

## **ANÁLISES FÍSICO-QUÍMICAS E SENSORIAIS DO QUEIJO COALHO DE VACA PRODUZIDOS EM SÃO JORGE - CABO VERDE**

### **PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF COW'S MILK CHEESE PRODUCED IN SÃO JORGE - CAPE VERDE**

### **ANALYSE PHYSIQUE-CHIMIQUE ET SENSORIELLE DU FROMAGE "COALHO" DE LAIT DE VACHE PRODUIT À SÃO JORGE - CABO VERDE**

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#### **Resumo**

O presente estudo teve como objetivo investigar as características físico-químicas, a aceitação sensorial e a intenção de compra do queijo de coalho produzido com leite de vaca. A qualidade do queijo depende diretamente da qualidade do leite, exigindo um controle de qualidade rigoroso durante todo o processo da produção. Parâmetros físico-químicos como pH, humidade, proteína, acidez titulável e gordura total foram determinados. Para o teste de aceitação sensorial (cor, sabor, aroma, textura e aceitação geral) foi realizado por 12 provadores. Relativamente às análises físicas, não foi encontrado diferença significativa no diâmetro, no entanto, foram verificadas diferenças significativas no peso e na altura do. O queijo estudado é caracterizado como queijo fresco, queijo meio gordo e de pasta mole com pH na faixa de 5,37 a 6,33 e acidez titulável de 0,32 a 0,72%. O teor de gordura, umidade e proteína foi semelhante ao dos queijos frescos produzidos no México. De maneira geral, esses resultados podem ajudar a controlar melhor o processo de produção do queijo de coalho com base nos parâmetros sensoriais e físico-químicos.

**Palavras-chave:** Leite, Queijo coalho, Qualidade, Proteínas, Acidez titulável.

#### **Abstract**

The present study was designed to investigate the physical-chemical characteristics, sensory acceptance and purchase intention of coalho cheese produced using cow's milk. The quality of cheese depends directly on the quality of milk, requiring a rigorous quality control during all production processing. Relevant physical-chemical parameters such as pH, moisture, protein, titratable acidity and fat were determined. In addition, sensory acceptance test (colour, taste, aroma, texture and overall acceptability) was carried out by 12 tasters. Regarding to physical analysis, no significant difference was found in the diameter, however, differences in weight and height were verified. The studied cheese is characterized as fresh cheese, semi-skimmed and semi-soft cheese with pH range of 5.37 to 6.33 and titratable acidity of 0.32 to 0.72%. Fat, moisture and protein content were similar to the fresh cheeses produced in Mexico. Overall, these findings may help to better control the production process of coalho cheese based on the sensory and physico-chemical parameters.

**Keywords:** Milk, Coalho cheese, Quality, Protein, Titratable acidity.

### Résumé

Cette étude visait à étudier les caractéristiques physico-chimiques, l'acceptation sensorielle et l'intention d'achat du fromage "Coalho" produit avec du lait de vache. La qualité du fromage dépend directement de la qualité du lait, ce qui nécessite un contrôle de qualité strict tout au long du processus de production. Les paramètres physico-chimiques tels que le pH, l'humidité, les protéines, l'acidité titrable et la graisse totale ont été déterminés. Pour le test d'acceptation sensorielle (couleur, saveur, arôme, texture et acceptation générale), a été réalisé par 12 dégustateurs. En ce qui concerne l'analyse physique, aucune différence significative de diamètre n'a été trouvée, cependant, des différences significatives de poids et de taille ont été trouvées. Le fromage étudié est caractérisé comme un fromage frais, semi-gras et à pâte molle avec un pH compris entre 5,37 et 6,33 et une acidité titrable de 0,32 à 0,72%. La teneur en matières grasses, en humidité et en protéines était similaire à celle des fromages frais produits au Mexique. En général, ces résultats peuvent aider à mieux contrôler le processus de production du fromage "Coalho" sur la base de paramètres sensoriels et physico-chimiques.

