Physicochemical analysis, consumer profile and sensory analysis of goat Coalho cheeses seasoned with alcoholic beverages

Análise físico-química, perfil de consumidor e análise sensorial de queijos de coalho de cabra condimentados com bebidas alcoólicas

Vanessa Bonfim da Silva
Mestre em Ciência Animal nos Trópicos pela Universidade Federal da Bahia
Instituição: Universidade Federal da Bahia
Endereço: Av. Adhemar de Barros, 500, Escola de Medicina Veterinária e Zootecnia da
UFBA, Ondina – Salvador, Bahia, Brasil – CEP 40170-110
E-mail: vbonfim90@gmail.com

Beatriz Pinheiro de Oliveira Alves
Graduanda em Medicina Veterinária pela Universidade Federal da Bahia
Instituição: Universidade Federal da Bahia
Endereço: Av. Adhemar de Barros, 500, Escola de Medicina Veterinária e Zootecnia da
UFBA, Ondina – Salvador, Bahia, Brasil – CEP 40170-110
E-mail: beatriz.pinheirooalves@gmail.com

Bruna Cerqueira dos Santos
Graduada em Medicina Veterinária pela Universidade Federal da Bahia
Instituição: Universidade Federal da Bahia
Endereço: Av. Adhemar de Barros, 500, Escola de Medicina Veterinária e Zootecnia da
UFBA, Ondina – Salvador, Bahia, Brasil – CEP 40170-110
E-mail: brunacerqueira_@hotmail.com

Leonardo Fonseca Maciel
Doutor em Ciência de Alimentos pela Universidade Estadual de Londrina
Instituição: Universidade Federal da Bahia
Endereço: Rua Barão de Jeremoabo, 147, Faculdade de Farmácia da UFBA, Ondina –
Salvador, Bahia, Brasil – CEP: 40170-115
E-mail: lfmaciel@ufba.br

Danilo Moreira Vilas Boas
Mestre em Ciência de Alimentos pela Universidade Federal da Bahia
Instituição: Universidade Federal da Bahia
Endereço: Rua Barão de Jeremoabo, 147, Faculdade de Farmácia da UFBA, Ondina –
Salvador, Bahia, Brasil – CEP: 40170-115
E-mail: danilo_mvb1808@hotmail.com

Joselene Conceição Nunes Nascimento
Mestre em Ciência de Alimentos pela Universidade Federal da Bahia
Instituição: Universidade Federal da Bahia

Endereço: Rua Barão de Jeremoabo, 147, Faculdade de Farmácia da UFBA, Ondina – Salvador, Bahia, Brasil – CEP: 40170-115
E-mail: microalim@hotmail.com

Clícia Capibaribe Leite
Mestre em Ciências Agrárias pela Universidade Federal da Bahia
Instituição: Universidade Federal da Bahia
Endereço: Rua Barão de Jeremoabo, 147, Faculdade de Farmácia da UFBA, Ondina – Salvador, Bahia, Brasil – CEP: 40170-115
E-mail: clicia@ufba.br

Emanoel Ferreira Martins Filho
Doutor em Cirurgia Veterinária pela Universidade Estadual Paulista Júlio de Mesquita Filho
Instituição: Universidade Federal da Bahia
Endereço: Av. Adhemar de Barros, 500, Escola de Medicina Veterinária e Zootecnia da UFBA, Ondina – Salvador, Bahia, Brasil – CEP 40170-110
E-mail: gugaossa@gmail.com

Alessandra Estrela-Lima
Doutora em Patologia pela Universidade Federal de Minas Gerais
Instituição: Universidade Federal da Bahia
Endereço: Av. Adhemar de Barros, 500, Escola de Medicina Veterinária e Zootecnia da UFBA, Ondina – Salvador, Bahia, Brasil – CEP 40170-110
E-mail: alestrela@gmail.com

Marion Pereira da Costa
Doutora em Medicina Veterinária (Higiene Veterinária e Processamento Tecnológico de Produtos de Origem Animal) pela Universidade Federal Fluminense
Instituição: Universidade Federal da Bahia
Endereço: Av. Adhemar de Barros, 500, Escola de Medicina Veterinária e Zootecnia da UFBA, Ondina – Salvador, Bahia, Brasil – CEP 40170-110
E-mail: marioncosta@ufba.br

