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EVALUATION OF PERCEPTION AND PREFERENCE OF SENSORY ATTRIBUTES FOUND IN FULL-FAT AND LOW-FAT PRATO CHEESE

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ABSTRACT: Prato cheese is the second most commercialized cheese in Brazil and its full-fat variety has very high fat content. The aim of this study was to evaluate the degree of perception and preference of untrained consumers to full-fat and low-fat Prato cheese. For such, eight Prato cheese sample (four full-fat and four low-fat version) weighing 500g each, were submitted to microbiological, physical and sensorial evaluations. The microbiological evaluation consisted of determining the Most Probable Number of coliforms at 35 and 45°C as well as the presence of *Salmonella* sp. In the physical analyses, we found the values of pH, shear force and performed a color analysis. The sensory analysis was performed from the Preference Test. Both cheese varieties had coliform counts at 35 and 45°C within the thresholds established by current legislation; and there was absence of *Salmonella* sp. In addition, the physical characteristics were within the expected for the type of cheese evaluated. As for the sensory evaluation, full-fat Prato cheese was preferred for the appearance (52%) and aroma (55%) attributes, however the low-fat variety was better scored for the taste (57%), texture (57%) and overall acceptance (55%). The tasters were able to differentiate the samples, and the low-fat Prato cheese was more widely accepted.

KEYWORDS: Acceptance, Cheese, Fat content, Sensory analysis.

AVALIAÇÃO DA PERCEPÇÃO E PREFERÊNCIA DE ATRIBUTOS SENSORIAIS EM QUEIJO PRATO TIPO LANCHE INTEGRAL E LIGHT

RESUMO: Queijo prato é o segundo queijo mais consumido no Brasil e sua versão integral possui alto teor de gordura. O objetivo do trabalho foi avaliar o grau de percepção e preferência de consumidores não treinados em relação ao queijo prato integral e light. Para tanto, oito amostras de queijo prato (4 versões integral e 4 versões light), pesando 500g cada, foram submetidas a avaliações microbiológicas, físicas e sensoriais. A avaliação microbiológica consistiu na determinação do Número Mais Provável (NMP) de coliformes a 35 e 45°C e pesquisa da Salmonella sp. Nas análises físicas foram determinados os valores de pH, força de cisalhamento e análise de cor. A análise sensorial foi realizada a partir do Teste de Preferência. Ambas as amostras de queijo apresentaram as contagens de coliformes a 35 e 45°C dentro do estabelecido pela legislação vigente e ausência de Salmonella spp.,

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adicionalmente, as características físicas estavam dentro do esperado para o tipo de queijo avaliado. Na avaliação sensorial o queijo prato integral foi o preferido para os atributos aparência (52%) e odor (55%), porém a versão light foi a escolhida no sabor (57%), textura (57%) e na aceitação global (55%). Diante disso, os provadores foram capazes de diferenciar as amostras, tendo o queijo prato light maior aceitação global.

Palavras-chave: aceitação, preferência, queijo prato, análise sensorial.

INTRODUCTION

The Prato cheese was initially produced in Brazil by Danish immigrants looking for a product similar to Gouda and Danbo cheeses (SPADOTI et al., 2005). It is a matured fatty cheese with medium moisture, which is obtained by coagulating the milk with rennet and/or other appropriate coagulating enzymes, supplemented or not by the action of specific lactic bacteria (BRASIL, 1997a). It was considered the second type of cheese most produced in Brazil until the 2000s, therefore having remarkable economic importance to the country (SILVEIRA; ABREU, 2003).

In the Brazilian dairy industry Prato cheese is the one with the best defined technological and commercial standard, and it is a product of abundant production and expressive marketing (CICHOSCKI et al., 2002).

Such as most cheeses manufactured in Brazil, it is produced with whole milk (DE RENSIS et al., 2009). Fatty and full-fat cheeses present high levels of saturated fat, which can compromise the taste of the food due to the chemical and biochemical reactions this component undergoes (MAYTA-HANCCO et al., 2019; SILVA; FERREIRA, 2010).