**Mot-clés:** Lait, Fromage "Coalho", Qualité, Protéines, Acidité titrable.

### Introduction

Since ancient times, cheese production has been considered a successful method of the exploitation of milk. Milk is one of the most complete food, mainly constituted by proteins, vitamins lactose, fat, minerals, salts and enzymes, however, this composition may vary according to the season of the year, lactation time, breed and number of animals (BORSZCZ, 2002).

Food quality and safety are current consumer first concerns. The regulation (EC) N° 853/2004 of the European Parliament and of the council of 29 April 2004 lay down the specific hygiene rules applicable to the production of raw milk. As mentioned by Silva *et al.* (2010), fresh cheese possesses high commercial value due to the simple technology applied during its manufacture, high yield, and good acceptance by the consumers. According to NCV012 (2015) cheese is defined as a product fresh, processed or matured obtained by the coagulation of casein with rennet, with or without addition of ripening yeasts and other optional ingredients. Villegas and Cervantes (2011) defined fresh cheese as a soft, high moisture content, without rind, mild taste, and with a shelf life no longer than 10 days. Commonly, the fresh cheese has the following characteristics: pH from 5.3 to 6.5, moisture content from 46% to 57%, protein content from 15% to 21%, fat content from 20% to 29% and salt content from 1 to 3% (HWANG and GUNASEKARAN, 2001; TUNICK and VAN HEKKEN, 2010).

The quality control of dairy products is of vital importance for health assurance and consumer acceptance. The quality of these products can be evaluated through physical, chemical, microbiological and sensorial determinations, where the chemical composition is the most important parameter for its manufacture and quality control (LIMA *et al.* 2016). Physical-chemical quality control of cheeses involves the determination of macronutrients, such as fat and protein, using standard methodologies recognized by the Association of Official Analytical Chemists (AOAC 2005). The physical characteristics of cheese, depend on different factors such as quality of milk and its composition, milk heat treatment, concentration and type of starter culture, pH, moisture and protein content (GUTIERREZ *et al.*, 2013). The sensory qualities of cheese are influenced by numerous factors, including animal genetics, milk production environment and processing technologies (FEKADUA *et al.* 2005) and to the chemical and microbiological characteristics of the raw milk used (COULON *et al.* 2004).

Cape Verdean coalho cheese is recognized as one of the key products that contributes to the economic development of certain regions, and is appreciated as a traditional snack or consumed with jelly, jams and bread. Most of the cheese produced in Cape Verde comes from an artisanal production system using on goat's milk, cow's milk, or a mixture of the two varieties (SANTOS, 2015). The production occurs mainly in rural areas as an alternative to the difficulties in transporting fresh milk (DELGADO, 2014). This cheese is acknowledged as a traditional and very appreciated product which is frequently consumed by the local population, is associated with culture and festivities and it reinforces gastronomy as a tourist attraction in Cape Verde. All the Cape Verde islands produce cheeses, but most cheeses are produced in Santo Antão, Boa Vista and Fogo islands.

In Cape Verde, the production and consumption of cheese is much appreciated, and its consumption is part of the local culture. The availability of goat cheeses has been limited due to the seasonal nature of the supply of goat milk so cow's cheese could be an excellent alternative. In the available literature, there is limited information relatively to the sensory and physical-chemical analyses of Cape Verdean cheese. This study was set, therefore, to characterize the sensorial and physico-chemical properties of the artisanal cow milk cheese produced in the region of São Jorge (Santiago Island – Cabo Verde) and to evaluate its acceptability. The results from this study would be useful for cheese making industry, for the protection and preservation of cheese-making traditions and provide a better understanding of cheese production in this region.

## **Material and methods**

### ***Materials and chemicals***

The experiments were carried out in the Biology and Chemistry Laboratory of the University of Cape Verde as well in São Jorge Center for Food Processing. The cheeses were donated by Professional Training Center for Food Processing, petroleum ether (45 – 60 °C) and sodium hydroxide (98.8 %) were achieved from VWR International (VWR Prolabo Chemicals – Czech Republic) and phenolphthalein (98 – 101 %) was purchased from PRS Panreac Qumica SA (PRS Panreac – Spain). All the chemicals and reagents used were of analytical grade.

