



Microbial, physical, chemical and sensory properties of Minas Frescal Cheese with Inulin and gum Acacia

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ABSTRACT. Minas frescal cheese is a semi-skimmed product with high moisture and simple preparation and one of the most consumed in Brazil. Thus, the aim of this study was to combine the characteristics of inulin and gum acacia (by having fibers and being prebiotic) to produce a minas frescal cheese. Were evaluate the characteristics physical and chemical, microbial and sensory acceptance (hedonic scale) of each cheese. Three cheeses were prepared; one as a standard (QP) without inulin, and others with 0.49% (QI25) and 0.98% (QI50) inulin, the amount of gum acacia was maintained. The yield of the formulations with gum acacia and inulin were 9.76% for (QI25) and to 20.03% (QI50) higher than the standard sample. In relation to moisture content, samples containing inulin and gum acacia showed values greater than the standard sample. The sensory analysis indicated no differences between scores for color, aroma and texture, but significant differences were detected for flavor, in which (QI25) received the highest acceptance. Regarding the energy value, it was obtained 276 kcal (QP), 215 kcal (QI25) and 190 kcal (QI50). Therefore, the developed product presents satisfactory results for sensory, microbiological and physical-chemical analyses.

Keywords: functional, yield, development of new product.

Propriedade microbiológica, física, química e sensorial de queijo Minas Frescal com Inulina e goma Acácia

RESUMO. O queijo Minas frescal é um produto semigordo, de alta umidade, de simples elaboração e um dos mais consumidos no Brasil. Deste modo, o objetivo do presente trabalho foi aliar as características da inulina e da goma acácia (por possuírem fibras e ser prebiótica) para produzir um queijo Minas frescal. Analisaram-se características físico-químicas, microbiológicas e aceitação sensorial (escala hedônica) de cada um dos queijos. Foram elaborados três tipos de queijo, um padrão, sem inulina (QP), um com 0,49% (QI25) e outro com 0,98% de inulina (QI50), a quantidade de goma acácia foi mantida. O rendimento das formulações adicionadas de goma acácia e inulina foram 9,76% para (QI25) e 20,03% para (QI50) sobre amostra padrão. Porém, em relação ao teor de umidade, as amostras com inulina e goma acácia apresentaram teor acima da amostra padrão. A análise sensorial não apresentou diferenças entre as notas para os atributos cor, aroma e textura, mas foi detectada diferença significativa para o atributo sabor, em que (QI25) obteve a maior aceitação. Em relação ao valor energético, obtiveram-se 276 kcal (QP), 215 kcal (QI25) e 190 kcal (QI50). Assim, o produto desenvolvido apresenta bons resultados sensoriais, microbiológicos e físico-químicos.

Palavras-chave: funcional, rendimento, desenvolvimento de novo produto.

Introduction

Minas Frescal Cheese, which is also known as 'white cheese', 'minas cheese' or simply 'frescal', is widely consumed in Brazil (LOGUERCIO; ALEIXO, 2001). This cheese is fresh, without any maturation and obtained only through milk coagulation by lactic acid, curds, and other appropriate coagulant enzymes, supplemented or not with particular lactic bacteria, also presenting a short shelf life.

Many companies have been developing products that aims to health promotion for, thus, functional foods are already a reality.

According to Souza et al. (2003), functional foods are any natural or prepared product containing one or more nutrient or non-nutrient substances; they are also able to delay the establishment of chronic-degenerative diseases and to improve quality and expectancy of life when acting beneficially in human metabolism and physiology.

Therefore, these functional products are food, not medicines. Among them, stand out the probiotics and prebiotics.

As a versatile food, fresh cheese allows the addition of other ingredients such as prebiotic fibers like inulin, which is a carbohydrate made of fructose subunits linked together and to a terminal glucose. Inulin selectively allows probiotics such as *Lactobacillus acidophilus* and *Bifidobacterium* to grow, providing benefits ranging from serum cholesterol levels reduction to some sorts of cancer prevention (BORGES, 2011).

The relevance of inulin for modern food industry is based on its ever increasing use as a fat and sugar replacer, as a texturizer especially in low fat dairy products (MEYER et al., 2007) and as a means to enhance the health characteristics of a food product therefore the properties as dietary fiber and prebiotic are important (TUNGLAND; MEYER, 2002).

Gum acacia or gum arabic is considered an alimentary fiber. As a soluble fiber it is not digested in the stomach, but only in the intestine where it is exposed to intestinal microbiota. When fermented, this product is converted into nutrients required for a better development of bifidobacteria and lactobacilli, beneficially increasing the bacterial microbiota. According to Oliveira and Jurkiewics (2009), the ingestion of acacia gum may contribute to cholesterol levels reduction and gastrointestinal infections and colon cancer prevention.

