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Physical, Chemical and Bioaccessibility Characterization of Minerals in Cream Marketed in Rio Grande Do Sul

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Abstract:- The food industry stands out strongly in the Brazilian economy, with consolidated milk being one of the most important products. Brazil is prominent in the production of bovine milk worldwide, and the South region occupies a prominent place in terms of production. In addition to milk, several other products derived from it can be obtained, including cream. This has recently had its normative instruction regulated, so one should be more careful about its origin and offer in the market. Thus, this work aims to develop a study on the physical and chemical characteristics of different samples of whole-grain cream, as well as the bioaccessibility analysis of minerals such as: Sodium, Calcium and Potassium. For this, analyzes of titratable acidity and fat, to compare with the current legislation, were carried out on 5 samples of cream acquired, 3 from Vale do Taquari and 2 from other regions of RS, to verify if they comply with the established standards. by Brazilian legislation. In addition, a study of the bioaccessibility of minerals will be carried out, using conditions that simulate the digestive tract (saliva, stomach and intestine) on a laboratory scale. With this, it is intended to verify the quality of the brands of cream presented in local shops. And publicize the mineral absorption disposition to your consumers. As a result of this study, it was found that all samples of cream with their respective analysis of fat and acidity presented values that are in accordance with what the legislation establishes. Regarding the analysis of bioaccessibility, it was only possible to analyze that of the mineral Potassium. Results ranged from 30 percent to 98 percent, indicating different proportions of mineral absorption by consumers.

Keywords: Cream, Physical and Chemical Analysis,Bioaccessibility,Quality.

1. INTRODUCTION

Dairy agribusiness stands out strongly in the Brazilian economy, with consolidated milk being one of the most important agricultural products in the country, generating and supplying food for the population. Brazil is considered one of the largest producers of bovine milk in the world, and the South region occupies a prominent place in terms of production (ZOCCAL, 2016). According to Venturini (2014), the increase in productivity is due to increased consumption, population growth and investments made in new technologies associated with dairy production, which in addition to increasing productivity per animal, also added longer shelf life to milk and dairy products (2014). VENTURINI, 2014.).

According to Tronco (2013), maintaining the physical-chemical quality of "in natura" milk is a way of ensuring greater safety when consumed by the population, in addition to adding greater use of raw material in the production of derivatives. Quality control, microbiological, physical and chemical analyzes performed are essential, as it is possible to evaluate the chemical composition of the milk, and the hygienic-sanitary conditions that were used during the stages of: milking, storage and transport (TRONCO, 2013).

Milk and its derivatives have high nutritional value, being considered very important for the human diet, since it is composed of a rich source of vitamins, proteins, minerals and nutrients (GDP, 2017). According to Muniz, in relation to minerals, milk is responsible for supplying the daily content of calcium to be ingested, an essential element to form and maintain bone structure (MUNIZ, 2013).

Knowing the total concentration of nutrients that are present in a given food is not considered sufficient to determine if what is being ingested really provides adequate nutritional needs. Therefore, it is very important to know the available fraction (bioaccessibility) that the human organism can actually absorb (Do Nascimento da Silva, 2013). Methods that simulate digestion processes are widely applied, and the purpose is to find out how foods, when consumed, act in the gastrointestinal tract in relation to the absorption of nutrients. The advantage of using these methods is the possibility of analyzing several samples in parallel, in addition, they have no limitations, high cost, ethical restrictions and are fast (Minekus et al., 2014).

With milk in its "*in natura*" form, it is possible to generate and supply the market with a series of derivatives, such as: pasteurized, sterilized, ultra-pasteurized milk, without lactose content, with the addition of vitamins and minerals, and others. Various products are manufactured, including: cheeses, cream, dairy drinks and desserts, powdered and fermented milk, cream, chocolate, among others (OLIVEIRA, 2009).

Cream is one of the products generated from milk, and has the Normative Instruction No. 23 of August 30, 2012 (IN 23) which was prepared with the purpose of standardizing the product. Its fat parameters should be around 45% (m/m) and acidity 0.2% (g of lactic acid/100g), as established (BRASIL, 2012).

