CORRESPONDENCE FACTOR ANALYSIS AS A TOOL FOR STUDYING THE BEHAVIOR OF YERBA MATE CONSUMERS

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Abstract

This paper sets out to analyze the preferences of yerba mate consumers to determine the criteria they use when purchasing the product. To this end, questionnaires based on theoretical models of purchase behavior have been applied to a non-probabilistic sample chosen for accessibility. The technique of correspondence factor analysis (CFA) was then employed to examine data generated from the questionnaires. Our results show that only some of the consumers consider mate price in their decision to purchase the product, which suggests that they would be willing to pay more if there were an additional advantage. Generally, consumers surveyed showed no brand loyalty, consistent with oscillations in product quality. They also showed awareness of packaged product expiration dates and "nutrition facts," information that is now required by Brazilian packaging laws. Considering the value consumers attach to foods rich in nutrients, producers have been slow to fully exploit these market characteristics. It was also found that many of the surveyed consumers strongly rejected the idea of having sugar and other ingredients added to the mate, which should also be taken into account by this sector's marketing professionals.

Key words: Yerba mate; consumer behavior; correspondence factor analysis.

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1. Introduction

In this paper, we analyze the preferences of yerba mate consumers to determine the criteria they use when purchasing the product.

Potentially, many products can be derived from yerba mate: mate[1], tereré[2], tea (hot or cold infusions), soft drinks, juices, beer, wine, energy drinks, natural dyes, preservatives, medicines for the treatment of high blood pressure, bronchitis and pneumonia, bactericides, sterilizers, emulsifiers, perfumes, deodorants, cosmetics and soap (EMATER, 1995 apud Mazuchowski & Rücker, 1998). However, yerba mate is today used solely in the production of tea-like beverages, such as mate tea and "chimarrão," a typical beverage in the state of Rio Grande do Sul, Brazil. "Chimarrão, a type of mate tea, is served in a gourd into which the yerba mate has been placed and then covered with hot water. This traditional drink evokes a series of emotions in the people who produce and consume it. A ritual has evolved in its preparation formalizing the way the dried leaves are put into the gourd, the way the water is boiled, the way the *bombilla*[3] is placed in it, and even the way people are served.

Ordered by quantity produced, Rio Grande do Sul, Santa Catarina, and Paraná are the three main Brazilian mate producing states. In 1994, these three states together produced 222,357 tons of green leaves, collected from an area of 16,457 ha. Within these states, there are 725 yerba mate processing enterprises employing 710,000 workers in 486 counties (Rücker, 1996).

The system used in the processing of yerba mate utilizes the leaves, the tender shoots, petioles, and peduncles of the forest species whose scientific name is *Ilex paraguariensis St. Hill.* From raw material to the end-product, processing consists of two main phases: dilaceration

[1] Hot unsweetened tea-like beverage brewed from the dried leaves of Ilex paraguensis.
[2] Similar to the mate, but prepared with cold water.
[3] A tube provided with a strainer at the lower end, through which the tea is drunk.

and improvement. The dilaceration cycle (process of grinding the dried leaves of the yerba mate) comprises the operations of collecting, scorching (exposing the mate leaves to heat for a short period of time in order to dehydrate them), drying, beating and sifting. The product resulting from this phase, called dilacerated mate, is then taken to the factory where the process of improvement begins. In this process, the mate is dried, cleaned once again, then ground and sieved to various degrees of granulation. The degree of granulation is geared to meet the preferences of the different target markets (BRDE, 1994).

Surprisingly enough, this agro-industrial sector still lacks information regarding mate consumption. It is a source of concern that the only data available are those related to apparent consumption: apparent consumption represents 85% of production (data from the period 1992-1995).

From this context, it is crucial to understand how mate consumers behave, although that is a difficult task, since one is frequently working with subjective and abstract variables.

The consumption of mate, like that of any other food, is influenced by psychological needs, tastes and preferences, habits, socio-cultural relations and economic factors. Since man lives in a society, his food preferences are culturally and socially influenced. Such social patterns result from five kinds of influence: (1) physiological values; (2) socio-psychological values; (3) economic values; (4) availability; and (5) the consumer's knowledge and information about foods (Kohls & Uhl, 1985).

