



## DEVELOPMENT OF *LIMÃO-CRAVO* (*Citrus limonial Osbeck*) CURD: VIABILITY ANALYSIS THROUGH PRELIMINARY SENSORY EVALUATION

*Desenvolvimento de curd de limão-cravo (Citrus limonial Osbeck): Análise da viabilidade através de avaliação sensorial preliminar*

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**ABSTRACT:** Lemon curd is a traditional English pastry cream originally made with lemon juice. This article deals with the proposal to replace, in its preparation, with another species of fruit that best represents the native foods of Brazil and reveals itself as a relevant alternative for the consumer market. The sensorial analysis was used in the process to aid the development of this new product from the adaptation of a traditional recipe, using the affective test of preferential ordering. This preliminary test was applied using three samples prepared with different proportions of sugar from the original formulation. These samples were coded and submitted to the analysis of 25 adult judges, students of the discipline NUTA174 - Sensorial Analysis, of the Federal University of Bahia, who ordered decreasingly according to their individual preferences. The objective of the test was to determine which proportion of sugar would be the most adequate for a better acceptance of the product by consumers, given the formula to be used in the manufacture of the new version of the lemon curd product, made from *limão-cravo*. After the submission of the elaborated formulations to the affective ordering test, it was concluded that the sample with intermediate sugar content was liked by most of the judges, showing that it has the most appropriate formulation for the product launch to the consumer market.

**Key words:** Development of new products; pastry; affective test; regional fruit.

**RESUMO:** O *lemon curd* é um creme tradicional da confeitaria inglesa no qual, originalmente, é utilizado o sumo do limão siciliano. Este artigo trata da proposta da substituição, na sua preparação, por outra espécie de fruta que represente melhor os alimentos nativos do Brasil e revele-se como uma alternativa pertinente para o mercado consumidor. A análise sensorial foi utilizada no processo para auxiliar o desenvolvimento deste novo produto a partir da adaptação de uma receita tradicional, empregando-se o teste afetivo de ordenação preferencial. Este teste preliminar foi aplicado utilizando três amostras elaboradas com diferentes proporções de açúcar da formulação original. Essas amostras foram codificadas e submetidas à análise de 25 julgadores adultos, alunos da disciplina NUTA174 – Análise Sensorial, da Universidade Federal da Bahia, que ordenaram de forma decrescente conforme suas preferências individuais. O objetivo do teste foi apurar qual proporção de açúcar seria a mais adequada para uma melhor aceitação do produto pelos consumidores, determinado a fórmula a ser utilizada na fabricação da nova versão do *lemon curd*, feito a partir do limão-cravo. Após a submissão das formulações elaboradas ao teste afetivo de ordenação, concluiu-se que a amostra com teor intermediário de açúcar foi a que agradou a maior parte dos julgadores, demonstrando ser a que possui formulação mais adequada para o lançamento do produto ao mercado consumidor.

**Palavras-chave:** Desenvolvimento de novos produtos; confeitaria; teste afetivo; fruta regional.

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## INTRODUCTION

Among the various preparations considered to be the basis of British pastry, the lemon curd is one of the most frequent in contemporary Brazilian pastry. This lemon cream, generally used as a filling for cakes and pies, or accompanying scones and bread, has a combination of sweet and citrus flavors, which give it a refreshing character (SUAS, 2011). The preparation originally uses lemon juice, which belongs to the species *Citrus Limonum*. According to Bhat et al. (2016), the juice obtained from the lemon has the highest acidity among the citrus fruits. This is due to its higher total citric acid content (3.3 g/ml). The fruit also contains ascorbic acid and polyphenols, in addition to inflammatory and antioxidant action, which makes it very valuable for the pharmaceutical and medical industry (ABDEL-DAIM et al., 2020).

However, because it is not a fruit that is well acclimated to the natural conditions of most of Brazil (JUNIOR et al., 2005), preparations made with this ingredient are expensive and difficult to access in places far from large cities in the country. Therefore, replacing it, in the preparation of the lemon curd, with another species of fruit that better represents native foods in Brazil, proves to be a relevant alternative for the consumer market.