ABSTRACT
The present study sought to characterize the physicochemical, bacteriological and sensorial effects that alcoholic beverages exert on goat Coalho cheese. For that, goat Coalho cheeses were seasoned with alcoholic beverages and physicochemical and bacteriological analyses were performed on day 0, as well as sensory analysis. The potential consumers were expected to be slightly familiar with goat dairy products. Among the seasoned cheeses, goat Coalho cheese with beer had the best acceptability and purchase intention, a result that is associated with the typical consumption of such alcoholic beverage by potential consumers. Soft and white characteristics were the most emphasized by taste testers, what is in agreement with the instrumental color and texture. According to the principal component analysis (PCA), acid and alcoholic aromas and taste were the characteristics responsible for acceptability. Therefore, it is concluded that goat cheese with alcoholic beverages can be elaborated and have good acceptability.

Keywords: Acceptance, Alcholic Seasoning, Consumer Expectation, Goat Milk, Instrumental Analysis.

RESUMO

O presente estudo buscou caracterizar os efeitos físico-químicos, bacteriológicos e sensoriais que as bebidas alcoólicas exercem sobre o queijo de Coalho de cabra. Para isso, queijos de Coalho de cabra foram condimentados com bebidas alcoólicas e realizadas análises físico-químicas e bacteriológicas no dia 0, além de análises sensoriais. Os potenciais consumidores esperavam estar pouco familiarizados com os derivados lácteos caprinos. Dentre os queijos condimentados, o queijo de Coalho de cabra com cerveja apresentou melhor aceitabilidade e intenção de compra, resultado que está associado ao consumo típico dessa bebida alcoólica por potenciais consumidores. As características macia e branca foram as mais enfatizadas pelos provadores, o que está de acordo com a cor e textura instrumentais. De acordo com a análise de componentes principais (ACP), os aromas e sabores ácidos e alcoólicos foram as características responsáveis pela aceitabilidade. Portanto, conclui-se que o queijo de cabra com bebida alcoólica pode ser elaborado e ter boa aceitabilidade.

Palavras-chave: Aceitabilidade, Análise Instrumental, Condimentação Alcoólica, Expectativa Do Consumidor, Leite De Cabra.

1 INTRODUCTION

Coalho cheese is a dairy product of great popularity, acceptance, consumption and production in Northeastern Brazil (Moraes et al., 2018). It is defined as " cheese obtained by coagulating milk by means of rennet or other appropriate coagulating enzymes, supplemented or not with the action of selected lactic bacteria and marketed normally with up to ten (10) days of manufacture" (Brazil, 2001). When obtained from goat's milk, it shows a drop in consumption and popularity due to the rejection that some consumers have towards goat cheese, which presents characteristic flavor and aroma, besides the nutritional characteristics, what makes goat milk an excellent substitute for bovine milk (Garcia and Travassos, 2012; Santos et al., 2012; Correia and Borges, 2009).

One way to mitigate rejection and attract new consumers is to flavor goat chesse with alcohol. Alcoholic beverages have a wide acceptance in the Brazilian national market, obtaining sales in 2014 of 13,501,241 million liters (IBGE, 2017). The most commercialized beverages are beer and *cachaça*, with the elaboration of craft drinks, what increases the supply and variety of such products in the market.

In light of that, potential beverages for seasoning in cheeses are liqueurs (a product obtained by mixing alcohol, water, sugar and substances which ensure aroma and flavor without fermentation in the production process) and mead (a product with alcoholic content of 4 to 14% by volume, at 20°C, obtained through alcoholic fermentation of bee honey solution, nutrient salts and drinking water), mainly for antioxidant properties,

adding a functional characteristic to the product as well as the strengthening of the craft production and thus the regional economy (Brazil, 2009; Carvalho, 2007; Efraim et al., 2011; Vieira et al., 2010). Hence, the seasoning of goat Coalho cheese with alcoholic beverages could help increase the variety of the dairy sector, boosting the regional economy. Its acceptability would contribute to its popularization and diffusion among consumers. Previously, Silva, Costa and Delfino (2017) carried out a study about the acceptability of goat Coalho cheese seasoned with *cachaça*, which gained good acceptability, with the concept "I liked it moderately". However, the authors did not assess the influence of seasoning on the physical, chemical and bacteriological characteristics of the cheese. Hence, from these results, the authors concluded that the development of new goat Coalho cheeses seasoned with different alcoholic beverages could increase the consumption of goat-derived products, encouraging the dairy sector of this species.

