

REVIEW

SENSOMAKER: A TOOL FOR SENSORIAL CHARACTERIZATION OF FOOD PRODUCTS

SensoMaker: Uma ferramenta para caracterização sensorial de produtos alimentícios

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ABSTRACT

SensoMaker is a free software for data analysis from sensory studies, which has modules with user-friendly interface. Data acquisition can be performed using different methods, such as category scale, linear scale, temporal dominance of sensations (TDS), and time-intensity (TI). Results can be analyzed by a variety of methods, such as conventional internal and external preference mapping, three-way internal and external preference mapping, principal component analysis, hierarchical cluster analysis, TDS and TI curves, in addition to Tukey and Dunnett tests. High quality graphics are easily obtained and exported to several formats. The software is useful during the development or improvement of products, when it is important to carefully note consumer preferences and to relate it to descriptive characteristics in order to ensure good product acceptance.

Index terms: Consumer, sensory analysis, software.

RESUMO

SensoMaker é um software livre para análise de dados de estudos sensoriais que tem módulos com uma interface gráfica amigável. A aquisição de dados pode ser realizada por meio de diferentes métodos, tais como escala de categoria, escala linear, dominância temporal de sensações (TDS) e tempo-intensidade (TI). Os resultados podem ser analisados por uma variedade de métodos, tais como mapas de preferência interno e externo (convencional e de três vias), análise de componentes principais, análise de agrupamento hierárquico, curvas de TDS e TI, além de testes de Tukey e Dunnett. Gráficos de alta qualidade são facilmente obtidos e exportados para vários formatos. O software é útil durante o desenvolvimento ou a melhoria de produtos, quando é importante observar cuidadosamente as preferências dos consumidores e relacioná-la com características descritivas, a fim de garantir sua boa aceitação.

Termos para indexação: Consumidor, análise sensorial, programa de computador.

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INTRODUCTION

Sensory analysis of foods is linked with quality and processing subjects of the products, and is focused on their sensory assessment. Sensory studies provide reliable information on expectations and/or acceptance of a product by consumers for the food and agriculture industry. These studies permit the identification of strong and weak points in a product, on both physicochemical and organoleptic levels, which make them an essential tool for new product development in the industry.

The software SensoMaker was developed in order to provide computational tool designed to data acquisition and data analysis in sensory experiments for product characterization. SensoMaker is a stand-alone MATLAB

application and does not require a MATLAB installation to run. It is necessary to install only MATLAB Component Runtime (MCR), which is available along with SensoMaker. MCR is a set of shared libraries that provides complete support for all the features of MATLAB. The SensoMaker is designed to run on Microsoft Windows, but it can be installed on Unix-like systems using a compatibility-layer software.

FEATURES

SensoMaker consists of modules that can be accessed from the home screen of the software; these modules are able to perform data acquisition and dataanalysis in sensory studies.

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Data acquisition modules

Data acquisition in sensory experiments can be performed using different methods, such as category scale, linear scale, temporal dominance of sensations (TDS), and time-intensity (TI).

A category scale is one that is divided into intervals or categories of equal size. The categories are labeled with descriptive terms and/or numbers. All the categories may be labeled or only a few, such as the endpoints and/or midpoint of the scale. The total number and types of categories used varies; however, 5 and 9 hedonic categories are common (LAWLESS; HEYMANN, 2010). This scale is particularly used in consumer preference tests. The category scale interface in the *SensoMaker* allows the tester insert the sample codes and the respective scores according to the previously defined scale. Sensory attributes to be evaluated are colored according to the scale type (5 or 9 points). The researcher can configure the number of samples and attributes to be evaluated, as well as type and terms of the scale.

Line scales, with endpoints and/or midpoint of the scale labeled (structured/unstructured scales), are commonly used to quantify characteristics. The response is recorded as the distance of the mark from one end of the scale. The technique is very popular in descriptive analysis in which multiple attributes are evaluated by trained panels, such as the Quantitative Descriptive Analysis (QDA) (LAWLESS; HEYMANN, 2010). *SensoMaker* has a line scale interface, which the tester inserts the sample codes and indicates the attribute intensities in a scale. The samples are evaluated one at a time. The researcher can configure the number of samples and attributes. The scale labels (midpoint) can be disabled.