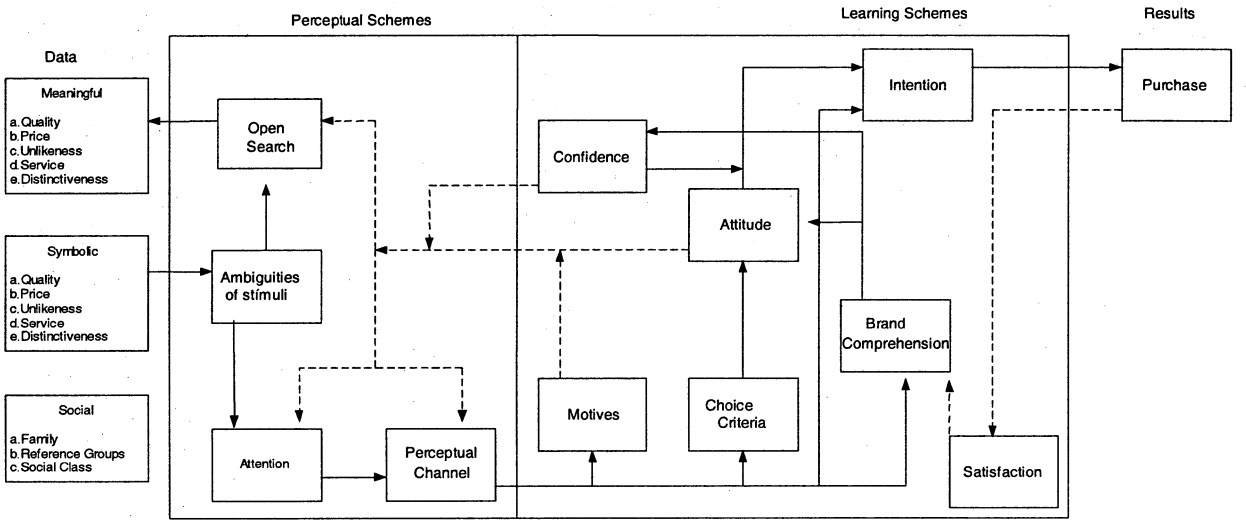
This paper is divided into five parts: this general introduction; a review of the literature on purchase behavior models; an explanation of the methodology, taking into account the survey technique and the correspondence factor analysis method; a discussion of the results; and final remarks.

2. Purchase Behavior Models

In this section, we introduce some of the main models of purchase behavior, which are used to understand the consumer's decision making process at the moment they choose a product to buy. We will present three behavior models: that of Howard and Sheth (see Sheth, 1973), that of Kotler (1992) and that of Engel *et al.* (1990).

The model proposed by Howard and Sheth, as shown in Bennett & Kassarjian (1975), is diagramed in Figure 1.

Figure 1: The Consumer Behavior Model proposed by Howard and Sheth.



Source: Bennett & Kassarjian (1975)
N.B.: Continuous lines indicate information flow; dotted lines indicate the feedback effects.

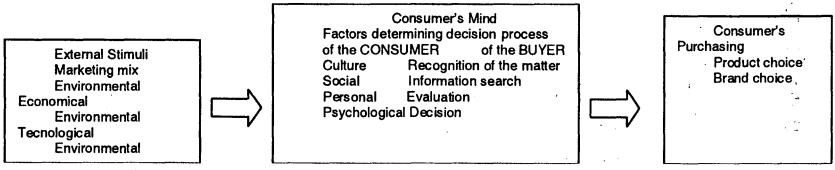
Note that the model has three parts: input, processing, and output. The part concerning input indicates that the most important stimuli influencing the consumer are the product's features (quality, price, availability and others), which are brought to the consumer's attention through a marketing effort, by the product itself, and/or by the consumer's family, friends, or members of groups to which the consumer belongs.

The model's second part, which concerns the way this input is processed, is divided into two stages: perceptual concepts and learning concepts. Perceptual concepts are those that deal with the way people receive and process information. An individual may not perceive pieces of information (input) coming from various sources, and the individual's frame of reference tends to distort that information (perceptual distortion). The learning concepts are too complex and numerous to be discussed in this study.

The final part of Howard and Sheth's model regards output, the individual's actual purchase decision. At that time, the information received is processed and the decision is made. In this model, the variables - social position, culture, and consumer income - are considered exogenous variables, although they are not seen as irrelevant.

Kotler (1992) presents a different model of consumer behavior (Figure 2), the division of which is similar to that of Howard and Sheth model.

Figure 2: Model of the consumer's purchasing decision.