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In Brazil, cream has a wide application in the culinary field of different gastronomic cultures. In Southeast regions it is used in the famous custard cookies, and in the Northeast, it serves as an accompaniment to typical June foods: pamonha, corn and mungunzá. The use of cream consists of improving the physical and sensorial characteristics of sauces and broths, highlighting flavors, textures, aspects and consistencies. It is also possible to use it in the wide area of confectionery and bakery. It can also be indicated to accompany fish-based dishes (Batalha & Bessa, 2018; Freixa & Chaves, 2017). As its regulation is recent, there is a need to assess whether its parameters are in accordance with current legislation.

1.1 Milk

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Knowing the total concentration of nutrients that are present in a given food is not considered sufficient to determine if what is being ingested really provides adequate nutritional needs. Therefore, it is very important to know the available fraction (bioaccessibility) that the human organism can actually absorb (Do Nascimento da Silva, 2013). Methods that simulate digestion processes are widely applied, and the purpose is to find out how foods, when consumed, act in the gastrointestinal tract in relation to the absorption of nutrients. The advantage of using these methods is the possibility of analyzing several samples in parallel, in addition, they have no limitations, high cost, ethical restrictions and are fast (Minekus et al., 2014).

With milk in its "*in natura*" form, it is possible to generate and supply the market with a series of derivatives, such as: pasteurized, sterilized, ultra-pasteurized milk, without lactose content, with the addition of vitamins and minerals, and others. Various products are manufactured, including: cheeses, cream, dairy drinks and desserts, powdered and fermented milk, cream, chocolate, among others (OLIVEIRA, 2009). Milk

According to Normative Instruction No. 62 (IN 62) of December 29, 2011, milk is defined as the product generated through complete and uninterrupted milking of well-fed, rested and healthy cows. Considering adequate hygienic conditions during the production process. Milk from other animals is called conformant, the species that comes from it (BRASIL, 2011).

According to Vidal and Netto (2018), bovine milk has about 87% water in its composition, being considered a complete food. When exposed to room temperature, there is a greater microbial development and its characteristics are rapidly modified (Vidal; Netto et al.; 2018). With its processing, it is possible to produce various types of products. Around a third of the milk produced in the country is used in the manufacture of cheese, long-life milk and powdered milk, with only 15% of the milk used for the development of other dairy products. Over the years, this production has increased (CRUZ et al., 2017).

Milk, in addition to being a rich source of calcium, is made up of other mineral constituents such as zinc, phosphorus, selenium and magnesium (Gaucheron, 2011). Contains fat-soluble vitamins (A, D and E), water-soluble vitamins (B complex) and proteins of high biological value (casein, β globulin, α globulin, and albumin). for presenting important nutritional value, its consumption is recommended, being important in the diet and for human health. It is considered an essential food for the development and growth of children (Ornelas, 2007; Silva et al., 2013).

The quality of the raw material is reflected in the product that will be produced. The production chain of milk and its derivatives is based on government supervisory bodies, which perform the function of inspecting and approving the manufacture and trade of dairy products. The main regulatory bodies are: Department of Inspection of Products of Animal Origin (DIPOA), Ministry of Agriculture, Livestock and Supply (MAPA) through IN 62 (Normative Instruction No. 62 of December 29, 2011, and Fede Inspection Service.

1.2 Cream

The milk cream called "cream" is a dairy derivative, obtained by separating the fat present in the milk, which must have a minimum lipid content of 45% (m/m) grams of fat / 100 grams and acidity must not exceed 0.2% (grams of lactic acid/100grams) (BRASIL, 2012). As defined in IN 23 of MAPA:

"Cream is defined as "the dairy product relatively rich in fat taken from milk, which takes the form of an emulsion of fat in water, homogenized or not, and subjected to the pasteurization process, through heat treatment and adequate technological procedures sufficient to destroy all pathogenic microorganisms" (BRASIL, 2012).

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In the southern region of Brazil, cream is widely consumed. According to the Dairy and Derived Products Industry Union of the State of Rio Grande do Sul (SINDILAT), this food originates from the 18th century, when European immigrants, coming from Italy and Germany started to use the milk cream that was left over from the scarce amount of milk that was expressed. At that time, cream served as a substitute for butter, which had a high added value. It is currently consumed in several states and used in different branches of cuisine, being a fundamental ingredient in the manufacture of breads, cookies, cakes and others (SINDILAT/RS, 2012).

Through technological advances and with the dairy facilities, cream started to be produced on an industrial scale in the state of RS, being considered one of the typical products. Due to its nutritional properties, light and mild flavor, it meets the taste of many people (SINDILAT/RS, 2012).

