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# Tds of cheese: Implications of analyzing texture and taste simultaneously

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ABSTRACT

This study aimed to evaluate the implications of analyzing texture and taste simultaneously on Temporal Dominance of Sensations (TDS) descriptions of Prato cheese. TDS tests were performed in two ways: I-panelists performed TDS tests of cheeses evaluating an attribute list with taste and texture sensations in a same session; II-TDS sessions were performed for each sensory modality. The difficulty and reliability degrees on performing the tests were assessed by the panelists; and some physico-chemical parameters were determined to compare the sensory and instrumental results. During TDS tests, simultaneous evaluations provided a higher number of significant sensations (considering both taste and texture sensations), but at lower dominance rates. Moreover, it was noted that one of the main implications of the simultaneous analysis on TDS results was the temporality differences (the time to reach the significance level, the sensation duration and the sensations sequence). However, regarding only the attributes that most characterized the samples, the results suggested a great similarity between the descriptions obtained from both TDS modalities. The simultaneous analysis implied greater difficulty in performing the tests and less reliable results according to the panelist's opinions. Moreover, the panel considered the texture evaluation more difficult than the taste evaluation. Regarding the instrumental analysis, the physico-chemical parameter intensity (amplitude) was not strongly linked to the maximum dominance rate.

## 1. Introduction

The complex process of food and beverages ingestion goes through a series of physical and chemical reactions, resulting in several perceived aroma, taste, flavor and texture sensations that change over the time. In this context, the use of dynamic sensory methods such as the Temporal Dominance of Sensations (TDS) have been proved to be useful to study the temporal dimension of different sensations during the food ingestion (Déléris et al., 2011; Di Monaco, Miele, Volpe, Picone, & Cavella, 2014; Dinnella, Masi, Zoboli, & Monteleone, 2012; Hutchings, Foster, Grigor, Bronlund, & Morgenstern, 2014; Lenfant, Loret, Pineau, Hartmann, & Martin, 2009; Morais, Pinheiro, Nunes, & Bolini, 2014; Rodrigues, Condino, Pinheiro, & Nunes, 2016; Rodrigues, Goncalves, Pereira, Carneiro, & Pinheiro, 2014; Rosenthal & Share, 2014; Souza et al., 2013).

TDS consists of presenting to the panel a complete list of attributes on a computer screen and asking them to identify sensations perceived as dominant until perception ends (Pineau et al., 2009). Therefore, TDS enables several attributes to be evaluated simultaneously at different time points during the product tasting and shows the sequence of the dominant sensations (Ng et al., 2012). Even though this method have been proved effective to describe several products, there are still some questions about the methodology (Monaco, Su, Masi, & Cavella, 2014; Rodrigues et al., 2016). It occurs due to the analysis complexity, in which the panelists are required to continuously make a choice among several attributes to determine the sequence of the dominant sensations (Ng et al., 2012; Pineau et al., 2012).

The attribute list used during the test was among these questions. Pineau et al. (2012) elucidated some aspects regarding how the panelists use the attribute list during a TDS experiment, and how the attribute list characteristics (number, modality and position) impact the panelist response. Traditionally, TDS tests are performed assessing only one attribute modality (texture or taste per example), but some studies suggested that the panelists were able to use different attribute modalities (taste, texture and aroma) in a single evaluation (Pessina, 2006; Pessina, Boivin, Moio, & Schlich, 2005; Pineau et al., 2012), hence

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saving time and money. Nevertheless, the exact influence of listing different sensory modalities in a same list remains unknown (Monaco et al., 2014). There are not many studies comparing the results obtained from a single attribute modality evaluation versus a set of attribute modalities in a same session. Moreover, though food perception analysis is a complex process per se, some kinds of food have complex structures that make this process even more arduous (Albert, Salvador, Schlich, & Fiszman, 2012). This raises the question about using different attribute modalities simultaneously to perform TDS analysis. Thus, there is a need to investigate more precisely the implications of using different attributes modalities in a same session in order to understand the advantages and limitations of this approach (Pineau et al., 2012).

In this context, this study aimed to evaluate the implications of analyzing texture and taste sensations both simultaneously and separately on TDS descriptions for Prato cheese. Moreover, we compared the TDS descriptions obtained through both evaluations (TDS with different attributes modalities - taste and texture - evaluated in a same list and TDS with the attributes modalities evaluated separately) with the instrumental physico-chemical characterization. This comparison was made to determine which of two conditions could describe the best the sample.

## 2. Material and methods

### 2.1. Samples

Five commercial Prato cheeses were acquired in the trade of Lavras – MG, Brazil. All cheeses had a rectangular shape (500 g) and presented a semi-cooked mass, compact texture, without mechanical or smooth eyes. The different products from different brands were selected in order to assess cheeses with variable sensory features; i.e., with different taste and texture sensory profiles. The cheeses from a same brand were from the same batch and within the product shelf life.