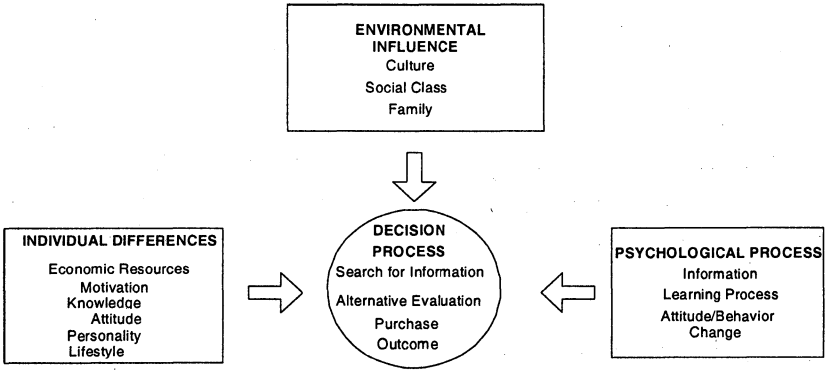
Source: Adapted from Kotler (1992)

In Kotler's model, the starting point of the process is found in the external stimuli received by consumers at the moment they make their purchase choice. Such stimuli may be presented by product marketing at the point of sale and may or may not be accompanied by

stimuli in the buyer's macro environment, whether from an economic, technological, political, or cultural viewpoint. Before the consumer decides to buy a product, such stimuli work on his wishes and needs. In this way cultural, social, personal, and psychological factors influence the consumer's decision-making process, making him recognize his needs, search for information about the product, assess it, and finally, decide to buy.

The model proposed by Engel *et al.* (1990) is shown in Figure 3. In this model, the decision process, represented by the circle at the center of the figure, is influenced by the environment, individual differences, and psychological process, which correspond to the three boxes adjacent to the center "decision process" circle.

Figure 3: Model of the consumer's purchasing decision.



SOURCE: Adapted from Engel *et al.* (1990)

Based on the principle that the environment influences people's opinions and that people in turn influence the environment where they live and work, we realize that it is necessary to understand clearly the groups and subgroups of environmental influence, its encoded signals and symbols, in order to understand people's reactions to these stimuli. The Environmental Influence box in Engle's model focuses on these influences.

The Model's Individual Differences box represents the affect of economic resources, attitudes, knowledge, lifestyle, and personality on consumer purchase decisions. It addresses the role personal idiosyncrasies play in the purchase process. The Psychological Process box is subdivided into information processing, learning, attitude/behavior, and change. Such factors shape consumer motivation and behavior.

The Decision Process in the central circle is being affected by the influences represented in by three boxes. It represents the combination of external and internal influences that trigger the purchase process. Each one of these sub-elements is important in the decision process, and they can be summarized and placed in the following order: recognition of need, search for information, purchase, and outcome. Up to the moment one finally makes the purchase, one receives a series of stimuli that lead to the purchase best suiting the moments need.

The three models presented in this paper show similarities and differences, but they all share the same general aim: to understand the how a consumer responds to a series of influences when making the purchase decision. Such models serve, therefore, as *insights*, setting parameters for the methodology used to understand how consumers behave. Concepts contained in these models are embedded in the tools used for collecting this study's yerba mate consumer data. Our results are detailed in the sections that follow.

3. Methodology

To achieve the aims of this study, a questionnaire was used to acquire three basic blocks of information. The questionnaire was aimed at finding out 1) whether the consumer is a buyer of the product, 2) his/her socio-economic profile, and 3) which features he wishes the mate to have and which features are taken into account when buying the product. The first part of the questionnaire was designed to make sure that the right people were surveyed, that is, mate consumers. The second

part was used to determine the respondent's socioeconomic profile. The third part constituted the core questions of the survey.

After the questionnaire had been prepared, a pre-test was conducted to prevent any failures in the consumer's interpretation of the questions to ensure the proper use of the methodology and to adapt the questions to the consumers' terminology (Katz, 1974; Suncion, 1984; Stal, 1991). After this pre-test, the survey was carried out in one primary through secondary public grade school in Santa Cruz do Sul (RS), in May 1999. Only teachers who were mate consumers were asked to fill in the questionnaire. In this case, the sample chosen was non-probabilistic and for "accessibility" (Gil, 1991). A non-probabilistic sample is characterized by uncertainty as to the hypothesis that all individuals of the population have the same probability of being included in the sample (Selltiz *et al.*, 1974).