### ***Cheese production***

The cheeses were produced by Professional Training Center for Food Processing. Coalho cheese production starts with microbiological and chemical analysis of milk. Then, the milk was filtered to eliminate the solid particles suspended and then pasteurized (65°C for 30 minutes). Afterward, the temperature of the milk was lowered to an optimum range for the coalho to act (32 - 35°C). Coagulation is the most decisive step in cheese production, which aims to concentrate milk protein, while also retaining fat. The coagulation process took 40 minutes at 35°C. Later, molding and pressing were carried out manually that allowed to give final shape to the cheese and eliminate excess whey using molds. The cheese was salted on the surface and left to stand for about 5 hours. Then the cheese was washed to remove excess salt, vacuum-packed and stored at 10°C.

### ***Sampling***

The cheeses were donated by Professional Training Center for Food Processing. The samples were transported to the Biology and Chemistry Laboratory of the University of Cape Verde in an ice box within 30 min. Half of the cheeses were prepared for sensory and physical analysis and the other half were weighted, homogenized and stored at  $-25^{\circ}\text{C}$  for further chemical analysis. Figure 1 shows the photograph of the studied cheese.



**Figure 1:** Photograph of the studied cheese.

### ***Physical analysis***

The weight of each cheese was determined using a digital weight scale (KERN, 440-55) and expressed in grams. The diameter and height were determined using a digital Vernier caliper (POWERFIX Profi, Z22855).

### ***Sensory analysis***

The acceptance test was assessed considering the following attributes: colour, taste, aroma, texture and overall acceptability. For the acceptance test of the produced cheeses, the effective method in the verbally structured 9 - points hedonic scale (9 – extremely like, 5 – neither like or dislike, and 1 – extremely dislike) was used. The prepared samples of approximately 3 cm x 3 cm x 0.5 cm were presented to a panel of non-professional tasters at cooling temperature followed with the evaluation file and a glass of water. The sensory evaluation of cheese was performed by a 12-members, including teachers and students from the laboratory of Biology and Chemistry at University of Cape Verde. The samples were considered as accepted when the majority of the tasters ( $\geq 70\%$ ) presented results as, at least, “like slightly” (value 6) in the mentioned scale (PINTO and ATZINGEN, 2010). For the purchase intention, the verbally structured 5-points hedonic scale (5 – definitely would buy it, 3 – Might or might not buy it, and 1 – definitely would not buy it) was used (SREBERNICH *et al.* 2015).

### ***pH and Titratable Acidity***

Titrate acidity and pH are two interrelated concepts in food analysis that deal with acidity. The pH of cheeses was determined after homogenizing the sample with distilled water (1:10, w/v) using a digital pH meter (CRISON, basic 20) calibrated with pH 4.0 and 7.0 buffers. Titratable acidity was determined according to the AOAC official method 942.15 (AOAC, 2000). Five grams of homogenised cheese sample was diluted in 25 ml of distilled water and titrated using sodium hydroxide (NaOH, 0.1M). Titratable acidity was expressed as a percentage of lactic acid.

### *Moisture, protein and lipid*

Physico-chemical parameters were analyzed by the AOAC - association of official analytical chemists (AOAC, 2005): Moisture was determined by drying under vacuum at 105 °C until constant weight (method 950.46) and lipids was extracted using solvent extraction in a soxhlet apparatus (method 991.36). To quantify protein content, nitrogen was performed using micro-Kjeldahl method, and a conversion factor (nitrogen-protein) of 6.38 was used to calculate protein content from the nitrogen content (method 928.08).

### *Statistical analysis*

The experiments data correspond to triplicated analysis. The results were expressed in means  $\pm$  standard deviation (SD). The statistical analysis was performed using SPSS 21.0 software, at a level of  $p < 0.05$  by one-way analysis of variance (ANOVA) and by Duncan test. The analysis of correlation between all the parameters analyzed in this study was evaluated by Pearson's correlation test, and  $p < 0.05$  or  $p < 0.01$  represented different statistically significant levels.

