1111/j.1745-459X.2003.tb00396.x

DI MONACO, R. et al. The effect of expectations generated by brand name on the acceptability of dried semolina pasta. **Food Quality and Preference**, v. 15, n. 5, p. 429-437, 2004. http://dx.doi.org/10.1016/j.foodqual.2003.07.003

DURY, S. et al. The determinants of urban plantain consumption in Cameroon. **Food Quality and Preference**, v. 13, n. 2, p. 81-88, 2002. http://dx.doi.org/10.1016/S0950-3293(01)00061-1

JACKMAN, S. Models for ordered outcomes. **Political Science**, v. 150C/350C, p. 1-14, 2000.

LIN, C. T. J.; JENSEN, K. L.; YEN, S. T. Awareness of foodborne pathogens among US consumers. **Food Quality and Preference**, v. 16, n. 5, p. 401-412, 2005. http://dx.doi.org/10.1016/j.foodqual.2004.07.001

LOBB, A. E.; MAZZOCCHI, M.; TRAILL, W. B. Modelling risk perception and trust in food safety information within the theory of planned behavior. **Food Quality and Preference**, v. 18, n. 2, p. 384-395, 2007. http://dx.doi.org/10.1016/j.foodqual.2006.04.004

MACFIE, H. J. H.; THOMSON, D. M. H. Preference Mapping and Multidimensional Scaling. In: PIGGOT, J. R. (Ed.). **Sensory Analysis of Foods**. 2nd. ed. New York: Elsevier, 1988. p. 38-409.

NAES, T. et al. A comparison of two new take-away strategies and their relation to rating and ranking of extrinsic properties of dry cured ham. **Food Quality and Preference**, v. 27, n. 1, p. 63-71, 2013. http://dx.doi.org/10.1016/j.foodqual.2012.06.001

NG, M.; CHAYA, C.; HORT, J. The influence of sensory and packaging cues on both liking and emotional, abstract and functional conceptualisations. **Food Quality and Preference**, v. 29, n. 2, p. 146-156, 2013. http://dx.doi.org/10.1016/j.foodqual.2013.03.006

REIS, R. C. et al. Mapa de preferência. In: MINIM, V. P. R. (Ed.). **Análise sensorial**: estudos com consumidores. 2nd. ed. Viçosa: Editora UFV, 2010. cap. 5, p. 108-124.

REIS, R. C.; MINIM, V. P. R. Teste de aceitação. In: MINIM, V. P. R. (Ed.). **Análise sensorial**: estudos com consumidores. 2nd. ed. Viçosa: Editora UFV, 2010. cap. 3, p. 66-82.

RESANO, H.; SANJUÁN, A.; ALBISU, L. M. Consumers' acceptability of cured ham in Spain and the influence of information. **Food Quality and Preference**, v. 18, n. 8, p. 1064-1076, 2007. http://dx.doi.org/10.1016/j.foodqual.2007.05.002

SALES, R. L. et al. Mapa de preferência de sorvetes ricos em fibras. **Ciência e Tecnologia de Alimentos**, v. 28, p. 27-31, 2008. Suplemento. http://dx.doi.org/10.1590/S0101-20612008000500005

SCHECHTER, L. The apple and your eye: Visual and taste rank-ordered probit analysis with correlated errors. **Food Quality and Preference**, v. 21, n. 1, p. 112-120, 2010. http://dx.doi.org/10.1016/j.foodqual.2009.08.009

SILVA, R. C. S. N. et al. Otimização da aceitabilidade sensorial de requeijão cremoso light. **Ciência Rural**, v. 42, n. 2, p. 360-366, 2012.

VALLI, C.; TRAILL, W. B. Culture and food: a model of yoghurt consumption in the EU. **Food Quality and Preference**, v. 16, n. 4, p. 291-304, 2005. http://dx.doi.org/10.1016/j.foodqual.2004.05.006

VARELA, P. et al. Influence of brand information on consumers' expectations and liking of powdered drinks in central location tests. **Food Quality and Preference**, v. 21, n. 7, p. 873-880, 2010. http://dx.doi.org/10.1016/j.foodqual.2010.05.012

VASCONCELOS, C. M. et al. Desenvolvimento e avaliação sensorial de sobremesa láctea potencialmente simbiótica. **Revista do Instituto de Laticínios Cândido Tostes**, v. 68, n. 391, p. 11-17, 2013. http://dx.doi.org/10.5935/2238-6416.20130015

VERBEKE, W. Consumer acceptance of functional foods: socio-demographic, cognitive and attitudinal determinants. **Food Quality and Preference**, v. 16, n. 1, p. 45-57, 2005. http://dx.doi.org/10.1016/j.foodqual.2004.01.001

VERBEKE, W.; WARD, R. W. Consumer interest in information cues denoting quality, traceability and origin: an application of ordered probit models to beef labels. **Food Quality and Preference**, v. 17, n. 6, p. 453-467, 2006. http://dx.doi.org/10.1016/j.foodqual.2005.05.010

XUE, H. et al. Consumer preferences and willingness to pay for grass-fed beef: Empirical evidence from in-store experiments. **Food Quality and Preference**, v. 21, n. 7, p. 857-866, 2010. http://dx.doi.org/10.1016/j.foodqual.2010.05.004