Since the survey is an exploratory one, we worked with a limited group of people; but they are likely to represent the mate consumer population. Forty-eight questionnaires were validated. These questionnaires were then analyzed by means of the statistical technique known as correspondence factor analysis (CFA).

Factor analysis is a multivariate analysis technique based on obtaining factors and scores by means of variances and co-variances (Morvan *et al.*, 1996). CFA is an exploratory analysis technique used to study the association between two or more categorical variables, graphically representing the relationship between lines and columns in the same space (Silva & Verdinelli, 1997). CFA makes possible the study of crosstabs, also known as contingency tables, and matrices in which lines represent objects or individuals and columns represent variables with one or several modalities.

There is considerable similarity between correspondence factor analysis and principal components analysis, which is the most commonly used factor analysis method. However, principal components analysis applies to quantitative data while CFA applies to qualitative aspects, or

continuous discrete data, with the restriction that they must be positive (Verdinelli, 1980). Like other factor methods, CFA can reduce the representation space without omitting substantial information.

CFA is an algorithm that provides a simplified visualization of multidimensional reality by algebraically manipulating contingency tables. This kind of analysis is grounded in the interdependence of variables hypothesis, and is considered highly flexible since it can be applied to different kinds of data (Hoffman & Franke, 1986).

In real life, one works with sets of categorical variables in a large number of modalities whose interrelations are difficult to understand. CFA makes it possible to interpret the variables by means of geometric representation, displaying the data's structure in an optimal form without the need to adopt models or distributions. In this context, CFA is an exploratory data analysis technique that makes it possible to generate hypotheses based on the associations and oppositions studied.

Technically, the factorial planes or inertial representations (vector subspaces) allow one to show the relationship between the values found in a table's rows and columns. The values found in the boxes at the intersections of lines with columns in Tables 1 & 2 are represented by points in Euclidian space on Graph 1 and are determined by the frequency vector of the cells. The distance between points or between points and the gravity center – the origin of the coordinates – is measured in distances of χ^2 (Chi-square). The contribution of the cloud of variable-points to the inertia is proportional to its distance from the center of coordinates, so the further from the center, the higher its contribution.

According to Carroll *et al.* (1986), given a frequency matrix F, whose marginal line and marginal column profiles are represented in two diagonal matrices R e C, the first transformation occurs in the normalization of matrix F, when a new matrix H is generated, as follows:

$$H = R^{-1/2} F C^{-1/2} \qquad (1)$$

The second step is to find the singular value of decomposition of H, denoted as:

$$H = P \Delta Q' \quad (2)$$

where $P'\ P = Q'$, $Q = I$ and Δ is diagonal. In this transformation, the first trivial solution eigenvector is discarded.

The third and last step is to define the configuration of the coordinates of the lines and columns X and Y, respectively, after reducing the matricial dimensions.

$$X = R^{-1/2} P \Delta \quad (3)$$
$$Y = C^{-1/2} Q \quad (4)$$

In works that makes use of CFA, the sets of transformed coordinates X and Y represent the set of interests and allow the use of the same graph space for lines and columns. However, each set must be analyzed separately (Hoffman & Franke, 1986). A traditional scale with X and Y coordinates does not allow for this kind of interpretation.

4. Results and Discussion

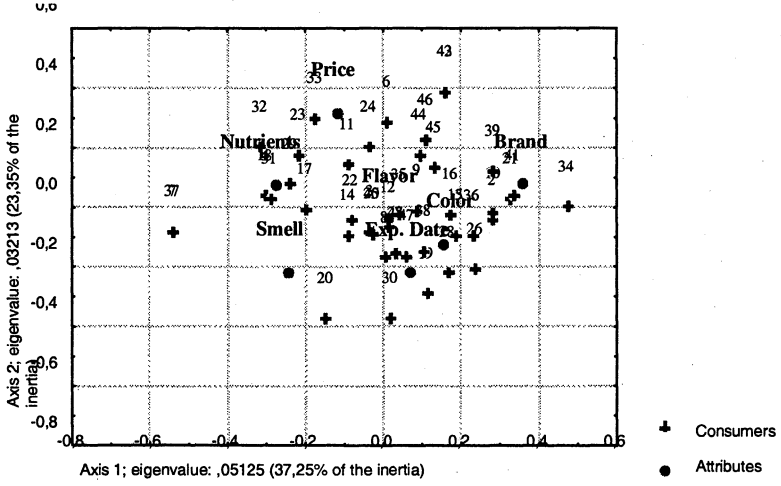
The attributes analyzed as features to taken into consideration in the purchase of mate were Color, Flavor, Price, Brand, Smell, Expiration Date, and Nutrients. Only the data from consumers who purchase the product for household use were considered, resulting in 48 validated interviews. Graph 1 is a representation of our results in relation to features sought and the respondents.