IN 23 was prepared for the purpose of standardizing the dairy derivative Nata. According to Brasil (2012) cream is produced industrially, through the skimming of milk with its fat content between 55 and 60%. Standardization adjustments are made, which consists of mixing the cream with skimmed milk, with the purpose of reducing the original fat of the cream, remaining within the established parameters of 45% of minimum fat content (BRASIL, 2012).

Thickeners and stabilizers can be used, such as: guar gum, carrageenan (sodium, calcium and potassium salts), carrageenan and gelatin, whose purpose is to prevent the cream from draining, that is, to avoid phase separation. Their concentration must comply with the standards established by the regulation (IN 23), with limited values of 0.5% for each one of them, except for gelatine, which does not have a stipulated maximum limit for application. These compounds, when used in the process, have the purpose of better highlighting the viscosity characteristics and shelf life of the product. (BRAZIL, 2012).
During the process, pasteurization is carried out, which, through heat treatment and the use of appropriate technological procedures, will eliminate pathogenic microorganisms. The homogenization step may or may not be used. It must be refrigerated at a temperature of 0 to 5 ºC (zero and five degrees Celsius), thus maintaining its characteristics. (BRAZIL, 2012).

Figure 1 represents the stages of cream processing. According to Brasil (2012), it is essential to comply with the techniques of good manufacturing practices, and to follow the established parameters, so that quality can be obtained in the generated product, since, because it is rich in fat, the cream is very susceptible to damage. contaminations (BRAZIL, 2012).

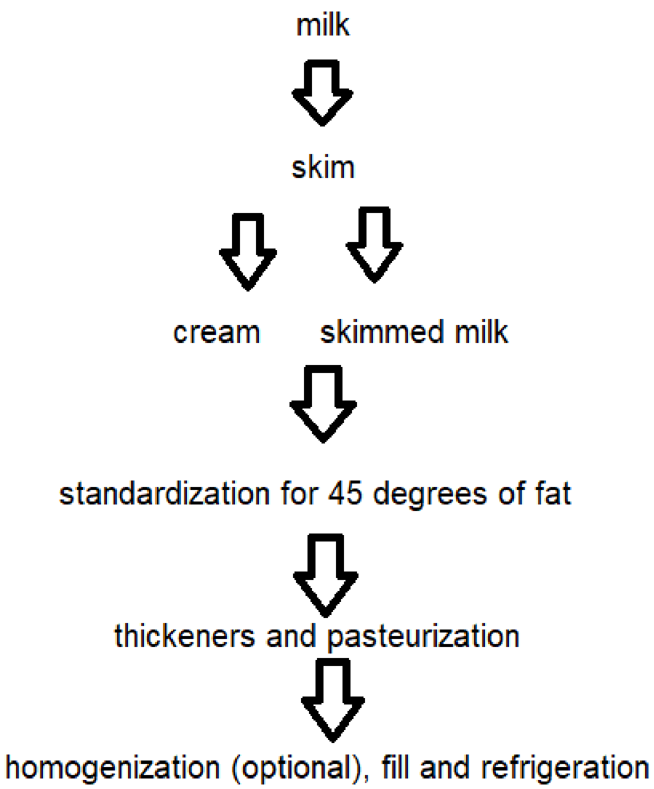

Figure 1 - Cream processing step

Source: Author (2022).

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Cream is considered a fresh product, obtained from milk cream, from the large amount of fat it contains. According to SINDILAT/RS (2012), cream differs from pasteurized cream because it has a more pasty and firm consistency, as well as a spreadable texture (SINDILAT/RS, 2012).

It is necessary that dairy products maintain this texture pattern, through technological solutions, avoiding draining during their short shelf life (SINDILAT/RS 2012). To be considered a quality product, cream must present some specific characteristics such as: creaminess, it does not have an aspect of the type that "forms threads", it must be easy to spread (RODRIGUES, 2012).

Currently in the state of RS, the cream produced and marketed maintains the original characteristics of the product initially consumed by European immigrants. Only some improvements were developed during the production process, such as the application of the pasteurization step, and addition of stabilizers that maintain the quality of the product, and refrigerated distribution. With these techniques applied during processing, it is possible to obtain an average shelf life of 30 days for the final product (SINDILAT/RS, 2012).

2 PHYSICAL, CHEMICAL AND BIOACCESSIBILITY ANALYSIS OF MINERALS

2.1 Fat Analysis

Lipids play an important role in food quality, showing the characteristics of: texture, flavor, nutrition and caloric density. In the last decades, many researches were carried out with an emphasis on the lipid content for product development (FENNEMA et al., 2010).