For sensory evaluation, the samples were prepared by cutting the cheeses to obtain a similar size (2 cm × 2 cm × 2 cm). The samples were stored at 10 °C and served in disposable cups coded with three digits in a balanced order (Walkeling & MacFie, 1995).

### 2.2. Physico-chemical characterization

Some physico-chemical parameters (NaCl and fat contents, acidity and texture parameters) were determined to compare the instrumental characterization with the sensory results. This comparison was made in order to evaluate the descriptions robustness. These parameters were elected considering the sensations involved in the TDS tests. The physico-chemical analyses were performed in triplicate, following the methodology described by Gorotiza et al. (2004).

The instrumental texture of the cheeses was determined using a TA-XT plus model - Stable Micro Systems® texturometer with a 4500 g load cell. The cheeses were cut into cylinders of 20 mm diameter and 25 mm in height, placed in sealed plastic bags (to avoid dehydration) and stored at 10° C for 1 h. Samples were taken from the middle of the cheese block to avoid surface effects. The speed of 1 mm/min was used at 40% compression test, using an acrylic cylindrical probe of 25.4 mm diameter and 35 mm height (Nepomuceno, Junior, & Costa, 2016). The analyzed parameters were hardness and springiness (Amamcharla & Metzger, 2015).

### 2.3. Panel and selection of terms

According to Pineau et al. (2009), when a confidence interval of a proportion based on the normal approximation is calculated, it is recommended that $np(1-p) > 5$, $n$ being the number of trials and p the probability of success. As eight attributes were evaluated in the TDS analysis, in this study p = 0.125. So, the minimum number of TDS evaluations should be $n = 5/[0.125 \ x \ (1 - 0.125)] = 46$. Thus, twenty-six panelists (14 females and 12 males, aged between 20 and 30 years) with previous experience in TDS analysis and selected based on the ISO 8586:, 2012 performed the TDS tests in duplicate, totaling 52 evaluations. All of them consumed Prato cheese at least once a week and they had good oral and general health.

Two preliminary sessions were conducted. In the first session the panelists were introduced to the TDS module of the Sensomaker software (Nunes & Pinheiro, 2012), proving two cheeses. So, they were instructed that the dominant perception is the one perceived to have the greatest clarity and predominance; i.e., the most striking perception at a given time (Pineau et al., 2009). The second session was used to select the sensations involved in the TDS analysis. During this session, they described all the in-mouth sensations regarding the taste and texture that they experienced while tasting all the samples (5 cheeses). Thus, the most-cited sensations for the taste (salt, sour and bitter) and for the texture (hard, creamy, soft and rubbery) attributes were selected for the TDS tests. The 'no perception' option was also included in the attribute list to indicate when no sensation was perceived. The number of attributes evaluated in this study was established according to the Pineau et al. (2012) recommendations. They suggested keeping the number of attributes around 8 to 10 based on the results of several studies.

### 2.4. TDS evaluation

The impact of simultaneous evaluation of taste and texture in the same TDS session was investigated. Thus, TDS tests were performed in two ways:

I- TDS tests of Prato cheeses were performed evaluating an attribute list with taste and texture sensations in a same session;
II- TDS evaluations were performed for each sensory modality, i.e., in one session the attribute list was composed by taste sensations; and in other session the tests were performed with texture sensations.

The test order was balanced. Thus, each panelist did a different TDS test approach firstly, i.e., the TDS test with different attributes in a same session and after testing the attributes separately, and vice-versa.

All evaluations were performed on the same products and within the same period of time (35 s). The panelists held one session per day and evaluations took place in a standardized sensory environment (ISO 8589:, 2007), in individual booths under white light with adequate ventilation and following the good sensory practices (Lawless & Heymann, 2010). The samples were coded with three digits numbers and they were presented following the balance order as suggested by Walkeling and MacFie (1995).

TDS tests were performed according to Pineau et al. (2009), in duplicate for each individual and under the same conditions: total time = 35 s and a 'delay time' = 2 s.

The attributes used in the module I (simultaneous evaluation of the five cheeses) were: salt, sour, bitter, hard, creamy, soft, rubbery and 'no perception'. In the module II, they evaluated the samples (5 cheeses) according to the taste sensations (salt, sour and bitter) and according to the texture sensations (hard, creamy, soft and rubbery) in different sessions. The option 'no perception' was also included in the separate evaluations (both taste and texture evaluations). Thus, the three different evaluations (combined list, taste only and texture only) were performed in separate sensory sessions (hence 3 data collection sessions in total).

The test order (module I or II) was balanced; and the module II conditions were also randomized, i.e. half of people assessed taste first and then texture and the second half conversely.

After the instructions, the panelists were instructed to put the sample in their mouth and start the TDS evaluation during 35 s. The "no perception" option was included in all tests to allow the panelist to indicate that no more sensation was perceived.