This cheese's manufacturing technology as well as the way it is consumed has undergone several changes over the years, mainly, due to the public's increased concern with health issues (JOHNSON, 2017). Part of the population has opted for products low-fat products, which are foods with lower fat contents. Faced with this reality, the dairy industry began to produce the low-fat Prato cheese in order to meet the demands of the consuming market. However, this product must present flavor, texture, aroma and firmness similar to the full-fat variety to have a good acceptance by the consumers (DE RENSIS et al., 2009).

In addition, food quality is directly related to microbiological and physical-chemical quality, so it is fundamental that the production of the Prato cheese is carried out according to the Prato Cheese Quality and Identity Technical Regulation,

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which establishes the necessary requirements for the correct and safe production of this cheese (BRASIL, 1997b).

In this context, it is necessary to understand consumer behavior regarding Prato cheese, their demands, tastes and habits to better outline this market's characteristics. The aim of this study was to evaluate the degree of perception and preference of untrained consumers regarding Prato cheese, both full-fat and low-fat varieties, considering the sensorial characteristics that most influence the acceptance or non-acceptance of the product by the consumers.

MATERIAL AND METHODS

Sample collection

The eight samples of Prato cheese were collected, with 500g each, in the city of Mossoró, Rio Grande do Norte, bearing the seal of the Federal Inspection (SIF) and within the "use by" date established by the producer. Half of the samples were full-fat and the other half were low-fat versions, and all the samples were from the same dairy. The fat content was specified on the product label. The transport of the samples to the laboratories was at room temperature; the full-fat sample was inside the original packaging produced by the manufacturer and the low-fat sample was placed in a plastic bag provided by the supermarket itself. Upon arriving at the laboratory, the cheese was about 27ºC of temperature, immediately going to the analyses.

Microbiological analyses

To perform the microbiological analyses, was weighed 25 g of the samples and transferred those into sterile plastic bags, where 225 ml of sterile buffered peptone water was added for further homogenization in Stomacher for 2 minutes. Thus, was obtained the 10^{-1}dilution, from which was got all other decimal dilutions up to 10^{-4}. After the dilutions, was performed the most probable number (MPN) analysis for coliforms at 35 and 45°C, and presence of *Salmonella* sp. essay using the methodology recommended by Normative Instruction No. 62, of the 26th of August 2003 (BRASIL, 2003).

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Physical analyses

The samples had their pH evaluated using a portable pH-meter for dairy products. Regarding the color analysis, samples were evaluated in three distinct points using the Konica Minolta colorimeter, CM-700d/600d (System CIE L*a*b*); with L* being the luminance coordinates (black/white), a* the red content (green/red) and b* the yellow content (blue/yellow). All analyses were performed in triplicate. Shear force was measure during a TA-XT-125 TEXTURE ANALYZER, coupled to the Warner-Bratzler device, which measures force in kgf/cm^2.

Sensory analysis

The sensory analysis was performed in the Laboratory of Instrumental and Sensorial Analyses of the Universidade Federal Rural do Semi-Árido - UFERSA. The Preference Test was the chosen tool used to qualify the sensory characteristics of the samples, was enlisted the help of 42 untrained tasters (males and females) and their average age was 28 years old. All participants read and signed the Informed Consent Form where they stated that they were aware of the purpose of the research and they were willing to participate in it. The tasters were recruited based on full-fat and low-fat cheese consumption, availability and interest in participating in the research.

The tasters received on a platter two 50 ml disposable plastic cups with the Prato cheese samples inside, both full-fat and low-fat, weighing approximately 25 grams each, and coded with a three digit number; also, on the platter, a glass of water and a cracker, used to clean the palate between the samples. Samples were kept at room temperature (24°C) for 30 minutes prior to tasting. Before this, they were kept under refrigeration (between 5 and 8°C). The volunteers also received tokens to mark the sample of their preference regarding appearance, taste, aroma, texture and overall acceptance.

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Statistical analysis

Results obtained from the microbiological analysis were presented in a descriptive form, as well as the results of the sensorial analysis, which were presented as percentages. To statistically evaluate the physical analyses, we applied the Tukey Test to the data using Action Stat 3.0 free software. A probability level of less than 5% was considered significant.