SensoMaker is also capturing data from time intensity measurements. These are covered by two methodologies: TI (time intensity) and TDS (temporal dominance of sensations). Time-intensity (TI) methods provide panelists with the opportunity to scale their perceived intensity over time (LAWLESS; HEYMANN, 2010). In TI method tester sets total time and delay time to measure performance of sample during time of analysis. On intensity scale (1-10 points) tester is capturing intensity of one analyzed attribute. TDS has little different approach to intensity measurements and testers are instructed to attend and choose only “dominant” sensation at any one time after tasting sample. Dominance is described like the most striking perception (PINEAU et al., 2009). Tester sets the time, clicks on start button and capturing dominance by clicking on buttons in dominance meter area. If the button of any taste is activated it is recorded the same

value until the new sensation is popping up and other dominance button is clicked. Buttons names are editable to change the sensation names.

Result from each tester is saved as text file, which can be imported by the appropriated analysis module in the *SensoMaker*.

Data analysis modules

Results from sensory tests can be analyzed by a variety of methods, such as conventional internal and external preference mapping, three-way internal and external preference mapping, principal component analysis, hierarchical cluster analysis, TDS and TI curves, in addition to Tukey and Dunnett tests.

Internal preference mapping provides a multidimensional representation of products and consumers. This representation is obtained through the singular value decomposition (i.e., principal component analysis, PCA) of a data matrix that has products as rows and consumers as columns. For a given consumer, the data are the hedonic scores assigned to a set of products. The internal map is a graphical representation of products and consumers, which the direction of the increasing preferences for each individual consumer is observed (GREENHOFF; MACFIE, 1999; VAN KLEEF; VAN TRIJP; LUNING, 2006).

External preference mapping provides a multidimensional representation of products based on their sensory profile or a set of other external data such as instrumental measures of color, texture, or flavor (VAN KLEEF; VAN TRIJP; LUNING, 2006; ELMORE et al., 1999). This representation is usually obtained through the PCA of a data matrix that has products as rows and external data as variables or columns. The second step in the analysis is to fit the consumer data in the sensory space. To do this, a certain type of polynomial model is used to regress the hedonic scores given to the products onto the coordinates of the products in the sensory space (CARROLL, 1972; ELMORE et al., 1999). The external map is then a graphical representation of products (PCA scores), sensory data (PCA loadings), and consumers (regression coefficients of the fitted model).

These preference maps can be obtained by *SensoMaker*. Consumer acceptance can be represented by vectors contour plots. For the external analysis, p-value and the model type can be selected. Consumer classes (such as age or gender) can be inserted and represented by different colors. Options to insert labels for samples and descriptors are also given.

The recently proposed three-way preference mapping (NUNES; PINHEIRO; BASTOS, 2011; NUNES et al., 2012) provides a general interpretation of consumer

acceptance considering several sensory attributes simultaneously. In addition, the external approach includes descriptive characteristics. This analysis is based on parallel factor analysis (PARAFAC), which is a method employed for the decomposition of high-order data and may be considered as a generalization of PCA for multidimensional data (BRO, 1997). Three-way preference maps can be obtained in the SensoMaker for each analysis mode separately (samples, consumers, sensory or descriptive attributes) or together by a multiplot. Options to insert labels for samples and attributes are also given.

Time intensity data analysis modules are possible to visualize curves for both time intensity methods (TI/TDS) and compute values for individual taster/whole panel (peak intensity, duration, plateau). Graphical interface is user-friendly and intuitive. TI/TDS data analysis modules could export (copy) data for further analysis of obtained values by ANOVA (LAWLESS; HEYMANN, 2010) or PCA (VAN BUUREN, 1992).

Methods listed above, such as principal component analysis, hierarchical cluster analysis (HCA), in addition to comparison of means by Tukey and Dunnett tests, also can be carried out through SensoMaker.

Additional tools

A tool to arrange data files from category scale or linear scale tests are available. Data files (one for each tester) are imported and converted in datasets adequately arranged to be analyzed using the analysis modules of the SensoMaker.

Univariate regression between dependent and independent variables using linear or quadratic models also can be carried out through SensoMaker. Regression statistics (R^2 , F, p-value, and model equation) and the regression graph are presented.

All graphics can be exported to several formats in high resolution.

FINAL CONSIDERATIONS

SensoMaker is free alternative software with a user-friendly interface that is useful for research/education institutions and industries for sensory studies.

The software is useful during the development or improvement of products, when it is important to carefully note consumer preferences and to relate it to physical, chemical, and physicochemical characteristics in order to ensure good product acceptance.

SensoMaker can be freely downloaded from the website of the Universidade Federal de Lavras (<http://ufla.br/sensomaker>).

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