Whole milk contains similar levels of protein and lipids. In the case of cream, the amount of fat is greater than that of proteins (10 parts of lipids for 1 part of protein). This higher concentration of fat, at the time of cooking, tends not to coagulate the proteins, since the lipid forms a protective layer (McGee, 2011).

The determination of lipids in foods can be performed through acid or alkaline hydrolysis. An example of this type of analysis is the Gerber Butyrometer methodology, widely used and important for the determination of fat in milk and its derivatives, such as cream, which has a high amount in its composition (BRASIL, 2006).

According to Brasil (2006), the butyrometer method for fat analysis is widely used by dairy quality control laboratories and follows the guidelines of Normative Instruction No. considered laborious, expensive, time-consuming and dangerous, since corrosive reagents are used (BRASIL, 2006).

To analyze the fat present in the cream, the Gerber principle is used. According to Castanheira (2012), this method consists of separating and quantifying the fat by treating the sample with sulfuric acid and isoamyl alcohol. The purpose of the acid is to dissolve the proteins that are bound to the fat, decreasing the viscosity generating an increase in the aqueous phase, melting the fat. With these changes, energy is released from the reaction, thus favoring the separation of fat by the extractor (CASTANHEIRA, 2012).

2.2 Titratable Acidity Analysis

The acidity analysis is very important in addition to being widely used to verify the quality of dairy products, from the receipt of the raw material, to the final product, since it provides parameters on the state of conservation of the product. According to Nascimento (2014) the acidity content of dairy products within the standards established by Organs current bodies, indicates good quality of the raw material, that its handling was carried out in hygienic conditions and with adequate refrigeration temperature. If these conditions are not followed, there is a greater possibility of microbial proliferation, making the product more acidic, and consequently making it unfit to be consumed (NASCIMENTO, 2014).

According to Brasil (2012) for cream, the acidity content should not exceed 0.2% (g of lactic acid/100g), which is the established standard (BRASIL, 2012).

2.3 Mineral Bioaccessibility Analysis

Developing products with the purpose of meeting the specific needs of different consumer groups contributes to better use of food, helps in the prevention of diseases, in addition to being a way of using natural resources in a sustainable way. (Shani-Levi et al., 2017; Brodkorb et al., 2019). After ingested, in the gastrointestinal tract, foods undergo processes, including biotransformation.

And possibly the bioaccessible content of nutrients offered to the organism may be lower than the total content ingested, this may be due to several factors (Fernández-García, CarvajalLérida & Pérez-Gálvez, 2009; Etcheverry, Grusak & Fleige, 2012; De Lima et al. ., 2014).

In recent years, there has been an increase in the number of works available in the literature that are related to mineral determination and bioaccessibility studies. Bioaccessibility corresponds to the fraction of an element that is released from the food matrix after ingested and solubilized in the intestine. (Barciela Alonso & Bermejo Barrera, 2015).

Some methods simulate the digestion process, relating it to bioaccessibility, including in vitro digestion models that can be: static, semi-dynamic or dynamic (Ménard et al., 2018). During the development of this process, the main digestive phases are

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considered: oral phase, in the mouth during which solid foods are chewed and processed, gastric phase, and intestinal (duodenal) phase (Bourlieu et al., 2014).

The conditions involved (temperature, agitation, pH, enzymes and chemical composition) resemble those of the human body during the digestive process. (Dominguez González & Bermejo Barrera, 2015). In vitro digestion models are considered an efficient screening tool, as they quickly analyze food ingredients, providing accurate results in a short time (Hur et al., 2011).

In the evaluation of bioaccessibility, with the use of in vitro methods, the most used foods are: vegetables (26%), dairy products (23%), bakery products (17%), and meat (13%), foods from seafood (12%) and egg-based foods (7%) (Lucas-González et al., 2018).

Regarding dairy products, components present such as proteins and phospholipids can contribute positively to the intestinal absorption of calcium, keeping it in the soluble form until it reaches the large intestine and is finally absorbed (FAO 2013).

With the development of these studies, it is possible to analyze promising food matrices for bioaccessibility, in addition to identifying the processing conditions (Etcheverry, Grusak & Fleige, 2012).