RESULTS

Through the microbiological analyses, we observed that the bacterial counts on the samples were within the limits advised by current legislation (BRASIL, 2001) both for coliforms at 35 and 45°C, with counts below 10^3. In addition, there was absence of *Salmonella* spp. in all samples (Table 1).

Table 1. Microbiological quality of commercial Prato cheese samples.

Tabela 1. Qualidade microbiológica em amostras comerciais de queijo prato.

	Full-fat Prato Cheese	Low-fat Prato Cheese
Coliforms at 35 ºC MPN/g	< 3	3.6 x 10^2
Coliforms at 45 ºC MPN/g	< 3	< 3
Salmonella sp.	Absent	Absent

Table 2 shows the averages found for the physical parameters evaluated in the samples of full-fat and low-fat Prato cheese commercialized in the city of Mossoró/RN.

Table 2. Mean values for the physical parameters evaluated in commercial samples of Prato cheese.

Tabela 2. Valores médios dos parâmetros físicos avaliados em amostras comerciais de queijo prato.

		Full-fat Prato Cheese	Low-fat Prato Cheese
pH		5.31 ± 0.02[a]	5.43 ± 0.12[a]
Shear force		2.85 ± 0.11[a]	5.91 ± 0.12[b]
Color	L*	72.75 ± 2.70[a]	70.82 ± 0.72[a]
	a*	13.32 ± 0.45[a]	7.31 ± 0.21[b]
	b*	37.28 ± 0.86[a]	25.89 ± 1.70[b]

[ab.] Mean values, in the same row, for each parameter, followed by distinct letters differ significantly ($p<0.05$) according to T Test.

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The data gathered show that only the pH and luminosity (L*) parameters did not present significant differences ($p < 0.05$) when comparing full-fat and low-fat Prato cheese samples.

Results presented in Table 2 show that there was a significant difference ($p < 0.05$) between the samples of full-fat and low-fat Prato cheese, the latter one presented significantly higher shear force ($p < 0.05$) when compared to Prato cheese produced with whole milk. The low-fat Prato cheese evaluated in this study also had firmer texture; however, this feature did not interfere in customer acceptance of the product, since the texture of the low-fat Prato cheese was preferred by tasters on the sensory analysis when compared to the Prato cheese made from whole milk.

The results for the analysis of color show that the parameter L*, which indicates luminosity and ranges from zero to 100, represents the ability of an object to reflect light, i.e., the larger the value of L* the whiter is the food in question. The other parameters a* and b* correspond to the variation of the green color (-) to red (+) and blue color (-) to yellow (+), respectively (ANDRADE et al., 2007). Having this in mind, we observed that the cheeses analyzed showed a tendency to white, red and yellow color, where there was a significant difference ($p < 0.05$) for the red and yellow colors between the full-fat and low-fat Prato cheese samples, the latter presenting lower content of red and yellow color.

The data gathered in the sensory analysis are shown in Table 3. It is possible to observe that among the sensorial attributes analyzed, the characteristic cheese appearance and aroma were more evident in the full-fat Prato cheese samples, whereas for taste and texture the tasters preferred the low-fat Prato cheese, which led to this cheese having the highest acceptance amongst tasters (55%).

Table 3. Sensory evaluation of Full-fat and Low-fat Prato cheese samples according to tasters' preference regarding appearance, flavor, aroma and texture attributes.
Tabela 3. Avalição sensorial de queijo prato e queijo prato light em relação à preferência dos julgadores quanto aos atributos de aparência, sabor, aroma e textura.

Type of cheese	Sensory attributes				Overall acceptance
	Appearance	Flavor	Aroma	Texture	
Full-fat Prato Cheese	22 (52%)	18 (43%)	23 (55%)	18 (43%)	19 (45%)
Low-fat Prato Cheese	20 (48%)	24 (57%)	19 (45%)	24 (57%)	23 (55%)

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These data show that the fat content influenced the tasters' decision, since the low-fat Prato cheese had a fat content of 58%, 16% less than the full-fat variety, and was preferred by the tasters.

