The effect of inulin addition in the production of coalho cheese: characterization assessment

O efeito da adição da inulina na produção do queijo coalho: avaliação da caracterização

Efecto de la adición de inulina en la producción de queso de cuajo: evaluación de la caracterización

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ABSTRACT
The present work proposed to analyze a coalho cheese with inulin. For that, inulin was added, in the stirring stage, during the process of making the coalho cheese to obtain two samples: SCC (standard coalho cheese) and ICC (coalho cheese with inulin). In the two studied samples, the following analyzes were carried out: pH, acidity, water activity and colorimetric. As well as it was possible to know the effect of the addition of inulin when stored under refrigeration for 14 days from the analysis of instrumental texture profile, melting capacity, acceptability test and purchase intention. The studied coalho cheese samples showed differences in physical-chemical and instrumental parameters evaluated. Inulin contributed to obtaining cheeses with less melting capacity and with a firm, soft texture and little adhesiveness. Both cheeses showed high luminosity (L*) and predominance of yellow color (b*) in detriment of green (a*). The various sensory attributes evaluated by tasters, as well as purchase intention, indicated good results for this new product. The proposed work contributes to the development of a profitable market for new dairy products enriched with physiologically active components, prebiotics, which is currently one of the research priorities of the food industry.

Keywords: coalho cheese, inulin, prebiotic cheese, functional food, sensorial characteristics.

RESUMO
O presente trabalho propôs analisar um queijo coalho com inulina. Para tanto, foi adicionada inulina, na etapa de agitação, durante o processo de fabricação do queijo de coalho para obtenção de duas amostras: SCC (queijo de coalho padrão) e ICC (queijo de coalho com inulina). Nas duas amostras estudadas foram realizadas as seguintes análises: pH, acidez, atividade de água e colorimétrica. Assim como foi possível conhecer o efeito da adição de inulina quando armazenados sob refrigeração por 14 dias a partir da análise do perfil de textura instrumental, capacidade de fusão, teste de aceitabilidade e intenção de compra. As amostras de queijo coalho estudadas apresentaram diferenças nos parâmetros físico-químicos e instrumentais avaliados. A inulina contribuiu para a obtenção de queijos com menor capacidade de fusão e com textura firme, macia e pouca adesividade. Ambos os queijos apresentaram elevada luminosidade (L*) e predomínio da cor amarela (b*) em detrimento do verde (a*). Os diversos atributos sensoriais avaliados pelos provadores, bem como a intenção de compra, indicaram bons resultados para este novo produto. O trabalho proposto contribui para o desenvolvimento de um mercado rentável para novos produtos lácteos enriquecidos com componentes fisiologicamente ativos, os prebióticos, que é atualmente uma das prioridades de investigação da indústria alimentar.

Palavras-chave: queijo coalho, inulina, queijo prebiótico, alimento funcional, características sensoriais.

RESUMEN
El objetivo de este estudio fue analizar el queso de cuajo con inulina. Para ello, se añadió inulina durante la fase de agitación del proceso de fabricación del queso de cuajo para obtener dos muestras: SCC (queso de cuajo estándar) e ICC (queso de cuajo con inulina). Se realizaron los

siguientes análisis en las dos muestras: pH, acidez, actividad del agua y colorimetría. También se pudo averiguar el efecto de la adición de inulina cuando se almacenó en refrigeración durante 14 días, analizando el perfil de textura instrumental, la capacidad de fusión, la prueba de aceptabilidad y la intención de compra. Las muestras de queso de cuajo estudiadas mostraron diferencias en los parámetros fisicoquímicos e instrumentales evaluados. La inulina contribuyó a la obtención de quesos con menor capacidad de fusión y textura firme, blanda y poco adherente. Ambos quesos mostraron una elevada luminosidad (L*) y un predominio del color amarillo (b*) en detrimento del verde (a*). Los diversos atributos sensoriales evaluados por los catadores, así como la intención de compra, indicaron buenos resultados para este nuevo producto. El trabajo propuesto contribuye al desarrollo de un mercado rentable para nuevos productos lácteos enriquecidos con componentes fisiológicamente activos, los prebióticos, que es actualmente una de las prioridades de investigación de la industria alimentaria.

Palabras clave: requesón, inulina, queso prebiótico, alimento funcional, características sensoriales.

1 INTRODUCTION

According to recent research, nutrient adequacy costs 2.66 times the cost of subsistence daily energy in poor countries [1]. In recent years, several studies on bioactive compounds added to foods have been conducted to reduce the risk of chronic non-communicable diseases (CNCDs) [2].