The graph shows the total value of the inertia (0.0137). The three first eigenvalues (0.0512; 0.00321; e 0.0023) represent 77% of the total inertia. There were six eigenvalues in total, and they account for 100% of the inertia. The total inertia can be decomposed along the main axes. Each eigenvalue indicates the fraction, in percentage, of the variance explained in each main axis shown in the graph.

We chose to analyze the two main axes (Graph 1), which represent 60% of the total inertia. This type of analysis was chosen because it provides a better understanding and visualization of the data

as it uses bi-dimensional graphic space, which simplifies interpretation without involving any significant loss of information.

Graph 1 : Bi-dimensional chart showing the consumers and the attributes they seek when purchasing the mate



The spatial arrangement of the two sets of variables (attributes and consumers) can reveal differences and similarities between all the groups. These two groups of variables when positioned on the same graph show correspondences between each other. However, the distances between points referring to different sets of variables cannot be interpreted simultaneously. Because the distances are peculiar to each set of variables, such an interpretation would be inaccurate. Thus, it would not be correct to say that consumer 6, when buying mate, considers price more than consumer 34 does. This conclusion could be reached if one analyzed the distances between these consumers and the price variable. The consumer belongs to one set of variables and the price belongs to another.

Graph 1 portrays the considered attributes by their differences. The first main axis, Axis 1, separates the attributes Brand and Color (on its positive side) from the attributes Nutrients and Smell (on its negative side). On the second main axis, Axis 2, one finds the attribute Price (on the positive side) in opposition to the attribute Expiration Date (on the negative side). Analyzing the chart, one can notice that consumer 34, on the positive side of Axis 1, and consumer 37, on its negative side, are far apart. The same holds for consumer 6, on the positive side of Axis 2, and consumer 30, on its negative side.

The points that are close to the origin have an undifferentiated profile, therefore no statements can be made about them; or one could say that all points laid out on this region are undifferentiated. This holds true for both the consumers and the attributes.

In Table 1, there are eight columns for the seven attributes (Color, Flavor, Smell, Price, Brand, Nutrients, and Expiration Date). The first two columns indicate the coordinates of the first and second main axes where the attributes are positioned (·) in Graph 1. The third column indicates the mass of each of the attributes, that is, the weight of each one in relation to the whole (the mass is an important component in data transformation formulas for obtaining the inertia). The fourth column shows the quality of the data, which is used to evaluate, as the name itself suggests, the quality of the points in the dimensions used. As the dimensions become larger, the quality of the points improves. The quality of the points in dimension 2 is reasonable, with a minimum of 0.02 (which is unfavorable in the Flavor attribute), but the quality values for the attributes Brand, Price and Smell are excellent. The fifth column shows the inertia.

The sixth and seventh columns contain the contribution to inertia, which measures the relative percentage of the inertia, that is, the percentage each attribute contributes to the main axes. The contribution of each point in each main axis can occur in two ways: when it has a high amount of mass and/or when it has little mass and is very far from

the centroid. In column six, the values of the Brand and Nutrients attributes predominate, contributing 48% and 23% respectively to the inertia of Axis 1. On the other hand, the Color and Price attributes predominate in the seventh column, contributing 60% and 48% to the inertia of Axis 2 respectively.

The cosines[2] of Axes 1 and 2 are the last columns to be evaluated. The cosine values do not depend on mass, unlike relative inertia. They are used to adjust numeric data to graphic representation; the closer the cosine values to the number one, the more adjusted. The cosine values of the attribute Smell show that it is more closely connected to Axis 1, whereas the Price attribute is more closely connected to Axis 2. Such information, complemented by the graphic representation from Graph 1, makes the analysis more complete.