## **Results**

### *Physical parameters of coalho cheese*

It's presented in Table 1, the results for the physical parameters (diameter, weight and height) of coalho cheese from five different lots. In this study, no significant difference ( $p > 0.05$ ) was found for diameter, due to the use uniform molds during the production of cheese. On the other hand, significant differences ( $p < 0.05$ ) were found in the weight and height of cheese, with variation between 84.30-113.7g and 2.54-3.71cm, respectively.

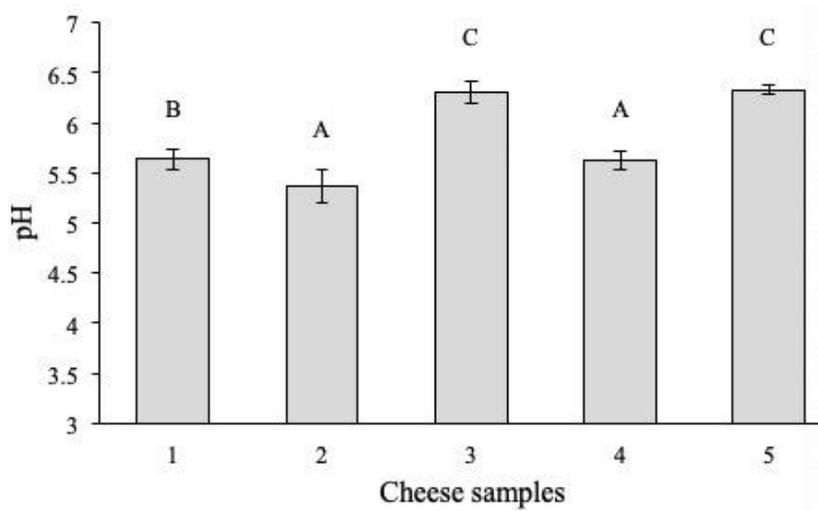
**Table 1:** Physical characteristics of fresh cheese. Different uppercase letters in the same column indicate significant differences ( $p < 0.05$ ).

<b>Lot</b>	<b>Weight (g)</b>	<b>Height (cm)</b>	<b>Diameter (cm)</b>
1	113.70 $\pm$ 0.28 <sup>D</sup>	3.71 $\pm$ 2.44 <sup>D</sup>	6.40 $\pm$ 0.07 <sup>A</sup>
2	84.30 $\pm$ 5.50 <sup>A</sup>	2.54 $\pm$ 1.12 <sup>A</sup>	6.31 $\pm$ 2.52 <sup>A</sup>
3	98.20 $\pm$ 8.30 <sup>AB</sup>	2.97 $\pm$ 0.95 <sup>AB</sup>	6.45 $\pm$ 0.41 <sup>A</sup>
4	105.05 $\pm$ 2.61 <sup>CD</sup>	3.62 $\pm$ 1.84 <sup>CD</sup>	5.91 $\pm$ 1.82 <sup>A</sup>
5	99.15 $\pm$ 0.35 <sup>BC</sup>	2.78 $\pm$ 0.97 <sup>AB</sup>	6.55 $\pm$ 0.37 <sup>A</sup>

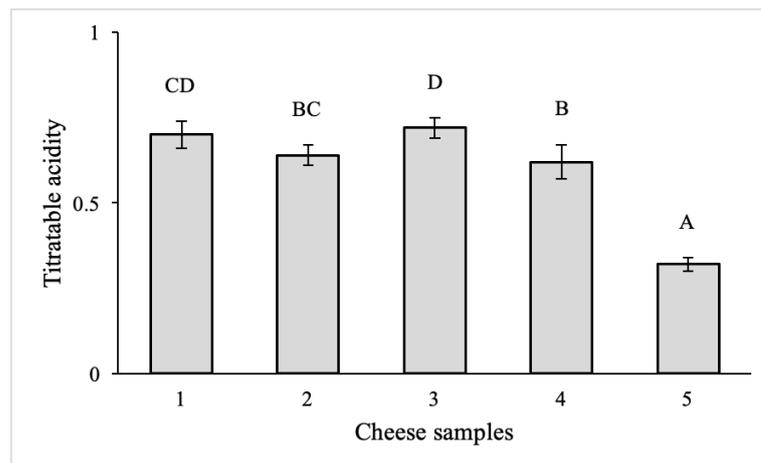
### *pH and titratable acidity analysis*