This way, in light of the possible benefits that the development of this product could bring, the present study sought to evaluate the effects of alcoholic seasoning on physicochemical, bacteriological and sensorial characteristics, drawing the profile of the consumer, as well as the acceptability and purchase intention towards seasoned cheeses.

2 MATERIAL AND METHODS

2.1 STUDY DESIGN

Sensory evaluation consisted of 2 steps (Figure 1). First, we evaluated the consumer profile and predictions of expected liking and expected familiarity using an online questionnaire (without consumption). Second, the best treatment was evaluated by global acceptability, purchase intention, the just-about-right scale (JAR) and the check-all-that-apply technique (CATA). Physicochemical parameters were analyzed to correlate with sensory data. Physicochemical analysis (pH, fat, moisture (n = 3), instrumental color (n = 4) and instrumental texture (n = 8)) and bacteriological analyses (n = 2) were performed in all samples.

Figure 1. Study Design.
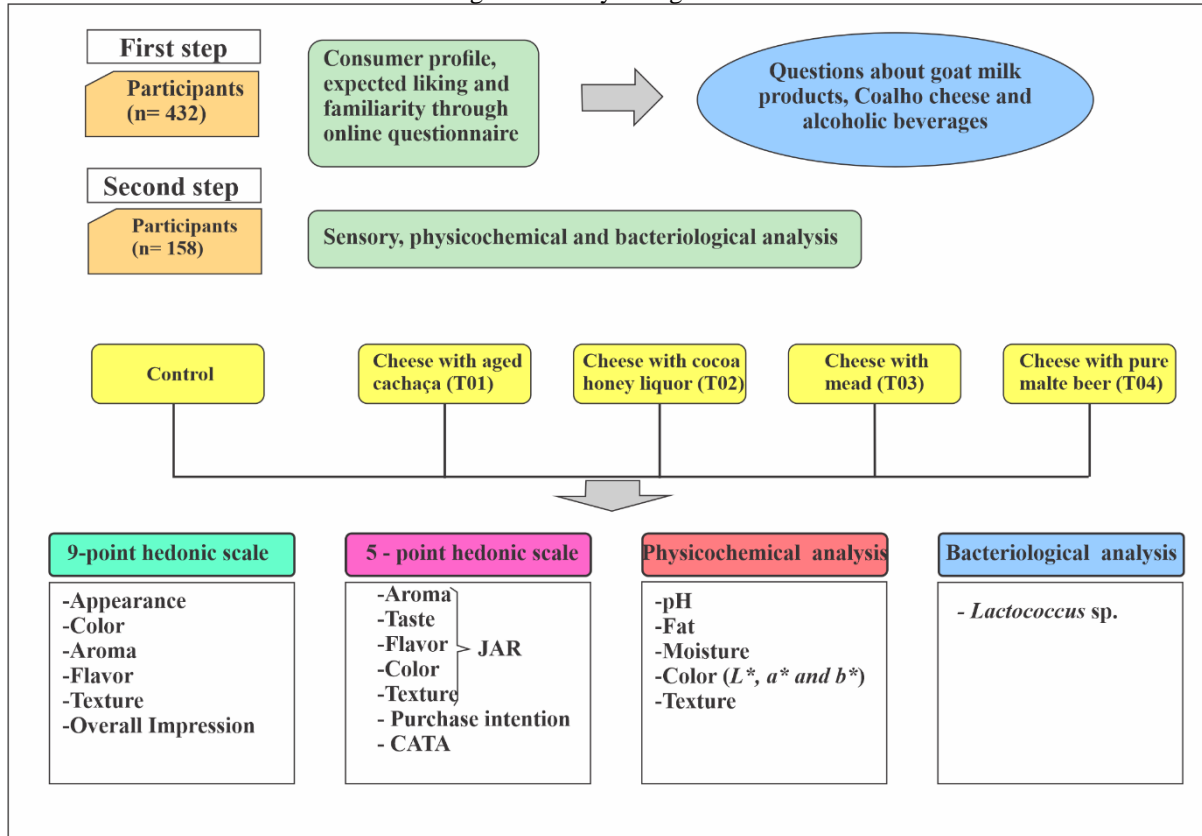
JAR = just-about-right scale; CATA = check-all-that-apply; *L** = lightness; *a** = redness; *b** = yellowness.