Statistics show that in Brazil 72% of deaths are caused by CNCDs. Factors such as hypertension, obesity, diabetes, dyslipidemia, physical inactivity, family history and smoking are responsible for the increased likelihood of developing cardiovascular diseases. A worrying fact of this population, in relation to eating habits, is the low intake of dietary fiber, greater consumption of refined products, lower frequency of natural foods in the diet and the replacement of homemade meals with fast foods [3].

As a result, in recent years, there has been a growing demand for foods that have specific functions to improve the general health and well-being of the population, these foods are called functional [4]. To be considered functional, a food must satisfy basic nutritional activities, promote health and reduce the risk of disease. [1,5]. Inulin, a prebiotic, which acts in the large intestine by stimulating the growth of bifid bacteria, stands out.

Among the ingredients considered functional, prebiotics stand out, which are defined as substances that are not hydrolyzed in the upper part of the gastrointestinal tract and serve as a substrate for a limited number of beneficial bacteria (lactobacilli and bifidobacteria), being able to alter the intestinal microflora favorable and induce intestinal or systemic beneficial effects [6].

Inulin is part of these prebiotics, presenting technical functionality that justifies its addition in the production of dairy products. Classified as a soluble fiber, it has a high hygroscopic characteristic. Due to its low caloric content (1.5 kcal/g), high dietary fiber content (97 %) and for not changing the taste or appearance of the food, it is widely used in the food industry. Research that evaluated the addition of inulin in products such as biscuits, yogurts and cakes showed good sensory acceptability, which can increase their commercialization [7,8]. Other research showed that the use of inulin enriched with oligofructose promoted an improvement in body composition, a decrease in interleukin-6 and triglycerides, and a change in the microbiota [9].

Several dairy products have been tested as carriers for prebiotic compounds. Among these products, cheese stands out as an important food matrix for the incorporation of these compounds, as it is one of the most versatile products, pleasing to many palates and suitable for all age groups. Its versatility offers opportunities for many market strategies. Studies carried out to evaluate the effect of the addition of prebiotics in cheese indicated a positive influence on the sensory and rheological characteristics of the product, as well as a good stability. Thus, the addition of prebiotics during cheese making seems to be an important alternative for the food industry, since the addition of these ingredients has shown positive effects on products [10].

A typical and very popular cheese in Northeast of Brazil is the coalho cheese, widely consumed by the population in its “in natura” form, roasted or fried. The states of Rio Grande do Norte, Ceará, Paraíba and Pernambuco are the main producers of this manufactured product. The this cheese does not require sophisticated equipment and the technology is relatively simple. Its production is important, regionally and nationally, as it guarantees sustainability both in the productive field, and in the social field, helping to ensure the creation of numerous jobs, generating income for rural producers [11].

Therefore, the objective of this work is to develop a product with functional characteristics, a cheese with the prebiotic inulin, using the regional matrix of great socioeconomic and technological importance, which is the coalho cheese. Adding value to the coalho cheese, which can provide the movement of the socioeconomic sector, contributing to regional development as it is a source of income and work for many rural producers. As well as contributing to the health of the population.

2 MATERIALS AND METHODS

2.1 CHEESE PRODUCTION

The standard coalho cheese (SCC) and the coalho cheese with inulin (ICC) were developed on a farm located in Cachoeirinha-PE, Brazil, in which a partnership has been established. In this form, the samples could be produced in appropriate conditions, meeting the standards of identity and quality recommended by current legislation. The quantities used of each component and equipment for formulating 1.0 kg of each coalho cheese sample are shown in Table 1.

Table 1 - Specification of ingredients and equipment

Ingredients	**SCC**	**ICC**
Milk	10.0 L	10.0 L
Commercial coagulant (Brand: Ha-la)	7.0 mL	7.0 Ml
Sodium chloride	20.0 g	20.0 g
Inulin (Brand: Clariant)	-	150 g
Equipament	Filter Cheese production tank Press Refrigerator	

Source: Authors.