According to Anvisa (BRASIL, 2008), the inulin amount should not be over 30 g in recommended daily allowance for the product consumption. Still, according to Mercosul (1996) the maximum allowable concentration should be of 5 g kg⁻¹ in the final product for gum acacia.

In this context, this paper aims to work with both inulin and gum acacia characteristics together to produce minas frescal cheese, considering as target public those who are interested in nutritionally good and low calorie products.

The objective of this study was to develop and evaluate microbiological, physical, chemical and sensory characteristics of minas frescal cheese with inulin and acacia gum.

Material and methods

Minas frescal cheese manufacturing

Gum acacia was kindly provided by Doce Aroma company and inulin prebiotic fiber (Orafti®HP) provided by Beneo Orafti – Belgium. We used liquid bovine rennet, non-homogenized pasteurized

whole milk with 3.00% fat, homogenized pasteurized skimmed milk (Frimesa®) with 0.50% fat. Salt was obtained at local market of Maringá, Paraná State.

Three types of minas frescal cheese were manufactured: one control without addition of gum acacia and inulin; and the remaining cheeses QI25 and QI50 made from the equivalent mixture between non-homogenized whole milk and homogenized skimmed milk, with the addition of 0.02% acacia gum and 0.49 and 0.98% inulin in QI25 and QI50, respectively.

Minas frescal cheese manufacturing was evaluated through a pre-test with an equivalent mixture between non-homogenized whole milk and homogenized skimmed milk, but the product had not presented the texture required to this type of cheese. And still, the intention was to compare the developed products with similar ones which are in the market, where whole milk is used to obtain minas frescal cheese.

The cheeses were manufactured according to Furtado and Lourenço-Neto (1994) recommendations.

Five liters of pasteurized milk were used to each formulation, heated at 35°C with controlled temperature and addition of 2 mL calcium chloride (CaCl₂) in aqueous solution and liquid rennet previously dissolved in 25 mL distilled water. Moreover, we added 0.49% inulin and 0.02% gum acacia for formulating QI25, and 0.98% inulin and 0.02% acacia gum for formulating QI50, the gum was previously dissolved in 20 mL of distilled water (Table 1).

Table 1. Proportion of the ingredients used in cheese manufacturing.

Ingredients	QP (%)	QI25 (%)	QI50 (%)
Whole Milk	98.67	49.08	48.84
Skimmed Milk	-	49.08	48.84
NaCl	1.18	1.18	1.18
CaCl ₂	0.05	0.05	0.05
Liquid Rennet	0.10	0.10	0.10
Gum Acacia	-	0.02	0.02
Inulin	-	0.49	0.98

The salting process was carried out directly in milk by using 1.18% iodized sodium chloride (NaCl). The mixture was homogenized and left to rest for 60 minutes to complete milk coagulation, and to reach a firmness suitable to the cut, when the formed curds became bright and the serum acquired a greenish coloring.

The cutting was performed subsequently, in nearly 2 cm side cubes, and left for over 3 minutes, followed by a five-minute mixing, by a careful and slow stirring to avoid an extensive

breaking. In a further step we carried out the curd whey drainage process, transferring the so called cheese mass into the appropriate shape with side holes and lacy bottom to facilitate the serum outflow. The cheese was stored under refrigeration for 24 hours and turned over twice in its own formwork for better whey drainage.

Yield Analysis

The cheese manufacturing yield analysis was carried out through the economic yield, which is described as the volume of milk (liters) required to produce a kilogram of cheese (L kg^{-1}).

Microbiological Analysis

The microbiological analyses were developed with cheese samples soon after their manufacturing, using the number of coliforms at 35 and 45°C through the FDA (1995).

Sensory Analysis

The sensory analysis was conducted at the Sensory Analysis Laboratory of the State University of Maringá 24 hours after the manufacturing under controlled conditions. Acceptance tests were applied by using of a nine-point hedonic scale in which: 1 – Really disliked it and 9 – Really liked it. The test involved the three formulations and evaluated color, odor, texture and taste. Simultaneously we carried out a purchase intention test for the three formulations using a three-point hedonic scale where: 1 – Would certainly buy it; 2 – Might buy it and 3 – Would not buy it - using 61 untrained tasters, potential consumers of minas frescal cheese. Cubic samples with approximately 2 edge cm were presented to the tasters in a balanced manner in disposable white plastic recipients codified with three-digit random numbers.