2.2 GOAT COALHO CHEESE PROCESSING

Coalho cheeses were elaborated at the Kadosh Dairy (Vila de Abrantes, Camaçari, Bahia, 12°48'03.0"S 38°17'41.0"W). For the preparation of 10 kg of Coalho cheese, 100 liters of goat milk was used (Saanen and Toggenburg breeds). The alcoholic beverages used were the aged *cachaça* (Cachaça de Abaíra®, Abaíra, Bahia), Cocoa Honey Liquor (Sabores da Cabrunca®, Camacan, Bahia), Mead (Sofia®, Salvador, Bahia) and pure malt Beer (Black Princess®, Petropólis, Rio de Janeiro).

Goat Coalho cheeses without seasoning (control) and seasoned with *cachaça* (T1), liquor (T2), mead (T3) and beer (T4) were elaborated. Goat milk was pasteurized (65 ° C / 30 min) and then cooled to 35°C. After heat treatment, Coalho cheese was prepared according to Silva, Costa and Delfino (2017). The pressing was carried out for 4 hours and the condimentation was performed after maturation for 3 days in a maturation chamber at 12ºC, by immersion for a period of 12 hours. The maturation occurred for another 7 days in a maturation chamber at 12ºC at the Kadosh Dairy. At the end of the processing, 2 Kg of cheese was produced for each treatment, corresponding to 8 units of 250g per treatment.

2.3 PHYSICOCHEMICAL ANALYSIS

Analyses of fat and moisture of the cheeses were carried out according to the methodology described in the "Official Methods of Analysis" in analytical triplicate. The fat analysis was carried out by the butirometric method for cheeses and the moisture by the gravimetric (AOAC, 2012), for the characterization of the final product (Day 0).

Determination of the pH was performed by electroanalytical method (Kasvi pH meter, K39-1014B, Brazil) in analytical triplicate (AOAC, 2012). Color and texture analyses were performed according to Andrade et al. (2007), using the Konica Minolta colorimeter (Chroma Meter CR5 model, United States) and the TA.XT Express Enhanced texturometer (Stable Micro Systems, Extralab Brazil), respectively. For color, parameters *a**, *b** and *L** were analyzed in analytical quadruplicate. The samples were cut into 5 cm x 5 cm cubes and placed in intact 75-mm Petri dishes for reading on the colorimeter. The reading was performed with the sample inside the Petri dish and on top of the light source. The entire system was covered with a dark film that did not allow the passage of external light into the system. For texture, the TPA was analyzed for the attributes of hardness, adhesiveness, elasticity, chewiness, gumminess, cohesiveness and resilience in analytical octoplicate. The samples were cut into 5 cm x 5 cm cubes and the pre-determined parameters were: cylindrical probe, 5 g (force), 1.0 mm/s (pre-test velocity), 2.0 mm/s (test velocity) and 10 mm/s (post-test velocity), 10 mm (distance) and 5 s (time). These analyses (pH, color and texture) were performed on day 3 of storage (third day after the complete maturation process).

2.4 BACTERIOLOGICAL ANALYSES

The count of *Lactococcus* sp. of the cheeses was performed using M17 Agar (Sigma-Aldrich cod. 63016-500G-F, Brazil) supplemented with lactose (Sigma-Aldrich cod. 63-42-3, Brazil) in analytical duplicate, incubated in an aerobic environment at 35°C/48 hours (APHA, 2015). This analysis was performed on day 3 of storage (third day after the complete maturation process).

2.5 SENSORY ANALYSIS

First, the profile of the consumers who are against the products was established through the Google Online Questionnaire. The category of answers to some questions related to consumer attitudes is of the likert type, using frequency ranges (daily to sporadically), familiarity (extremely familiarized to extremely unfamiliarized), taste (will

greatly like to will greatly disgust it) and yes or no, as well as open-ended questions such as the most consumed dairy products and beverages.