3. METHODOLOGICAL PROCEDURES

The purpose of this work was to carry out analyzes of physical, chemical and bioaccessibility characterization of minerals, in 5 samples of different brands of cream that were acquired in local commerce. The samples were designated as: 1,2 ,3 ,4 ,5, and samples 4 and 5 were produced in Vale do Taquari-RS and samples 1,2 and 3 from other regions of RS.

The transport of the samples was carried out in thermal boxes in order to keep the temperature controlled, to the chemistry laboratory at the University of Vale do Taquari-RS, where the Bioaccessibility analysis of minerals was carried out, with emphasis on nutrients: sodium, calcium and potassium. All samples were done in triplicate. The titratable acidity and fat analyzes were outsourced in accredited laboratories.

3.1 Fat Analysis

Fat Analysis In a fume hood, the protective cover was placed on the butyrometer and 10 mL of sulfuric acid with density 1.820 to 1.825 g/ml was carefully added, with the aid of a dispenser in the Gerber butyrometer for milk cream.

Then, 5 mL of cream was pipetted, and the cream was slowladded to the butyrometer containing the sulfuric acid. The pipette with cream residue was washed with 5 mL of hot water (approximately 70 °C). This wash water was slowly added to the butyrometer. Then, 1 mL of (isoamyl) alcohol was added, using a 1 mL parrot nozzle coupled to a 500 mL Erlenmeyer flask, and the stopper was carefully placed in the butyrometer.

After stirring, in order to mix the liquids and in a centrifuge, the butyrometer was placed for 5 minutes with rotation from 1000 to 1200 rotation per minute (rpm). After centrifuging, the samples were placed in a water bath at 65+-2°C for 10 minutes. Finally, immediately after removing the device from the water bath, the percentage of fat present on the scale of the device was read, at the base of the meniscus formed by the layer of fat. The value read on the scale is the result of the analysis in percentage, it is not necessary to make calculations (IN 68).

3.2 Titratable Acidity Analysis flask.

Then, 50 mL of carbon dioxide-free water (previously boiled and cooled) was added. 10 drops of 1% phenolphthalein alcoholic solution were added and then titrated with 0.111N sodium hydroxide solution until the appearance of a persistent pink color for up to 30 seconds (IN 68). Calculation:

g % lactic acid = (Vxf x 0.9)/m where:

V=volume of 0.111N sodium hydroxide solution;

f= correction factor of 0.111N sodium hydroxide solution;

m = sample mass in grams;

3.3 Bioaccessibility

Initially, the three solutions to be simulated were prepared: saliva, gastric juice and intestinal juice, which was made from stock solutions, previously prepared and stored in schott flasks.

3.3.1 Preparation of stock solutions

The stock solutions were prepared according to the concentrations described in Table 1. The solutions were placed in a volumetric flask, in the volume to be used, using ultrapure water to solubilize it.

Table 1 - Concentration of reagents necessary for the production of stock solutions.

Reagent	Concentration	Reagent	Concentration
KCl	37.3 g L^{-1}	$CaCl_2(H_2O)_2$	7.5 mmol L^{-1}
KH_2PO_4	34.0 g L^{-1}	$CaCl_2(H_2O)_2$	2.0 mmol L^{-1}
$NaHCO_3$	84.0 g L^{-1}	$CaCl_2(H_2O)_2$	9.0 mmol L^{-1}
NaCl	117.0 g L^{-1}	NaOH	40.0 (1 mol L^{-1})
$MgCl_2(H_2O)_6$	15.2 g L^{-1}	HCl	6.0 mol L^{-1}
$(NH_4)_2CO_3$	12.0 g L^{-1}	HCl	1.0 mol

Source: Author (2022).

3.3.2 Preparation of working solutions: saliva, gastric and intestinal juices

In this step, the preparation of fluids that simulate saliva, gastric juice and intestinal juice was carried out. Table 2 presents the compositions of digestion fluid solutions, containing salts and enzymes. For this, the stock solutions prepared in item 1 were used, and a dilution was carried out in a volumetric flask in a volume sufficient to perform all the tests.

Table 2 - Compositions of digestion fluid solutions, containing salts and enzymes.