To produce 1.0 kg of standard coalho cheese, 10.0 L of milk were transferred to a cheese-making tank at room temperature (25 °C). 7.0 mL of coagulant was added thereto, dissolved in 125 mL of water and left to stand for 30 min for coalho formation. The cut was performed when it was firm and shiny (cut point), breaking with vertical and horizontal lyres. After this step, the coalho was left to rest for 3 to 5 min. Later, manual mixing was performed (slowly), gradually increasing the speed, as the grains were agglomerated, for 20 min. This procedure was performed to prevent the grains from precipitating or melting, which would make it difficult to remove the serum. Then, partial desorption (removal of serum) was carried out until the mass appeared in the bottom of the tank. After checking the point of the grains (firm and shiny), total desorption and pre-pressing was performed for 20 min. The cheese mass was placed in 1.0 kg rectangular molds lined with deodorants, to prevent the cheese mass from sticking to the mold wall and to facilitate the whey coming out during pressing, and the pressing was carried out for 30 min. The pressed cheese was then salted, placing approximately 20.0 g of salt on top of the cheese [12].

Maturation was carried out to develop aroma and flavor. This step was initially carried out for 10 to 12 hours at room temperature (25 °C) and then the cheese was taken to a refrigerated chamber, at 10 °C to 12 °C for 24 hours. The cheese was packed in plastic

packaging, pasting the label containing the date of manufacture, expiration date, complete producer data, according to Resolution No. 259, of 9/20/2002 and Ordinance No. 371 of 4/ 9/1997, Brazil [12]. Storage was at a temperature of 10 °C to 12 °C. This process resulted in 1.0 kg of coalho cheese.

In this study, two samples of coalho cheese were prepared: the SCC, which followed the process described. And for the ICC sample, 150 g of inulin (previously dissolved in whey) were added to the cheese mass, after the partial desorption step, constantly stirring the mass.

2.2 PHYSICAL-CHEMICAL ASSESSMENT

The analyzes were carried out at the Food Experimentation and Analysis Laboratory (LEAAL), located at the Nutrition Department of the Federal University of Pernambuco, Brazil. Determinations of pH, titratable acidity, water activity, melting capacity, color and texture were performed in triplicate. [13].

The pH values were determined by diluting the samples in water until obtaining a homogeneous mass and reading them directly using a digital potentiometer [13]. Acidity was measured by neutralization titration, using standard solution of 0.1 mol/L sodium hydroxide and phenolphthalein as indicator [13]. Water activity was performed at 25 ºC (± 2 ºC), using the water activity analyzer – LabTouch – Tecnal (brand: Novasina). The results were obtained from direct reading on the equipment.

2.3 COLORIMETRIC ANALYSIS

Color analysis was performed in a Konica Minolta brand colorimeter, model CR-400, using the CIELab system, with measurement of the intensity of the L*(brightness), a*(red to green) and b* (yellow to blue) parameters. The measurements were made in triplicate with the equipment previously calibrated and the average was obtained for each of the parameters, using the inner part of the cheese for analysis, right after the cheese was removed from the packaging at room temperature.

2.4 TEXTURE PROFILE ANALYSIS

Cheese samples (SCC and ICC) were stored for 14 days, and aliquots were removed at intervals of: 1 day, 7 days and 14 days. Aliquots were cut into three-centimeter-thick slices. Then, with the aid of a stainless-steel cylindrical pourer (Ref. AISI 316), with a diameter of 3.8 cm, the samples were cut. The cheeses were packed in plastic bags and placed in an isothermal container. The double compression test of the rennet cheese cylinders was carried out in a

texture analyzer BROOKFIELD, model CT3-25 kg, to obtain the texture profile. The type of test used was the Texture Profile Analysis (TPA), which reproduces the action of two bites (incisors or molars), giving the material a certain time (5 s) for recovery. Test speed was 1.0 mm/s, compression distance 10.0 mm (equivalent to 50 % compression), contact force 5.0 g, probe used: aluminum cylinder 35 mm in diameter (P35). Data were collected using the "TexturePro CT V1.4 Build 17" program, to create the texture profile graphics of each analyzed coalho cheese.

2.5 ASSESSMENT OF MELTING CAPACITY

The melting capacity (MC) of coalho cheeses being performed in triplicate. Thus, in the 14 days of refrigerated storage - 1 day, 7 days and 14 days - slices 7 mm thick in the central region were removed from each piece of SCC and ICC. Then, with the aid of a 38 mm diameter cylinder, samples for melt analysis were obtained. In a petri dish marked with four lines forming an angle of 45°, a slice of each sample was deposited, and four initial diameters (Di) were measured. The plates with the samples were left at room temperature (25 °C) for 30 min and placed in an oven at 107 °C for 7 min. Afterwards, the plates were left for another 30 min at room temperature (25 °C) for cooling and reading of the final diameters (Df). The MC was calculated using Eq. 1.

$$MC\ (\%) = (Df2 - Di2)/Di2 \times 100 \quad (1)$$

2.6 SENSORIAL ASSESSMENT

During 14 days of refrigerated storage - 1 day, 7 days and 14 days - 60 volunteers from the Federal University of Pernambuco, from the Department of Chemical Engineering and Nutrition, comprising professors, students, and employees, were invited in each session, totaling 180 untrained evaluators. The attributes evaluated were appearance, aroma, color, texture, flavor and overall quality, through a structured hedonic scale with nine categories (1 = really disliked; 5 = neither liked/not disliked; 9 = really liked). The purchase intention test was also performed using a five-point structured hedonic scale (1 = certainly would not buy; 3 = maybe buy/maybe not buy; 5 = certainly would buy).