As pointed out by Oliveira et al. (2019), in Brazil, there is a great diversity of exotic fruits with a pleasant taste and health benefits, which can be added to many products or be eaten fresh. As a substitute, an affordable option is the *limão-cravo* (*Citrus limonial Osbeck*), as it was better acclimated to the country, to the point of fruiting without human intervention (JUNIOR et al., 2005). However, because it is sweeter than the lemon, the new product would need further testing to develop a formulation suitable for the sweetness of the new ingredient.

Added to this is the fact that, in 2013, were initiated discussions towards the gradual reduction of sugar levels until 2020 (PINELI et al., 2016). According to Pineli et al. (2016), such discussions were motivated by the signing of the Cooperation Agreement to promote healthy lifestyles, focusing on reducing the amount of sugar and other ingredients, due to obesity, which is increasing substantially in the world (MA et al., 2016).

On the part of consumers, there is also a greater concern with food, looking for products that combine quality with healthier attributes (MAMEDE et al., 2013; MCCAIN et al., 2018). However, reductions in the levels of sugars in foods are challenging, mainly because sugars have properties that affect the final product (GOLDFEIN and SLAVIN, 2015), in addition to the feeling of pleasure, which can have a negative impact on sales when reduced (MCCAIN et al., 2018).

Thus, as a process to assist the development of this new product from the adaptation of a traditional recipe, sensory analysis is of fundamental importance (ARAÚJO et al., 2014). The application of this scientific discipline is extremely important to evaluate the sensorial quality of the experimental samples before their commercialization, since a product, in addition to its nutritional value, must produce satisfaction and be pleasant to the consumer, this being the result of the balance of different sensory quality (ARAÚJO et al., 2012; LEITE JUNIOR et al., 2013).

Sensory analysis has three different testing methodologies, namely: a) discriminative tests, which are used to determine the probability of difference or similarity between two samples; b) descriptive, which serve to characterize the

sensory properties of the product; and c) affective ones, which present the consumer's personal opinion about a product (GULARTE, 2009).

Among affective tests, one of the ways to check the different levels of acceptance of product samples by consumers is called the preferential ordering test. In it, different samples are presented to the evaluators who are asked to order them, in ascending or descending order in an analysis form, according to personal preference for the product (GULARTE, 2009).

Bearing in mind that few studies have analyzed the impact of reducing sugars in foods without replacing them with sweeteners, coupled with the little use of cloves lemon by the food industry, this work aims to apply a preferential ordering test in order to determine which proportion of sugar it will be the most suitable for the formulation of lemon curd of *limão-cravo*.

## MATERIALS AND METHODS

The present work was developed, as a practical activity, in the discipline NUTA174 - Sensory Analysis of Food, given for the bachelor's degree in Gastronomy by Professor Dr. <sup>a</sup> Deborah Otero, from the Department of Food Science of the School of Nutrition of the Federal University from Bahia, and, because it is an activity carried out within the discipline, it did not need approval by the Ethics Committee.

### Materials

The formulation of the traditional lemon curd found in Suas (2011) was used as a reference for the preparation of the new product.

For the execution of this study, three different formulations of *limão-cravo* curd were elaborated, whose ingredients were obtained in the local trade of Salvador - Bahia. The first was produced by substituting, in the formulation of the traditional product, the juice and zest of the lemon by the juice and zest of the *limão-cravo* (F1). Subsequently, two other formulations were prepared as the first, but with a reduction of 100g (F2) and 200g (F3) in the amount of sugar in the preparations (Table 1).

### Elaboration of the products

The three formulations were prepared following the same instructions as the original recipe. Sugar, egg yolks, juice and lemon zest were combined in a stainless-steel container and placed in a water bath. The mixture was stirred until it acquired a firmer consistency, removed from the heat, strained over a clean container and added butter, using a mixer to homogenize the product. Finally, the cream was packaged and refrigerated.