Cheese acceptance test was carried out at the Laboratório de Inspeção e Tecnologia de Leites e Derivados Lácteos (LaiTLácteos) at Escola de Medicina Veterinária e Zootecnia of Universidade Federal da Bahia (Campus Ondina, Salvador, Bahia) on day 3 of cheese storage (third day after the complete maturation process), in which 158 consumers were recruited on a random basis using as selection criteria that they are, preferably, habitual consumers of dairy products.

Tasters were instructed to evaluate the samples for appearance, color, aroma, flavor, texture and overall impression using a 9-point hybrid hedonic scale (1 = extremely disliked, 9 = extremely liked) (Drake, 2007) and the Just-About-Right scale (JAR) (Costa et al., 2017, 2015). Samples were provided coded and balanced for ordering sample delivery and did not influence the result. For the JAR scale, aroma (acid, alcoholic, fruity, caprine), taste (sweet, acid, salty and sour), flavor (fruity, malted, alcoholic, caprine), color (white, yellow, orange and brown) and texture (consistency, adhesiveness, hardness and chewiness) were evaluated by means of a 5-point JAR scale, which was anchored at both ends (1 = not enough to 5 = very much), with a center point at 3 (Costa et al., 2017, 2015). Participants also marked their intention to purchase on a 5-point scale, ranging from 1 = decidedly not to buy until 5 = decidedly to buy. In addition, purchase intention of products was evaluated, as well as the use of the Check-All-That-Apply technique (CATA) for the most frequent terms in the literature used in the description of cheeses.

2.6 STATISTICAL ANALYSIS

Results for physicochemical and sensorial analyses were performed by means of the analysis of variance (one-way ANOVA). Bacteriological analysis was performed with Kruskal-Wallis test, using a commercially available statistical package, the SPSS software (v. 17, Chicago IL, USA). Statistical significance was set at the 0.05 level of confidence ($p < 0.05$) using Tukey´s test. For the sensory analysis data, principal component analysis (PCA) was performed to visualize the parameters that were affected by the treatments. Factor analysis was used to verify whether the determinant parameters contributed positively or negatively to the general acceptability of the products elaborated. Also, in order to evaluate reliability of the questionnaires, Cronbach's alpha coefficient was used, which measures the correlation between the answers provided by

the interviewees. Kaiser-Meyer-Olkin (KMO) test was performed to evaluate the adequacy of the factorial analysis method to the data collected.

3 RESULTS AND DISCUSSION

3.1 PHYSICOCHEMICAL ANALYSES OF GOAT COALHO CHEESES

From the data obtained in the physicochemical analysis (Table 1), we were able to characterize the cheeses offered in the sensorial analysis as cheeses of fat and of medium moisture, what is in agreement with the current Brazilian legislation for this product (Brazil, 2001). However, is the results fo the analysis are also consistent with the values reported in the literature for goat cheeses, especially in relation to pH (Moraes et al., 2018; Oliveira et al., 2012; Pino et al., 2017). The pH revealed the typical acidification that occurs in cheese due to the presence of LAB. When the LAB count (*Lactococcus* sp.) was evaluated (Table 1), it was observed that the treatments with alcoholic beverages did not influence the viability of these bacteria in the cheeses. This result is consistent with the pH observed for all treatments, since *Lactococcus lactis* ssp. *cremoris* and *Lactococcus lactis* ssp. *lactis* convert lactose to lactic acid, thus accounting for the pH of the cheeses evaluated.

Table 1. Physicochemical parameters and Lactococcus sp. count of goat Coalho cheeses seasoned with alcoholic beverages.