Thus, two samples of roasted cheese were offered, one with 50.0 g of SCC and the other with 50.0 g of ICC, accompanied by a glass of water. The tests took place at the Laboratory of Dietetic Technique and Sensory Analysis of the Nutrition Department at UFPE, where there were three individual and air-conditioned cabins. This work was submitted for evaluation and

appreciation by the Research Ethics Committee of the Health Sciences Center (UFPE) and approved (CAAE nº 57635416.5.0000.5208).

2.7 STATISTICAL ANALYSIS

The data from sensory analysis were submitted to Analysis of Variance (ANOVA), and the Duncan test was performed to compare the obtained means. For comparison between the samples (ICC and SCC) the Student's "t" test was used, both at a 5 % significance level through the software Statistics for Windows 7.0.

3 RESULTS AND DISCUSSION

3.1 PHYSICAL-CHEMICAL PROPERTIES

In the characterization of cheeses, pH is important due to its influence on texture, microbial activity and maturation [16]. Table 2 shows that the pH of SCC and ICC had no significant difference ($p<0.05$), results similar to those obtained by Nassu and coworkers [12], who analyzed 43 samples of coalho cheese in the State of Ceará (Brazil) and found a pH ranging from 5.3 to 6.64.

The ICC showed a significant increase in acidity ($p<0.05$) compared to the SCC (Table 2). According to Sousa and coworkers [16], acidity comes from the production of lactic acid from the degradation of lactose by lactic bacteria present in milk. Gustaw and coworkers [17] evaluated the influence of selected prebiotics on the growth of lactic acid bacteria for the production of bio-yogurt and concluded that inulin added to bio-yogurt exhibited a stimulating effect on growth of Lb Acidophilus and Bifidobacterium sp, which caused an increase in lactic acid production. The values found (Table 2) corroborate those obtained by Freitas et al. (0.110–0.490 %) [14] and Sousa et al. (0.120–1.01 %) [16].

In Table 2, it can be seen that the water activity did not present a significant difference between the two cheeses ($p>0.05$), noting that the ICC had a higher value, probably due to the high hygroscopic power of inulin, which makes the water retention capacity increase [15]. The water activity values of both cheeses (Table 2) corroborate those found by Sousa and coworkers (0.911–0.963) [16].

Table 2 - pH, Acidity, Water activity analyses and means of instrumental color determinations in SCC and ICC samples *in natura*.

Analises	**SCC**	**ICC**
pH	6.06 ± 0.07 [a]	5.97 ± 0.19 [a]
Acidity (%)	0.230 ± 0 [b]	0.440 ± 0 [a]
Water activity	0.960 ± 0.01 [a]	0.970 ± 0 [a]
Colorimetric parameters	**SCC**	**ICC**
L*	95,46 ± 1,10 [b]	97,03 ± 0,59 [a]
a*	-9,26 ± 0,28 [a]	-8,97 ± 0,22 [b]
b*	29,60 ± 0,81 [a]	27,74 ± 1,33 [b]

[a] Means followed by equal letters on the horizontal do not differ significantly by the Student "t" test (p>0.05).
Source: Authors.

3.2 COLORIMETRIC ANALYSIS

Table 2 shows that the ICC showed significant differences (p<0.05) in the three parameters (L, a* and b*) in relation to the SCC. The first one had a greater value of L* and a lower value of b*, that is, it had a whiter and less yellow color than the SCC. SCC sample stood out as darker. Higher greater values of L* values mean light reflectance, which leads to a lighter color in coalho cheeses. Thus, greater values of L* can be associated with the degree of internal aggregation of the cheese's protein matrix, the more hydrated the matrix, the smaller the number of centers that allow light to spread.

It is observed that the two samples had high luminosity (L*). There is a predominance of the yellow color (b*) in both cheeses in detriment to the green one (a*), demonstrating that the yellowish white color is characteristic of the coalho cheese.