### Sensory analysis

The preliminary test was applied following the guidelines of Gularte (2009). The formulations were separated into 10-gram samples and coded, with code 273 for the F1 sample, 459 for F2 and 731 for F3. These samples were submitted to the analysis of 25 adult judges, students of the discipline NUTA174, who were instructed not to exchange information during the test and to correctly answer their personal data, namely, age and gender, in addition to effectively conducting

the analysis of the product, ordering them in decreasing order according to their individual preferences, and may also indicate the reasons for such choices.

**Table 1** – Formulations of *limão-cravo* curds in grams.

Ingredients	F1	F2	F3
Sugar	250 g	150 g	50 g
Egg yolks	122 g	122 g	122 g
<i>Limão-cravo</i> juice	125 g	125 g	125 g
<i>Limão-cravo</i> zest	8 g	8 g	8 g
Butter	100 g	100 g	100 g

F1: Sample with the amount of standard sugar in the original formulation (SUAS, 2011); F2: Sample with a reduction of 100g of sugar, when compared to F1; F3: Sample with 200g sugar reduction, when compared to F1.

At the time of presentation of the products to the judges, the evaluation form was provided, as well as 120 ml of sparkling water, to be used as a white to clean the taste between tasting the different samples. The order of presentation of the samples was randomized among the judges, to avoid biased responses and to meet the assumptions of the statistical tests (OLIVEIRA et al., 2019).

### Statistical analysis

The data obtained were evaluated by Friedman's test (critical value: 16,  $p \leq 5\%$ ) to verify differences between samples, considering three samples and 24 judges, since one of the files of the 25 judges in the analysis was unusable because it was not answered correctly.

The result of this preliminary test was given by the sum of the orders obtained from the judges for each of the samples. The evaluation of the results sought to ascertain whether or not there was a significant difference between the samples, since, according to the Instituto Adolfo Lutz (2008), if the difference between the sums of orders is greater than or equal to the tabulated value, it is concluded that there is significant difference between samples at the corresponding significance level.

## RESULTS AND DISCUSSION

Since the universe of the research was composed by the students of the Sensory Analysis discipline of the Bachelor in

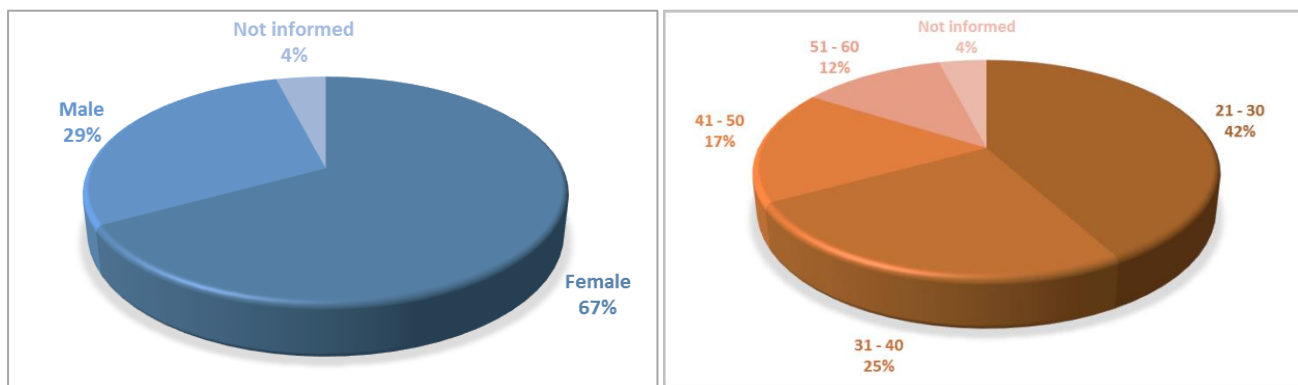
Gastronomy at the Federal University of Bahia, the judges of the analysis were not selected using any criteria. Thus, as can be seen in Graphs 1 and 2, the universe consisted of a majority belonging to the female gender (67%) and the predominant age group was between 21 and 30 years old (42%).