DISCUSSION

The low-fat Prato cheese samples presented low coliform at 35 °C count, which was expected because this is a cheese with high levels of water activity and diverse nutritional composition, in addition to the presence of factors that favor the proliferation of spoilage microbiota, which hinders food safety. High counts of these microorganisms may indicate failures during the hygiene process, i.e. lack of good manufacturing practices in the production site, contamination on the supermarket shelf or inadequate storage (SANTOS et al., 2008; MATSUMOTO et al., 2016).

Was not found *Salmonella* spp., in all samples, which is a similar result with other studies performed on cheeses (VIANNA et al., 2008; GALINARI et al., 2014; ADAMI et al., 2015). Therefore, the Prato cheese samples analyzed are suitable for consumption because they are within the microbiological parameters established by the brazilian legislation (BRASIL, 2001).

According to Spadoti et al. (2005), matured Prato cheese usually has pH between 5.2 and 5.4, and Prato cheese samples evaluated after 10 and 45 days of storage presented pH values of 5.38 and 5.72, respectively. In the present study, the cheeses analyzed presented pH values within the expected for this type of cheese, however the cheese made with whole milk had a pH value lower than that found in the study mentioned above. For low-fat Prato cheese, De Rensis et al. (2009) found pH ranging from 5.38 to 5.52 in commercial samples, these values are similar to those found for the low-fat Prato cheese analyzed on the present study.

Texture is one of the most important factors for the quality of cheeses and other dairy products, and so, it is used as an indicator of quality and consumer preference. In addition to the sensory evaluation, the analysis of texture by instrumental methods is important and must be done aiming a better understanding of this parameter in foods (STEFFENS et al., 2005).The higher shear force and firmness values found in low-fat Prato cheese are characteristics of cheeses that have reduced fat content, which usually are harder, since the removal of fat promotes a greater protein-protein interaction and, therefore, the cheese acquires a closer consistence and becomes

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firmer due to the increase and intensity of these connections (PINHEIRO; PENNA, 2004).

The lower red and yellow content presented by the low-fat Prato cheese samples are attributed to the lower opacity of this product, since the removal or reduction of fat from cheese decreases the number of centers that allow the light to spread in the food (GARCIA; PENNA, 2010). In addition, the yellow content of a given food relates to its levels of carotenoids, which are important fat-soluble pigments found in milk and cheeses. Therefore, the lesser the amount of fat globules, such as in foods with lower fat content, the less these pigments influence the color of the food, as we observed for the low-fat Prato cheese samples we analyzed (FIGUEIREDO et al., 2015).

In the tasters' opinion, the full-fat Prato cheese presented appearance and aroma that was more characteristic of cheese, probably related to the greater uniformity of the product. The composition of milk, especially the fat content, is important to produce good quality and standardized cheese. In addition, fat works as a solvent for substances that interfere with the taste and aroma of foods (BELITZ et al., 2009).

According to Bastos et al. (2013) for consumers, the most important feature of Prato cheese is flavor. Han et al. (2019) highlights taste as the most important attribute in food evaluation and choice, being the interaction of different sensory perceptions. Thus, there is a trend towards overall acceptance for the cheese with the best flavor, as observed in this research, in which there was a greater preference for low-fat Prato cheese, that had flavor attribute marked higher than the full-fat variety. The taste, like the others properties of quality, are essential for consumer choice of product and direction of industry production (LEI; SUN, 2019).

Currently there is a tendency of the population to look for healthier products, which implies the search for lower fat foods, especially cheeses (DRAKE et al., 2010). This corroborates with what we observed in the analysis of the Prato cheese, in which the low-fat Prato cheese samples were the ones preferred by the tasters. There is a growing consumer concern about the nutritional quality and the intake of foods that are not harmful to health. The reduction of fat content in the Prato cheese did not interfere with flavor and acceptance of the product by consumers.

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CONCLUSION

The cheese samples analyzed were within the standards regarded as safe for consumption. Physical analyses showed samples had all expected characteristics according to their particular constitution.

Tasters were able to observe that there were differences between the samples. There were no differences in most sensory attributes when separately evaluated, however in the overall acceptance, most tasters preferred the low-fat Prato cheese to the full-fat variety.

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