The values of pH are presented in Figure 2. The pH of fresh cheese should be close to the fresh cow milk, which according to the USDA (United States Department of Agriculture) should range from 6.5 to 6.9. Figure 3 shows the values of titratable acidity where a

significant difference ( $p < 0.05$ ) was verified. The acidity of the studied cheese ranged from 0.32 to 0.72% and the lot 5 presented the lowest value of titratable acidity (0.32%).



**Figure 2:** pH of cow's milk cheese; Different letters on top of bars denote significant differences ( $p < 0.05$ ).



**Figure 3:** Titratable acidity of cow's milk cheese. Different letters on top of bars denote significant ( $p < 0.05$ ).

**Physico-chemical parameters of coalho cheese**

The proximate composition (fat, moisture and protein) of coalho cheese is shown in Table 2. The results from the 5 studied lots varied: Moisture ranged from 48.45 to 61.78%, fat from 23.85 to 30.67% and protein from 10.79 to 12.52%.

**Table 2:** Proximate composition of fresh cheese. Different uppercase letters in the same column indicate significant differences ( $p < 0.05$ ).

Lot	Moisture (%)	Fat (%)	Protein (%)
1	49.55 ± 1.68 <sup>A</sup>	26.59 ± 2.25 <sup>B</sup>	12.19 ± 0.43 <sup>A</sup>
2	48.45 ± 0.39 <sup>A</sup>	30.67 ± 2.31 <sup>CD</sup>	12.52 ± 0.50 <sup>A</sup>
3	61.78 ± 0.38 <sup>D</sup>	23.85 ± 0.25 <sup>A</sup>	12.31 ± 1.23 <sup>A</sup>
4	54.67 ± 0.05 <sup>B</sup>	38.67 ± 2.30 <sup>E</sup>	10.79 ± 1.48 <sup>A</sup>

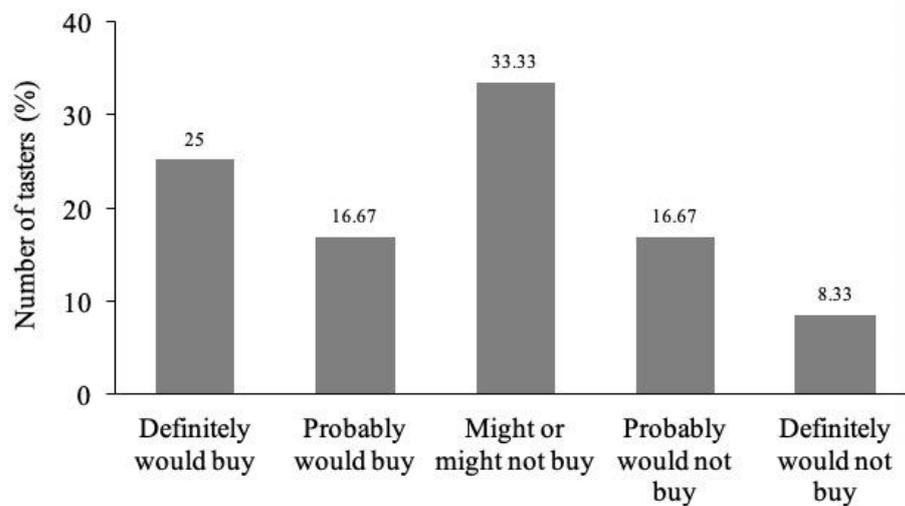
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5	58.16 ± 1.70 <sup>C</sup>	30.66 ± 3.31 <sup>CD</sup>	11.62 ± 1.27 <sup>A</sup>
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***Sensory acceptance and purchase intention***

Through statistical analysis, Table 3 shows the average and percentage of acceptance of coalho cheese obtained based on the values attributed by tasters following the 9-point hedonic scale. In this study, all the cheeses presented an acceptance higher than 70% for all the intrinsic attributes, which could be an indicator that the tasters probably would buy this cheese. Figure 4 shows the purchase intention of the studied cow’s milk cheeses.