Saliva (g L^{-1})		Gastric juice (g L^{-1})		Intestinal juice (g L^{-1})	
KCl	1.1	KCl	0.5	KCl	0.5
KH_2PO_4	0.5	KH_2PO_4	0.01	KH_2PO_4	0.1
$NaHCO_3$	1.1	$NaHCO_3$	2.1	$NaHCO_3$	7.1
$MgCl_2(H_2O)_6$	0.03	NaCl	2.7	NaCl	2.2
$(NH_4)_2CO_3$	0.006	$MgCl_2(H_2O)_6$	0.02	$MgCl_2(H_2O)_6$	0.07
HCl 1mol L^{-1}	120 µL	$(NH_4)_2CO_3$	0.05	HCl 6 mol L^{-1}	140
α Amilase	25	HCl 6 mol $^{L-1}$	260 µL	Bile	27
		Pepsine	17.6	Pancreatine	2.68

Source: Author (2022).

Table 3 represents the volume of reagents used in the preparation of 100 mL of saliva.

Table 3 - Volume of reagents used in the preparation of 100mL of saliva

Reagent (g/L)	Volume (mL)
KCl 1.1 g/L	2.949
KH_2PO_4 0.5 g/L	1.4706
$NaHCO_3$ 1.1 g/L	1.3095
$MgCl_2(H_2O)_6$ 0.03 g/L	0.197
$(NH_4)_2CO_3$ 0.006 g/L	0.05
HCl 1mol L^{-1} 260 µL	0.12
α Amilase 25 g/L	2.5 g

Source: Author (2022).

Table 4 represents the volume of reagents used in the preparation of 100 mL of saliva.

Table 4 - Volume of reagents used in the preparation of 100mL of gastric juice.

Reagent (g/L)	Volume (mL)
KCl 0.5	1.34 mL
KH_2PO_4 0.01	0.0294 mL
$NaHCO_3$ 2.1	2.5 mL
NaCl 2.7	2.31 mL
$MgCl_2(H_2O)_6$ 0.02	0.132 mL
$(NH_4)_2CO_3$ 0.05	0.417 mL
HCl 6 mol 260 µL	0.26 mL
Pepsine 17.6	1.76 g

Source: Author (2022).

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Table 5 represents the volume of reagents used in the preparation of 250 mL of intestinal juice.

Table 5 - Volume of reagents used in the preparation of 250mL of gastric juice.

Reagent (g/L)	Volume (mL)
KCl 0.5	3.35 mL
KH_2PO_4 0.1	0.740 mL
NaHCO3 7.1	21.13 mL
NaCl 2.2	4.7 mL
$MgCl_2(H_2O)_6$ 0.07	1.150 mL
HCl 6 mol 140 µL	0.350 mL
Bile 27	6.75 g
Pancreatine 2.68	0.67 g

Source: Author (2022).

3.4 Sample preparation

In identified erlenmeyers, 2 grams of sample (cream) were placed and the mass was recorded. This procedure was performed in triplicate. In addition, a triplicate of the analytical blank was prepared, where 2 mL of ultrapure water were added to the erlenmeyers.

3.4.1 Simulation of mineral bioaccessibility

3.4.1.1 Mouth simulation (first step)

In this step, 8 mL of ready-made saliva solution and 1 mL of 7.5 mM CaC_{l2} were added to each of the prepared samples, along with the blanks. Then the pH was adjusted to 7. Subsequently, the solutions were sent to the water bath with heating at 37 ºC for 10 minutes. The Erlenmeyers were removed from the equipment after this period.

3.4.1.2 Stomach simulation (second step)

9.1 mL of gastric juice, 700 µ of 2 mM $CaCl_2$ were added. The pH of the solutions was adjusted to 3 by adding 1 mol L^{-1} HCl. Afterwards, the solutions were again sent to the bath and heated to 37 °C for a period of 2 hours.

3.4.1.3 Gut simulation (third step)

In this step, 18.5 mL of intestinal juice, 1.35 mL of 9 mM $CaCl_2$ were added and the pH of the solution was adjusted again to 7. The resulting solutions were sent to the water bath with agitation and heating at a temperature of 37 ºC for 2 hours. After completion of the heating step, the samples were removed and placed in an ice bath for 20 minutes, in order to inactivate the enzymes. Then they were sent for centrifugation with a rotation of 10,000 rotation per minute (rpm) for 30 minutes, and the bioaccessible fraction was separated to be quantified according to the chosen technique (Minekus et al., 2014). After the mineral bioaccessibility analysis, the samples were analyzed by flame photometer .

4. RESULTS

The results of the acidity and fat analysis of the samples, which were carried out in an external laboratory, are shown in Table 6.