Physical and Chemical Analysis

Each cheese sample was ground and homogenized to conduct physical and chemical analysis. The proximate composition analysis was performed for the manufactured cheeses in their three formulations.

Moisture and ash levels were determined according to IAL (2005). The total nitrogen and crude protein were determined according to the Kjeldahl method, and used the factor 6.38 for converting it into protein. Level of lipids was gravimetrically determined through Gravimetria-Monjonier. Carbohydrates were calculated by difference.

To calculate the caloric value we used the Atwater coefficient (WATT; MERRILL, 1963),

being 4.00 for proteins and carbohydrates and 9.00 for lipids.

Statistical Treatment

All chemical analyses were conducted in triplicate and the results presented as mean \pm standard deviation. We compared the data obtained from the proximate composition and the sensory analysis of the different formulations through the analysis of variance (ANOVA) with 5% significance level, and the mean values were compared by Tukey's test using the software SAS 9.1 (SAS, 2004).

Results and discussion

Yield

Along the process of preparing the particular cheeses it was possible to observe that the formulations with gum acacia and inulin added had a greater difficulty in draining the serum during whey drainage and molding than did the standard formulation.

The milk necessary (in liters) to produce 1 kg of cheese was 5.74 for QP, 5.18 QI25 and 4.59 for QI50. This probably because in the control treatment it was used whole milk, which would explain higher yield due to the higher fat content compared with other treatments that used a mixture of whole and skimmed milk.

The use of gum acacia and inulin in cheese production enabled a higher yield of approximately 9.76% for QI25 formulation and of 20.03% for QI50 formulation compared with the QP formulation.

Bearing in mind that to manufacture minas frescal cheese the average yield may vary from 5 to 7 liters milk to every 1 kg of cheese Embrapa (2007), in this study the formulations of acacia gum and inulin added, apart from having presented a yield higher than in QP formulation, also used pasteurized, homogenized skimmed milk, making the samples economically and nutritionally viable.

Neves-Souza and Silva (2005) evaluated the yield of minas frescal cheese with rennet or microbial coagulant and reported a yield of 6.09 (L kg^{-1}) when used rennet and 6.00 (L kg^{-1}) for microbial coagulant.

Microbiology

The number of fecal coliforms per gram at 45°C showed a growth smaller than three colony forming units to each of the three evaluated samples. According to the RDC 12 from 01/02/01 (BRASIL, 2001), the tolerance to coliforms at 45°C is of 5×10^2 UFC g^{-1} , presenting a good sanitization while

performing the practices, as well as good quality of the raw material.

Regarding the microbiological analysis, the number of coliforms per gram at 35°C, total coliforms, showed an increase of 4.3×10^1 UFC g⁻¹ for the QP sample, 9 UFC g⁻¹ for the QI25 sample and 2.4×10^3 UFC g⁻¹ for the QI50 sample. However the Brazilian legislation does not establish any limits to this analysis.

Sensory Analysis

Mostly both male and female young students took part in the sensory analysis. Table 2 and Figure 1 show the average scores given by tasters for each of three cheese formulations to color, taste, odor and texture attributes.

Table 2. Average scores given by tasters for each of three cheese formulations.

Attributes	QP	QI25	QI50
Color	7.65 ^a ± 1.82	7.60 ^a ± 1.68	7.52 ^a ± 2.29
Odor	6.53 ^a ± 2.29	6.56 ^a ± 1.79	6.72 ^a ± 2.10
Texture	6.85 ^a ± 2.74	7.23 ^a ± 1.94	7.30 ^a ± 1.74
Taste	6.89 ^a ± 2.05	7.62 ^b ± 0.98	7.27 ^{ab} ± 1.78

Result shown as mean ± standard deviation of triplicate analysis. Mean values followed by different letters in the same row are significantly different by Tukey's test ($p < 0.05$).

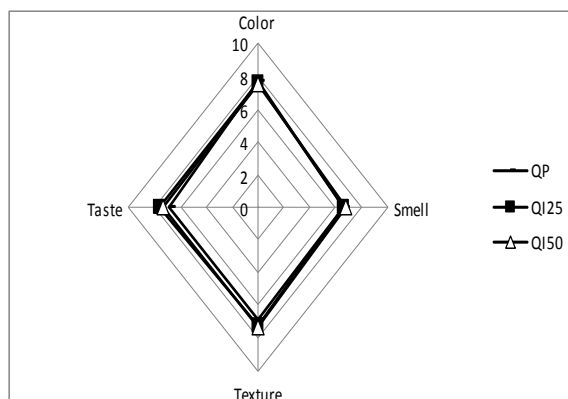


Figure 1. Average scores given by tasters for each of three cheese formulations.