**Figure 4:** Purchase intention of tasters with regard to fresh cheese.

***Relationship evaluation (Pearson correlation)***

A correlation study was completed to establish links between all parameters analyzed in this study (Table 4). Highly positive significant correlations were obtained between fat content and acidity ( $r = 0.89, p < 0.01$ ) and between fat and taste ( $r = 0.69, p < 0.05$ ).

**Table 3:** Sensory acceptance of fresh cheese. Different uppercase letters in the same column indicate significant differences ( $p < 0.05$ ).

Lot	Colour		Taste		Aroma		Texture		Overall acceptability	
	Mean $\pm$ SD	%Acceptance	Mean $\pm$ SD	%Acceptance	Mean $\pm$ SD	%Acceptance	Mean $\pm$ SD	%Acceptance	Mean $\pm$ SD	%Acceptance
1	7.92 $\pm$ 0.76 <sup>B</sup>	88.00	6.46 $\pm$ 1.56 <sup>A</sup>	71.68	6.69 $\pm$ 1.31 <sup>A</sup>	83.63	7.31 $\pm$ 0.85 <sup>A</sup>	81.22	7.08 $\pm$ 0.95 <sup>A</sup>	78.67
2	7.00 $\pm$ 1.22 <sup>A</sup>	87.5	6.77 $\pm$ 0.83 <sup>AB</sup>	84.63	6.85 $\pm$ 0.99 <sup>A</sup>	85.63	7.00 $\pm$ 1.52 <sup>A</sup>	77.78	7.08 $\pm$ 1.19 <sup>A</sup>	78.67
3	8.00 $\pm$ 0.60 <sup>B</sup>	88.89	6.58 $\pm$ 2.15 <sup>AB</sup>	73.11	6.58 $\pm$ 2.15 <sup>A</sup>	77.13	7.00 $\pm$ 1.27 <sup>A</sup>	77.78	7.33 $\pm$ 0.98 <sup>A</sup>	81.44
4	7.58 $\pm$ 0.90 <sup>AB</sup>	84.22	7.75 $\pm$ 0.96 <sup>B</sup>	86.11	6.17 $\pm$ 1.64 <sup>A</sup>	83.33	7.00 $\pm$ 0.85 <sup>A</sup>	87.50	8.25 $\pm$ 0.75 <sup>B</sup>	91.67
5	7.50 $\pm$ 0.79 <sup>AB</sup>	93.75	7.67 $\pm$ 1.46 <sup>AB</sup>	93.75	7.33 $\pm$ 1.23 <sup>A</sup>	81.44	7.83 $\pm$ 0.94 <sup>A</sup>	87.00	7.67 $\pm$ 0.49 <sup>AB</sup>	95.88

**Table 4:** Correlation matrix of sensory and physico-chemical parameters of coalho cheese. \*Significant correlation at  $P < 0.05$ ; \*\*Significant correlation at  $P < 0.01$ .

Variables	Moisture	Fat	Protein	pH	Acidity	Colour	Taste	Aroma	Texture	Overall acceptability
Moisture	1.00									
Fat	-0.10	1.00								
Protein	-0.05	-	1.00							
pH	<b>0.83**</b>	-0.12	-0.45	1.00						
Acidity	0.2	<b>0.89**</b>	0.35	0.54	1.00					
Colour	0.26	0.24	0.00	0.27	0.56	1.00				
Taste	0.06	<b>0.69*</b>	<b>0.75*</b>	0.00	<b>-0.65*</b>	-0.08	1.00			
Aroma	0.00	-0.11	0.15	0.16	0.14	-0.08	0.00	1.00		
Texture	0.02	0.00	-0.02	0.27	0.18	0.00	0.14	<b>0.65*</b>	1.00	
Overall acceptability	0.13	<b>0.66*</b>	<b>-0.94**</b>	-0.02	-0.34	0.00	<b>0.78*</b>	-0.15	0.00	1.00