When asked about their favorite sample, among the three that were presented during the analysis, most of the judges (58.3%) preferred sample 459, which represented curd formulation number 2, with 150 grams of sugar. The formulation identified by code 273 (F1), which contained the highest sugar content, was the preferred sample by 33.3% of the judges. The formulation with the lowest sugar content (F3), code 731, was chosen as the best by only 8.3% of the judges.

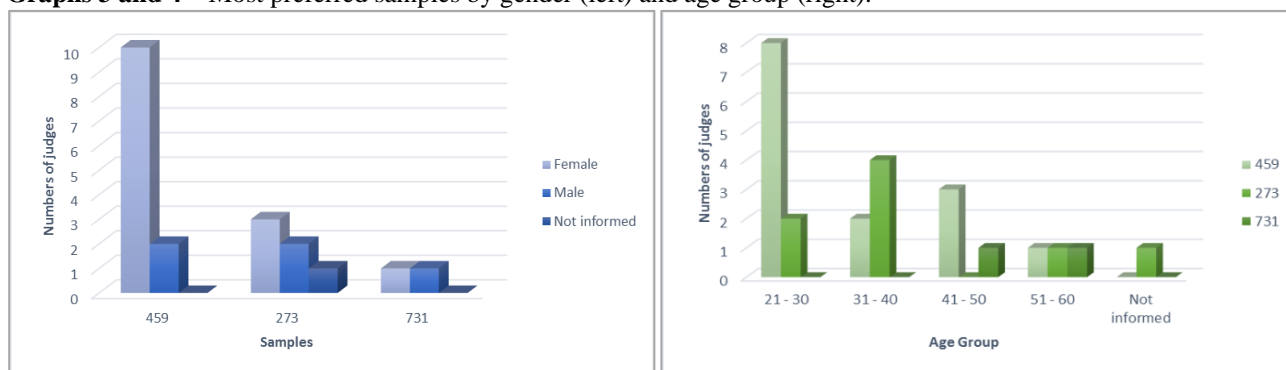
When analyzing gender preferences, as can be seen in Graph 3, the female gender showed a significant preference for sample 459, which represented formulation 2. However, for males, there was no difference in preference between samples 459 and 273 (F1, with higher sugar content).

When analyzing Graph 4, it can be seen that there were significant differences between the preferred formulations for each of the expressed age groups. The judges who were between 21 and 30 years old and those who were between 41 and 50 years old showed, for the most part, a preference for sample 459 (F2). However, those between 31 and 40 years old and those who did not register their age preferred the sample 273 (F3), with a greater amount of sugar. As for the range representing the judges between 51 and 60 years old, there was no difference between the preferred samples.

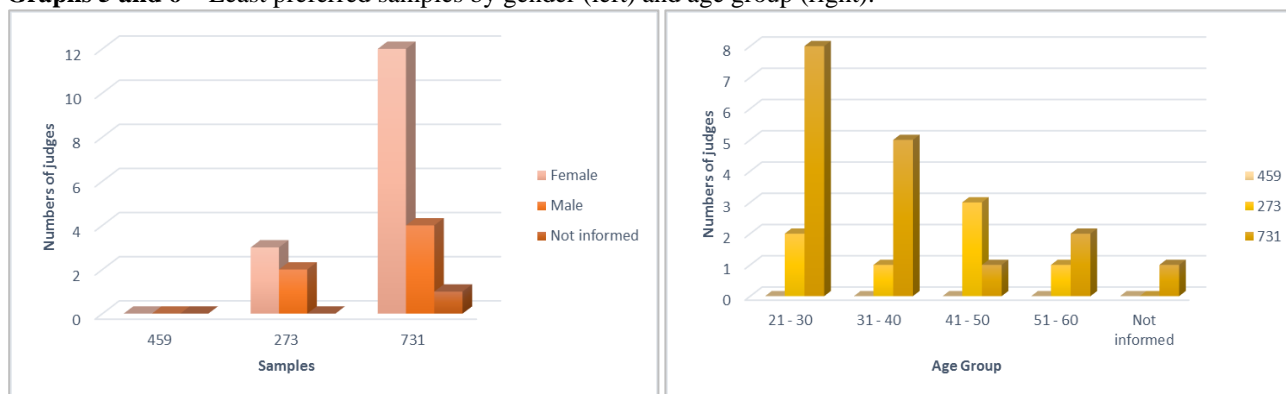
**Graphs 1 and 2** – Gender (left) and age group (right) of the analysis universe.