Table 6 - Results of acidity and fat analysis of the samples.

sample	acidity %	fat (g/ 100 grams)
1	0.08	51
2	0.09	55
3	0.08	52
4	0.08	54
5	0.08	50

Source: Author (2022).

One of the fundamental parameters that evaluate the microbiological quality of food is acidity. It is related to the conservation conditions. According to Nascimento (2014), conservation is a major concern, as it interferes with the physicochemical quality of the food (NASCIMENTO, 2014). High acidity is an indication of contamination through microorganisms and/or product commercialization beyond the expiration date, which is worrying from a public health point of view (SOARES, et al. 2013). With the result of the analyzed samples, in relation to acidity, it is possible to verify that all are in accordance with Brazilian legislation, and according to Ribeiro Jr. et al, 2012, demonstrate that heat treatment is essential, since, in addition to helping to eliminate microorganisms, it keeps the acidity of the product stable (Ribeiro Jr. et al, 2012).

Fat analyzes resulted in values between 50 and 55 grams of fat / 100 grams. In the dairy derivative, according to Brasil (2012), the lipid content must be at least 45% (m/m) g of fat / 100 g (BRASIL, 2012).

According to Castanheira (2012), lipids play an important role in food quality and in the dairy industry (CASTANHEIRA, 2012). Its functions in the body are related to the formation of hormones, and cell membrane, which act in the transmission of nerve impulses. (FERREIRA, 2009).

In the analysis of the bioaccessibility of minerals, carried out on different brands of cream from the state of RS, it was possible to verify the content of each mineral: Na, Ca, and K, as shown in table 7.

Minerals are essential to the body, they are present, as well as vitamins and proteins in the composition of dairy products, which stand out for constituting a group of foods with high nutritional value (Muniz et al., 2013). According to Murray (2007), minerals participate in the physiological and biochemical functions of the human body. The elements: Na, Mg, P, K, Ca, S are classified as macrominerals and their insufficient intake can cause deficiencies (MURRAY, 2007).

Table 7 - Total mineral concentrations in the sample.

	Concentration total (mg/g)		
sample	Na	Ca	K
1	0.115	0.040	0.402
2	0.077	0	0.262
3	0.094	0	0.301
4	0.220	0.052	0.56
5	0.084	0	0.157

Source: Author (2022).

Table 8 presents the results of bioaccessibility of minerals.

Table 8 - Result of Bioaccessibility of minerals.

sample	K (total)	K (bioacessibiliry)	%
1	0.4025	0.178	44.34
2	0.262	0.14	53.43
3	0.301	0.1	33.22
4	0.56	0.55	98.21
5	0.1575	0.15	95.23

Source: Author (2022).

The results of the mineral bioaccessibility analysis indicated that Na is not present in significant amounts. Sodium in the body performs important cellular functions, such as osmotic regulation and the passage of nerve impulses, but if consumed in excess, it contributes to the development of cardiovascular diseases (LIMA and MELO, 2012; DICKINSON, 2007; HE and MACGREGOR, 2009).

Generally, adults absorb only 30% of ingested calcium, but in some individuals they can absorb up to 10% (MAHAN; ESCOTT-STUMP, 2010). Some aspects such as: physiological factors, the composition of the diet and the components present in the milk itself (such as the presence of lactose) influence calcium absorption. The concentration of lactose physiologically also influences the intestinal absorption of minerals such as Ca, since the content present in cream is lower than that present in milk (Hunt et al., 2009; FAO, 2013). Due to the minerals Ca and Na being below the detection limit, it was not possible to evaluate them in detail.

The result of the K content of the analyzes performed on the samples was satisfactory. Potassium is considered the main cation of the human body in the intracellular environment, it helps in muscle contractions, in various reactions and transmissions of nerve impulses (IOM, 2004; WHITNEY, 2008). This mineral showed the highest absorption when compared to the other minerals studied.

5. CONCLUSION

The developed study proved that the physical, chemical and bioaccessibility analyzes of minerals performed on five different brands of cream, from different regions of RS, are in accordance with the parameters established by IN 23. There are no significant differences in the results of the analyzes.

With this study, it was possible to conclude that when ingesting some food, not all its nutrients will be used by the body, because what we ingest is not fully absorbed by the body, that is, only bioaccessible fractions are absorbed. In addition, in the literature, there are few studies that carry out studies on the bioaccessibility of minerals in dairy products, especially in cream, which is a food widely consumed in the state of RS.

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