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## Discussion

### *Physical parameters of coalho cheese*

Usually fresh soft cheese produced in Cape Verde has cylindrical shape with weight approximately 180 g, however the low weight and the difference found in the height and weight of cheese is due to the product is made manually and the cheese is less compact. The weight variation may have a negative impact with regard to the sales revenue once the fresh cheese in Cape Verde is usually sold per piece and not by weight.

### *pH and titratable acidity analysis*

The values of pH in the present study ranged from 5.37 to 6.33, which was lower than pH of cow milk. As mentioned by Caro *et al.* (2014), this decrease could be probably result of bacterial growth in milk and the consequent acidification of cheese. According to Guo *et al.* (2011), concerning to the raw milk, the pH of cheese decreases during maturation due the presence of lactic acid bacteria that resist pasteurization or contaminating bacteria after pasteurization process. Similar to the pH levels found for coalho cheese in this study, Van Hekken *et al.* (2012) reported a pH value of  $6.36 \pm 0.03$  in fresh cheese and Caro *et al.* (2014) reported pH values of  $6.12 \pm 0.41$  and  $5.30 \pm 0.21$  in samples of Mexican Panela and Manchego cheese, respectively.

As mentioned by Pinho *et al.* (2004), the acidity of cheeses trends to increase when the storage time increases due to the presence of microorganisms, either starter cultures or microorganisms typically found in unpasteurized milk used to produce cheese. Our results were similar to the values mentioned by Vasek *et al.* (2013) and Diamantino *et al.* (2013) which reported acidity values of 0.75% in artisanal cheeses from Argentina and 0.4-0.7% in serrano cheese from Brazil, respectively. According to González *et al.* (2018), this range of acidity is normal in fresh cheeses or those with a short maturation period. On the other hand, Hordofa (2018) found higher titratable acidity (0.74 – 1.04%) in soft cheese made using cow milk.

### *Physico-chemical parameters of coalho cheese*

Significant difference ( $p < 0.05$ ) was verified for moisture. There are numerous studies on the physical-chemical characterization of fresh cheese with moisture content similar to the presented in table 2. González *et al.* (2018) reported moisture of 59.04, 63.67, 60.49 and 63.16% in Mexican Aro cheeses, Gutierrez *et al.* (2013) mentioned 50.6 to 55.63% of moisture in fresh cheeses and Solís *et al.* (2013) presented 50.4 to 53.8% in Ranchero artisanal cheese. Since moisture content is associated to the shelf life of cheese, good manufacturing process and good manufacturing practice is essential to reduce all risks of contamination. According to Longaray *et al.* (2012) cheese with high moisture can be vulnerable to several changes caused by the development of microorganisms, essentially by mesophilic and coliforms.

Significant difference ( $p < 0.05$ ) was shown for fat content, and the lowest fat content (23.85%) was found in cheese from lot 3 which showed the highest moisture content. Fat content may have direct influence on sensory acceptance, since fat can improve the colour and texture of cheeses. The results of fat content found in this research was similar to that found by Caro *et al.* (2014), which reported 28.4% in manchego, 25.9% in botanero 31.8% in tenate

and 29% in moral cheeses. On the other hand, fat content was higher than those mentioned by Funck *et al.* (2015), Van Hekken *et al.* (2012) and Restrepo *et al.* (2018). With regard to the protein content, no significant difference ( $p > 0.05$ ) was found between the cheeses from the 5 lots. Values of protein in the present study was lower than the results mentioned by Funck *et al.* (2015) but higher than the findings of Fangmeoer *et al.* (2018). Proteins contents in this study aligns with the values reported by González *et al.* (2018) and Van Hekken *et al.* (2012). In general, the content of protein and fat is affected directly by the quality of milk, and as previously mentioned, it depends on several factors such as diet supplementation, type of feeding, hygiene condition in milking, breed of cattle and cattle's health. According to NCV012 (2015), the studied cheese can be classified as fresh cheese, semi-skimmed (fat content greater or equal to 24% and less than 45%), semi-soft or soft cheese due its high moisture content.