3.3 WATER ACTIVITY AND MELTING CAPACITY

Table 3 shows that the water activity is in a range from 0.944 to 0.956 for the SCC and from 0.943 to 0.957 for the ICC. The reduction in the value of water activity during storage for cheeses (Table 2) is a result of the loss of whey (syneresis). This reduction showed a significant difference (p<0.05) only for SCC as can be seen in Table 3. The presence of inulin prevented excessive drying of the cheese due to its water retention capacity, which explains the non-significant reduction (p>0.05) of the water activity in the ICC [18]. According to Aryana and coworkers [19], yoghurts containing inulin had less syneresis than the control yoghurt.

The study of the melting process is important in coalho cheese, as the ability to be subjected to heat without changing its original shape is one of the characteristics of this type of cheese [20].

Observing the results, it is possible to verify that the SCC melting capacity increased significantly (p<0.05), especially on the fourteenth day, in which a value close to 100 % is observed. In the study by Machado and coworkers [20] in coalho cheeses, the analysis of

variance showed that melting increased with time, being greater in longer storage times, this behavior can be explained by advanced primary proteolysis (casein is converted into large peptides) than cheeses demonstrated during storage [20]. However, the ICC showed a negative value on the seventieth day of storage, characterizing a retraction. On the fourteenth day, the melting capacity returns to a positive value (Table 3). When comparing the two cheeses on the same day of storage, it appears that the percentage of melting was significantly higher for SCC ($p<0.05$). Karimi and coworkers, reports in their study with functional cheese that inulin can become part of the protein structural network by forming complexes with protein aggregates [10], which would justify this differentiated behavior of the ICC.

Additionally, in Table 3 it is observed that the SRC at the beginning of storage had greater difficulty in melting, probably due to its high molecular weight proteins, which make them poorly soluble. After two weeks these proteins are hydrolyzed, becoming more soluble, which increases the melting' capacity. Contrary behavior obtained by the ICC, as it had a lower melting capacity, which can be explained by the lower proteolysis rate [21].

Table 3 - Data of water activity and melting capacity (in %) of SCC and ICC during 14 days of refrigerated storage

WATER ACTIVITY		
Storage time	**SCC**	**ICC**
1 day	0.956 ± 0.005 ^{Aa}	0.957 ± 0.005 ^{Aa}
7 days	0.957 ± 0.001 ^{Aa}	0.945 ± 0.002 ^{Ab}
14 days	0.944 ± 0.007 ^{Ba}	0.943 ± 0.012 ^{Aa}
MELTING CAPACITY (%)		
Storage time	**SCC**	**ICC**
1 day	32.04 ± 19.07 ^{Ca}	30,04 ± 3.47 ^{Ab}
7 days	34.07 ± 18.28 ^{Ba}	-6,89 ± 7.70 ^{Cb}
14 days	99.45 ± 25.98 ^{Aa}	10,24 ± 8.75 ^{Bb}

$^{a, b, c}$ Means followed by equal letters on the horizontal do not differ significantly by the Student "t" test ($p>0.05$). ^{A,B,C} Means followed by equal letters vertically do not differ significantly by Duncan's test. Both tests at the 5 % level of significance.
Source: Authors.

3.5 SENSORIAL ANALYSIS

At the end of storage (14 days) the attributes color, aroma, flavor and overall impression showed no significant difference ($p>0.05$) between the cheeses, noting that the highest means in all attributes were given to the coalho cheese with inulin, as summarized in Table 4.

It was shown by Creamer and Olson (1982) that the water-holding capacity of inulin could increase the available water that interacts with protein chains, resulting in a smoother, smoother cheese [22]. Karimi and coworkers observed in their study of cheeses with inulin that there is an increase in viscosity with the amount of inulin added, and that the interaction of

hydrocolloids with milk protein can result in an improvement in texture properties [10]. Thus, the addition of inulin to the product helped to promote the softness of the texture by retaining water, improving its acceptability.

The grades given to appearance may be related to the color of the ICC, as in the instrumental colorimetric analysis, presented above, it had a whiter and less yellow color than the SCC. Salem and coworkers compared the effects of 1.0 % inulin and other fat substitutes on the sensory attributes of Labneh cheese [23]. According to their findings, Labneh cheese made with a culture of Lactobacillus reuteri containing 1.0 % inulin scored higher for consistency and appearance.