There were no large score variations regarding attributes such as color, odor and texture, in 5% significance level, and only when comparing QP and QI50 the taste attribute had a higher acceptance level for QI50. In general scores were about 6 and 7, meaning 'slightly liked it' and 'regularly liked it', respectively. Table 3 shows the average scores regarding the purchase intention for all three cheese formulations.

The scores were about 1 and 2 for the purchase intention, meaning 'would certainly buy it' and 'might buy it', respectively. Statistically, there was a significant difference between formulations QP and QI25 at 5% significance level.

Table 3. Average scores regarding the purchase intention for all three cheese formulations.

	QP	QI25	QI50
Average Scores	2.03 ^a ± 0.73	1.59 ^b ± 0.44	1.80 ^{ab} ± 0.36

Result shown as mean ± standard deviation of triplicate analysis. Mean values followed by different letters in the same row are significantly different by Tukey's test ($p < 0.05$).

Oliveira and Jurkiewics (2009) performed a sensory study on the gum acacia and inulin effect on viability of probiotic bacteria in the fermented milk using a nine-point scale with the sum of all sensory perceptions about the product quality and obtained the score of 7.2 for the standard sample without prebiotic, 7.4 for the 3% gum acacia sample, 7.4 for the 3% inulin sample, and 7.6 for the 1.5% gum acacia and 1.5% inulin sample; those values are similar those presented in this study.

In the sensory study on minas frescal cheese enriched with iron, using a nine point scale, Zarbielli et al. (2004) obtained for the sample without iron and containing different amounts of fat, an average of 6.3 for taste and texture, and 5.8 for odor, and all values were lower than those presented herein.

Proximate composition

The results obtained from the proximate composition analysis are listed in Table 4. Carbohydrates values were disregarded since were minimal.

Table 4. Proximate composition for each of three cheese formulations.

Parameters (%)	QP	QI25	QI50
Moisture	56.57 ^a ± 2.44	60.69 ^b ± 0.40	64.81 ^c ± 0.02
Ash	2.06 ^a ± 0.02	2.81 ^b ± 0.01	2.84 ^b ± 0.01
Lipid	22.12 ^a ± 0.55	13.85 ^b ± 0.40	12.02 ^b ± 0.01
Protein	19.24 ^a ± 0.48	22.64 ^b ± 0.01	20.39 ^{ab} ± 0.02
Carbohydrate	-	-	-

Result shown as mean ± standard deviation of triplicate analysis. Mean values followed by different letters in the same row are significantly different by Tukey's test ($p < 0.05$).

Analyzing Table 4, it is observed a significant difference in moisture values probably due to an insufficient molding and whey removal, mainly for QI50, which presented a higher moisture. According to Anvisa (BRASIL, 2001), minas frescal cheese can be classified as of high humidity (46%) or of greatly high (55%) with abundant and viable lactic bacteria; and also of greatly high humidity (55%) developed through enzymatic coagulation without the activity of lactic bacteria, thus the moisture are higher than established by applicable law.

The lowest moisture level was presented by the QP cheese, which also presented the lowest contents for protein and ash. However, QP also presented the highest lipid value since it was made of whole milk.

There was a significant difference as for proteins at a 5% significance level between formulations QI and QI25 with an average value of 20.76%.

No significant difference was detected regarding ash at a 5% significance level between formulations QI25 and QI50; however they differ from formulation QP due to gum acacia and inulin.

According to Buriti et al. (2008) who developed symbiotic cream cheese added with inulin, moisture, ash, protein and lipid were of 65.70, 1.84, 11.86 and 7.70%, respectively. Both moisture and ash levels were similar to those presented in this study, however, both protein and lipid were lower due to the type of cheese and the use of different strains.

For the caloric content in 100 g of QP, QI25 and QI50 cheese we obtained 276, 215 and 190 kcal, respectively. Zarbielli et al. (2004) found in 100 g of minas frescal cheese without the addition of iron, produced with whole milk and partially and completely skimmed milk a caloric value of 238.5, 166.5 and 130.8 kcal, respectively. These values were lower than in our study, probably due to a longer storage period before the analysis, which leads to cheese dehydration, and the addition of gum acacia and inulin leads to a healthy increase in fibers and proteins.

Conclusion

The formulations of minas frescal cheese added with gum acacia and inulin showed a yield higher than the standard formulation, the lipid level was practically halved, thus decreasing the caloric content and significantly increasing the protein level; in short, all three formulations had a good acceptance when sensorially tested. The microbiological data indicated a good sanitization during cheese production and a high quality of raw material, and the product complies with the current legislation.

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