### ***Sensory acceptance and purchase intention***

In general, all the five samples were well accepted relatively to all five attributes studied (colour, taste, aroma, texture and overall acceptability), where the minimum acceptance percentage found was 71.68%. Among all the analysed parameters, colour and taste were the characteristics showing higher scores. Acceptance tests revealed no significant difference ( $p > 0.05$ ) for the aroma and texture, however, significant difference ( $p < 0.05$ ) was found for overall acceptability, taste and colour among the studied cow's milk cheeses.

Delgado *et al.* (2011) mentioned that the flavour of cheeses depends on numerous reactions, such as the metabolism of lactose and lactate, lipolysis and proteolysis in the cheese matrix. The cheese samples of lot 3 and lot 5 presented higher pH (6.3 and 6.33, respectively) and consequently showed the lower acceptance (77% and 81%, respectively) than the other cheeses. According to Ceballos *et al.* (2009), the flavor of cheeses is mostly intensified when the product possesses pH values of six or higher. Morand-Fehr *et al.* (2004) reported that the use of good hygienic practices during milking could decrease the development of disagreeable taste and aroma in cheeses due to the decrease in lipolysis caused by contaminating bacteria.

The purchase intention shows that the sum of the two first items (“definitely would buy it” and “probably would buy it”) was 41.67%, where 25% of tasters marked as “definitely would buy it” and 16.67% as “probably would buy it”. Regarding to third item is considered (“might or might not buy it”), the value was 35%. According to Chiciudean *et al.* (2016), intrinsic and extrinsic attributes of cheese are the important factors that might affect the buying decision process. In their study, results showed that costumers are more interested in the intrinsic attributes such as taste (made from natural ingredients) and aspect than the extrinsic factors.

### ***Relationship evaluation (Pearson correlation)***

Significant correlation between fat and overall acceptability ( $r = 0.66$ ,  $p < 0.05$ ) could be related to the fact that fat content has positive impact on sensory acceptance of cheese, since fat content greatly improve the colour and texture of coalho cheese. Moisture exhibited good positive correlations with pH content ( $r = 0.83$ ,  $p < 0.01$ ) which is in accordance to that reported by Guerra-Martínez *et al.* (2012) and Fallico *et al.* (2004). Protein content only significantly correlated well with fat, taste and overall acceptability ( $r = -0.67$  and  $r = 0.75$ ,  $p < 0.05$ ,  $r = -0.94$ ,  $p < 0.05$ , respectively). Titratable acidity was positively associated with pH

content ( $r = 0.54$ ). To the best of our knowledge, the investigation about relationship between sensory acceptance and physico-chemical properties of cheese is still limited. The sensory characteristic of food depends directly on the microbiological and physico-chemical parameters. Guerra-Martínez *et al.* (2012), found highly negatively correlation between moisture content and Hardness and Chewiness ( $r = - 0.76$  and  $r = - 0.88$ , respectively). In their study, moisture and pH were negatively and highly correlated with all proteolytic indexes ( $r = 0.82$ ), while moisture was positively associated with total protein content ( $r = 0.53$ ).

## Conclusion

The studied cheese, traditionally produced with raw milk in the region of São Jorge (Santiago Island – Cabo Verde), was categorized as fresh and semi-soft cheese. This product showed fat, protein, moisture, pH and titratable acidity contents similar to different other varieties of fresh cheese. All the five lots were well accepted for the colour, taste, aroma, texture and overall acceptability, showing a minimum acceptance percentage of 71.68%. Overall, cheeses quality depends directly on the quality of raw milk and the procedures used during production processing, thus the results from this study suggest that a strict control during the production is essential to improve and acquire high quality of coalho cheese. Therefore, future research should investigate the changes in microbiological, sensory and physico-chemical characteristics of this cheese during the storage time.

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