Still in Table 4, it can be seen that the SCC did not present a significant difference ($p>0.05$) in all attributes at the beginning and end of storage. The same behavior had the ICC for the attributes Appearance, Color and Aroma. Regarding the attributes Texture, Flavor and Global Impression, the ICC showed a significant difference ($p<0.05$) between the beginning and end of storage, noting that the grades were higher at the end. According to Modzelewska-Kapituła and coworkers [24], who evaluated the influence of inulin and Lactobacillus plantarum on the organoleptic properties of cottage cheese, the sensory quality was positively affected by the presence of inulin in the products. After production and 45 days of storage, the cheese produced with inulin had the most desirable properties, followed by the control cheese. Zamora-Vega and coworkers also reported in their study, on the addition of Saccharomyces boulardii and inulin to fresh cheese [25]. It is reported an improvement in organoleptic properties including color, odor, flavor and general acceptability, making the cheese more acceptable to consumers.

Table 4 - Attribute ratings: appearance, color, scent, texture, flavor, overall impression and purchase intent of ICC and SCC during 14 days of refrigerated storage

Attributes	**1 day**		**7 days**		**14 days**	
	SCC	**ICC**	**SCC**	**ICC**	**SCC**	**ICC**
Appearance	7.12 ± 1.47^{Ab}	8.08 ± 1.09^{Aa}	6.57 ± 1.73^{Bb}	7.82 ± 1.43^{Aa}	7.50 ± 1.32^{Ab}	7.93 ± 1.05^{Aa}
Color	7.39 ± 1.35^{ABb}	7.91 ± 1.19^{Aa}	7.03 ± 1.45^{Bb}	7.73 ± 1.44^{Aa}	7.82 ± 1.08^{Aa}	7.92 ± 1.06^{Aa}
Scent	7.50 ± 1.34^{Aa}	7.32 ± 1.65^{Aa}	7.50 ± 1.47^{Aa}	7.40 ± 1.55^{Aa}	7.77 ± 1.31^{Aa}	7.80 ± 1.01^{Aa}
Texture	7.47 ± 1.34^{Aa}	7.29 ± 1.74^{Ba}	6.87 ± 1.77^{Bb}	7.65 ± 1.46^{Aba}	7.42 ± 1.37^{Ab}	7.88 ± 1.15^{Aa}
Flavor	7.84 ± 0.99^{Aa}	6.96 ± 1.93^{Bb}	7.65 ± 1.34^{Aa}	7.32 ± 1.84^{Aba}	7.77 ± 1.32^{Aa}	7.87 ± 1.29^{Aa}
Impression overall	7.67 ± 0.96^{Aa}	7.31 ± 1.64^{Ba}	7.22 ± 1.51^{Ba}	7.42 ± 1.62^{Aba}	7.78 ± 1.14^{Aa}	7.92 ± 1.01^{Aa}
Purchase intente	4.37 ± 0.82^{Aa}	4.00 ± 1.22^{Aa}	4.07 ± 0.86^{Aa}	4.17 ± 1.09^{Aa}	4.20 ± 0.94^{Aa}	4.29 ± 0.85^{Aa}

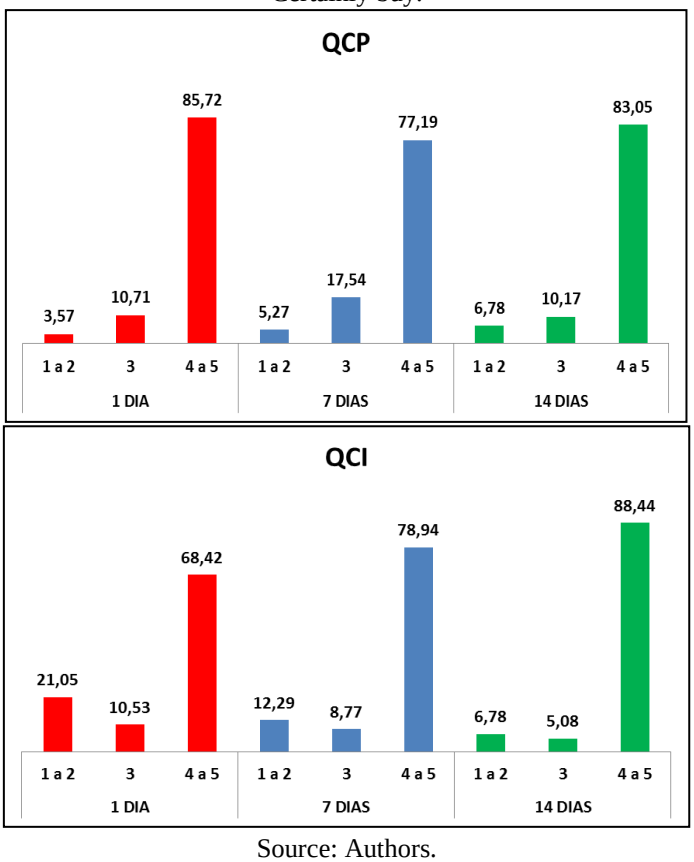
[a, b, c] Means followed by equal letters horizontally at the same time do not differ significantly at the 5% level of significance by the Student "t" test.
[A, B, C] Means followed by equal letters horizontally in the same product at different times do not differ significantly at the 5.0% level of significance by Duncan's test.
Source: Authors.