Table 1: Results of the analysis of the first group of variables

Attributes	Coordinates Axis 1	Coordinates Axis 2	Mass	Quality	Inertia	Inertia Axis 1	Inertia Axis 2	Cosine² Axis 1	Cosine² Axis 2
Color	0.154	-0.121	0.132	0.355	0.104	0.061	0.604	0.220	0.136
Flavor	0.013	-0.038	0.099	0.027	0.055	0.003	0.004	0.002	0.019
Smell	-0.242	-0.215	0.152	0.631	0.184	0.174	0.218	0.354	0.278
Price	-0.120	0.319	0.152	0.768	0.168	0.043	0.483	0.095	0.673
Brand	0.355	0.080	0.194	0.805	0.233	0.479	0.038	0.766	0.039
Nutrients	-0.274	0.079	0.158	0.587	0.159	0.231	0.308	0.542	0.045
Expiration date	0.068	-0.217	0.112	0.4318	0.097	0.102	0.163	0.039	0.393

The consumers can be analyzed in the same way as the attributes, using the above mentioned variables. The analysis below focuses on consumers 7, 37, 30, 6 and 34, which have some very well represented variables, both graphically and in the statistical results shown in Table 2. Table 2 uses the same system and follows the same reasoning as that presented for Table 1.

Table 2: Results of the analysis of some individuals

Individuals	Coordinates Axis 1	Coordinates Axis 2	Mass	Quality	Inertia	Inertia Axis 1	Inertia Axis 2	Cosine² Axis 1	Cosine² Axis 2
Individual 7	0.010	-0.079	0.026	0.100	0.065	0.000	0.102	0.838	0.018
Individual 37	0,000	-0.079	0.026	0.371	0.065	0.005	0.036	0.838	0.018
Individual 30	0,018	-0.372	0.022	0.193	0.018	0.003	0.070	0.002	0.806
Individual 6	0,010	0.289	0.0026	0.361	0.021	0.000	0.102	0.001	0.733
Individual 34	0,472	0.004	0.020	0.856	0.036	0.003	0.000	0.897	0.000

If we make an analysis considering both the attributes and the consumers, we find that consumers who show similar values in Table 2 have similar consumer profiles.

Through the CFA analysis, we observe that the two axes tend to separate the sensory attributes from the physical ones, placing the former on Axis 1 and the latter on Axis 2. In this way, those individuals on the upper right side of Graph 1 tend to select the particular mate after considering both the sensory and the physical attributes. On the other hand, the individuals positioned on the upper left side of Graph 1 are more inclined to choose their mate because of its physical attributes while the individuals in Graph 1's lower right side tend to choose their mate determined by sensory criteria. Finally, individuals in the Graph 1's lower left side use purchase criteria not considered in this work. Data plotted next to the origin cannot be assessed.

5. Final Remarks

This work has sought to analyze the preferences of yerba mate consumers to understand the criteria they use when purchasing the product.

Our survey revealed some particular product attributes that influence consumers in their purchase of a particular mate. This shows that the lines of consumer research followed by our study offer a fertile area to be explored by professionals wishing to increase product demand. The individual affect of mate price, brand, expiration date, and nutrient composition on consumer purchase decisions should be analyzed through a more precise investigation. Price, for example, is taken into consideration by many but not all consumers prior to purchase. This suggests that there is a consumer willingness to spend more money provided an additional advantage is offered. The results of the study made by Rücker (1996), as well as those from Rocha Jr. *et al.* (1998), corroborate this. The affect of brand name on consumer purchase

decisions remains to be further explored. The people we interviewed are not faithful to any specific brand, possibly due to constant product quality oscillations.

Manufacturers should pay special attention to the significance of the product's expiration date. Consumers are very aware its importance and the law requires manufactures to respect this consumer right to information. Because of this, manufactures must always make sure the expiration date of products sold at various distribution points and retail stores has not passed. Product nutrient information is a highly interesting element in consumer purchase decisions and has aroused the curiosity of many consumers; though, few enterprises consider this. Also, the Brazilian Ministry of Health's Order #42 requires that manufacturers provide composition and nutrient information on the product label. As yerba mate is rich in vitamins and minerals, this legal requirement should be much better exploited. Many of the consumers in this survey strongly rejected the idea of adding sugar and other ingredients to the mate, a preference that professionals in this sector should note.

The chief limitation of this work is the small population surveyed. The survey was conducted at only one school in a single town, restricting the statistical significance of our findings. However, this study can be used as a starting point for future research in the area.

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