**Graphs 3 and 4 – Most preferred samples by gender (left) and age group (right).**



**Graphs 5 and 6 – Least preferred samples by gender (left) and age group (right).**



Regarding the least preferred formulation by the judges, when analyzing the data obtained, it is observed that the sample of code 731 (F3), with lower sugar content, was the choice of 70.8% of these. The remaining 29.2% of the judges opted for sample 273 (F1) as the least preferred. The code sample 459 (F2) was not placed as the least preferred, in the ranking scale, by any of the participants who performed the analysis.

When analyzing the data showing the number of judges, grouped by gender, who least liked each sample, expressed in Graph 5, it is possible to notice that all genders belonging to the studied universe presented the sample 731 (F3) as the least preferred.

Analyzing the age group variable, except for the judges who were between 41 and 50 years old, whose least preferred sample was 273 (F1), all other age groups presented the sample 731 (F3), less sweet, such as least preferred among those presented during the analysis, as shown in Graph 6.

After collecting and processing the data obtained with the application of the analysis, submitting them to the Friedman test, the following differences between the samples were obtained: 2 between samples 273 and 459; 16 between samples 273 and 731, and 14 between samples 459 and 731. Since the critical value for applying the test is 16, when due to a margin of error of up to 5%, it is possible to conclude that there is a significant difference only between samples 273 and 731, that is, between more and less sweet samples, respectively.

Finally, concerning the justifications for the preferences, the most common responses were about the excess of sugar in sample 273 and the lack of sugar in sample 731, which also mentioned a certain residual bitterness and a milder taste of lemon. This last comment can be justified by the fact that sugar is a flavor enhancer.

According to Goldfein and Slavin (2015), this flavor enhance is due to the interactions of sugar with other

ingredients, increasing the aroma of flavor. Since the aroma of flavor has no taste properties, when the flavor aroma is concerted with the sugar sweetness, they have a synergistic work.

In addition to contributing to the sweet taste and the balance of acidity in fruit-based products (GOLDFEIN and SLAVIN, 2015), the presence of sugar also interferes the texture and mouthfeel of the product (MONACO et al., 2018). It is important to highlight the interference since, as pointed out by McCain et al. (2018), both the texture and the presence of fat strongly affect the perception of sweet taste. Thus, since curd is a viscous product with a high fat content, the decrease in the amount of sugar can be more disguised.

## CONCLUSIONS

With the submission of the formulations prepared to the affective ordination test, it is possible to conclude that the sample with intermediate sugar content (459) was the one that pleased most of the judges and, for not presenting, at any time, as the sample in least preferred position, demonstrates that it has the most suitable formulation for launching the product to the consumer market.

This conclusion can be reinforced by observing the result of the Friedman test applied to the analysis, which showed a large difference (although not significant) between the intermediate sample (459) and the least preferred (731). At the same time, the significant difference between formulation 1 (273) and formulation 3 (731) demonstrates that both occupy opposite positions on the scale between formulations, presenting formulation 2 as, in fact, an intermediary between them.

As a suggestion for future work, for a better investigation of the most suitable formulation for launching the product to

the consumer market, a new analysis would be necessary with more judges and formulations increased and reduced in sugar content to formulation 2, but in a lower gradation (<100 grams).

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