3.6 PURCHASE INTENT DETAILMENT

As for the purchase intention, it appears that all the averages of the scores obtained during the storage period for the SCC and ICC were greater than or equal to 4.00, that is, “I would possibly buy the product” and “I would certainly buy the product”. This fact can be proven by the higher percentage of frequency between grades 4 and 5 (Fig. 1). Still in Fig. 1, it is observed that with 7 and 14 days of storage, the ICC was the one with the highest percentage of frequency between grades 4.00 and 5.00, that is, the ICC had good acceptance in the purchase intention.

When comparing the purchase intention notes of SCC with ICC at each storage time, as well as SCC and ICC throughout storage, it appears that there was no significant difference ($p>0.05$). In the final storage times (7 and 14 days) it is observed that the highest scores in purchase intention were obtained in the ICC (Table 4).

Figure 1 - Frequency of grades assigned to purchase intent for SCC and ICC. SCC/ICC: Standard curd cheese; 1: Certainly wouldn't buy; 2: Possibly wouldn't buy; 3: Maybe buy/Maybe not buy; 4: Possibly buy and 5: Certainly buy.



Source: Authors.

3.7 ASSESSMENT OF TEXTURE PROFILE

Several factors are known to influence the texture of cheese such as: protein, fat, salt, minerals and pH levels [26].

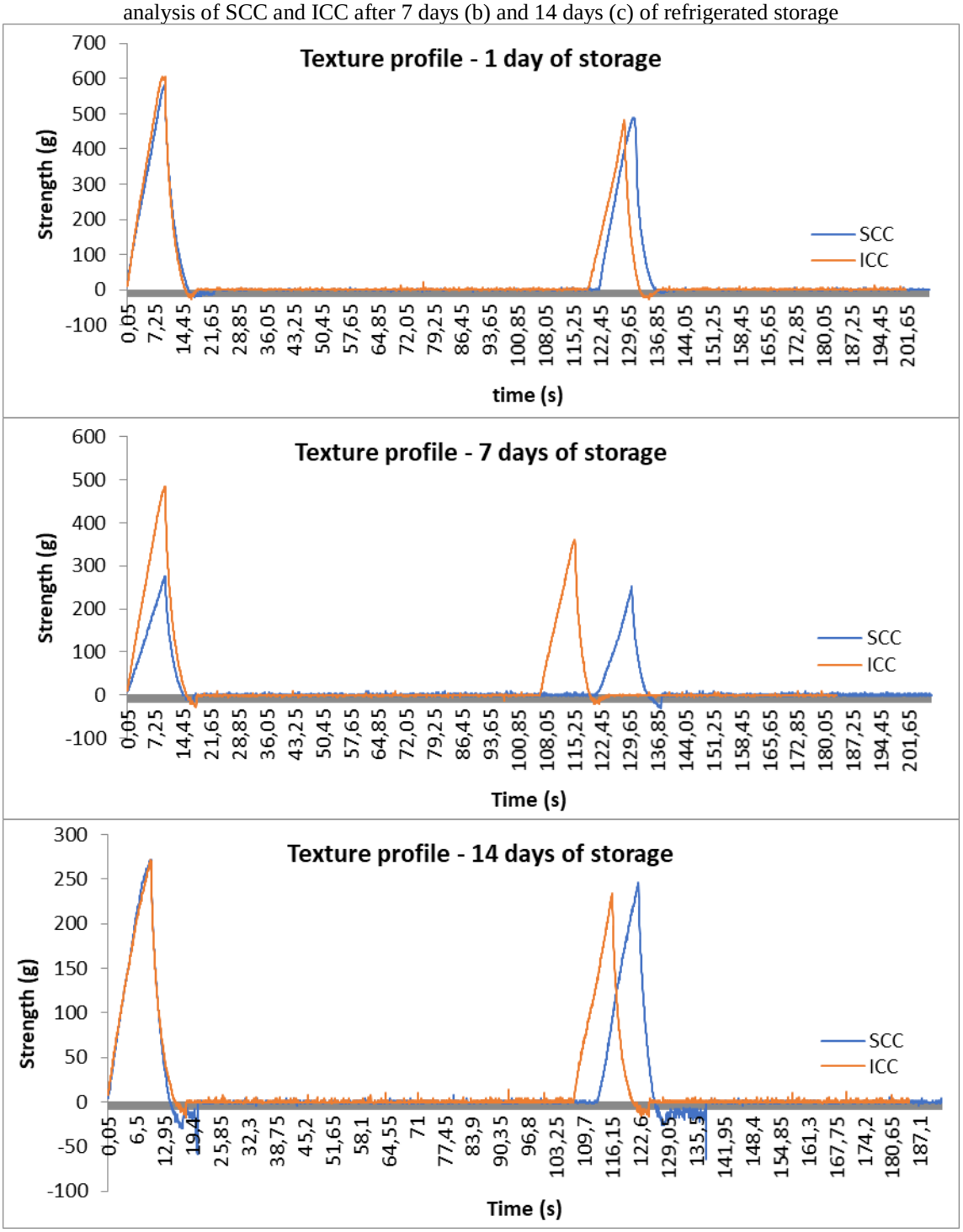
Fig. 2a indicates that the ICC on the first day of refrigerated storage required a greater force (force equal to 604 gf) to be cut and compressed compared to the SCC (force equal to 580 gf). Soon, the ICC proved to be harder and firmer. The results are in agreement with the studies carried out by Meyer et al. [27], on inulin as a texture modifier in dairy products; and by Hennelly et al. [28], who observed significantly higher hardness values in cheese samples with inulin than in the control sample.

With 7 days of refrigerated storage the force to cut and compress the ICC was lower, yet it continued to be harder and firmer than the SCC (force: SCC 276 gf and ICC 484 gf), as shown in Fig. 2b. Comparing the typical texture profile of 7 and 14 days of refrigerated storage, the SCC demonstrated a great change in its hardness, going from 580.0 g to 276.0 g. The behavior observed at the beginning demonstrates that the cheese presented greater difficulty to compress, certainly due to the high molecular weight proteins being hydrolyzed after a week [21]. The protein, of all the compounds present in cheese, is the one that deserves more attention, as it is the main responsible for the elasticity, texture and formation of compounds that characterize the cheese aroma after proteolysis [29].

From Fig. 2c, it can be seen that the two samples presented similar behavior, the first curve shown for the ICC overlapped the curve of the SCC. Thus, there was a reduction in hardness and firmness of the samples after 14 days of storage, showing similar values of 272.0 g.

The negative force represents the degree of adhesiveness or viscosity of the sample, whereas the fracture is represented by the first significant drop of the curve during the first compression cycle. Through all the analyzed characteristic curves (Fig. 2 a – c) it is observed that the two analyzed samples of coalho cheese showed slight adhesiveness and did not present fractures. However, the adhesiveness was lower in ICC, although this parameter has little relevance in coalho cheese as it is a low adhesive product [30].

Figure 2 a) analysis of the texture profile of SCC and ICC with 1 day of refrigerated storage; and texture profile analysis of SCC and ICC after 7 days (b) and 14 days (c) of refrigerated storage



Source: Authors.

4 CONCLUSIONS

Although there are no reference values in the current legislation for the analysis of water activity, acidity and pH of coalho cheese, the results obtained are similar to those found in the literature. The colorimetric analysis showed that the samples of standard coalho cheese and with inulin showed high luminosity (L*) and a predominance of yellow (b*) in detriment of

green (a*), confirming the yellowish white color that is characteristic of coalho cheese. Inulin also contributed to obtaining cheeses with a firm, soft texture, no fractures and little adhesiveness.

The melting capacity analysis showed that the melting percentage was significantly higher for the standard coalho cheese, therefore, the coalho cheese with inulin was more preserved against melting until the end of storage. Regarding sensory analysis, the various sensory attributes evaluated by tasters indicated good results for this new product. Therefore, the coalho cheese with inulin obtained good acceptance by consumers (scores above 7 on the 14th day) and good results for purchase intent (scores above 4 on the 14th day).

Therefore, the proposed work contributes to the future development of a profitable market for new dairy products enriched with physiologically active components, prebiotics, which is currently one of the research priorities of the food industry.

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