Parameters	Treatment				
	Control	**T01**	**T02**	**T03**	**T04**
pH	6.65 ± 0.03^A	5.45 ± 0.04^B	5.28 ± 0.02^C	5.24 ± 0.01^C	5.35 ± 0.02^D
Fat (%)	26.67 ± 0.58^A	30.33 ± 0.29^A	29.50 ± 0.50^A	29.50 ± 0.87^A	28.17 ± 0.29^A
Moisture (%)	43.94 ± 1.09^A	40.01 ± 0.72^B	$40.95 \pm 0.26^{A, B}$	$42.35 \pm 2.51^{A, B}$	$42.38 \pm 0.37^{A, B}$
TDE (%)	56.06 ± 1.09^A	59.99 ± 0.72^B	$59.05 \pm 0.26^{A, B}$	$57.65 \pm 2.51^{A, B}$	$57.62 \pm 0.37^{A, B}$
FMDE (%)	$47.59 \pm 0.92^{A, B}$	$50.56 \pm 0.60^{A,B}$	$49.95 \pm 0.22^{A, B}$	51.24 ± 2.25^B	$48.89 \pm 0.32^{A, B}$
L*	81.73 ± 1.20^A	85.70 ± 0.90^B	86.31 ± 0.78^B	85.44 ± 1.22^B	85.31 ± 0.40^B
a*	$-3.00 \pm 1.16^{A, B}$	-2.56 ± 0.05^A	-2.47 ± 0.21^A	-2.66 ± 0.25^B	-2.62 ± 0.25^B
b*	16.37 ± 0.79^A	13.55 ± 0.32^B	13.59 ± 1.41^B	13.43 ± 0.91^B	14.33 ± 0.63^B
Lactococcus log CFU/g	7.26 ± 0.17^A	8.51 ± 0.33^A	11.71 ± 0.42^A	7.18 ± 0.16^A	8.52 ± 0.93^A
Hardness (g)	$786.62 \pm 53.72^{A, B}$	$763.32 \pm 102.19^{B, C}$	738.55 ± 62.15^B	700.19 ± 100.83^B	$490.39 \pm 41.97^{A, C}$
Adhesiveness (g.s)	-132.62 ± 29.04^A	$-284.34 \pm 90.33^{A, B}$	$-467.20 \pm 143.10^{A, B}$	-367.13 ± 118.33^A	-180.90 ± 84.44^B
Elasticity	1.20 ± 0.33^A	1.03 ± 0.09^A	1.00 ± 0.01^A	1.09 ± 0.34^A	1.04 ± 0.14^A
Chewiness	502.82 ± 119.18^A	348.76 ± 37.50^B	327.17 ± 40.75^B	335.47 ± 88.28^B	235.73 ± 26.43^B
Gumminess	420.50 ± 38.50^A	340.43 ± 45.55^B	328.19 ± 39.09^B	310.94 ± 48.96^B	226.29 ± 16.86^B
Cohesiveness	0.53 ± 0.03^A	0.45 ± 0.02^B	0.44 ± 0.03^B	0.44 ± 0.03^B	0.46 ± 0.02^B
Resilience	0.17 ± 0.01^A	0.09 ± 0.00^B	0.09 ± 0.00^B	0.09 ± 0.00^B	0.11 ± 0.00^B

*Letters indicate significant differences ($p < 0.05$) among samples.
TDE = Total Dry Extract; FMDE = Fatty matter in dry extract; *L** = lightness; *a** = redness; *b** = yellowness; T01 = cheese with *cachaça*; T02 = cheese with cocoa honey liquor; T03 = cheese with mead; T04 = cheese with beer.

Color analysis showed that the cheeses had high *L** values (Table 1), indicating high luminosity and tendency to white color, since the component *b** presented low values and the component *a** tended to green coloration. These results are in accordance with the coloration observed for goat Coalho cheese in another study (Queiroga et al., 2013; Silva et al., 2020a; 2020b).

Through the texture analysis (Table 1), we managed to observe that the control treatment obtained the highest values for all the texture attributes, presenting a significant difference in the hardness for samples T01, T02 and T03. These data do not corroborate with what is discussed in the literature because the control sample had the highest moisture obtained and cheeses with high moisture have their protein network weakened, making them a softer cheese (Buriti, Rocha and Saad, 2005). Texture parameters evaluated in the present study showed lower values than those found by Oliveira et al. (2012), with goat cheese added with bacteria from probiotic lactic acid.

3.2 BACTERIOLOGICAL ANALYSES OF GOAT COALHO CHEESES

In order to evaluate the count of *Lactococcus* sp., it was observed that the bacteria were able to develop, as evidenced by the agreement with the pH results. The observed LAB count is higher than in some studies reported in the literature. Pino et al. (2017), when carrying out the microbiological characterization of craft Nicastrese goat cheese by the M17 medium, found values lower than those of the present study. However, Bezerra et al. (2016), when evaluating goat Coalho cheese supplemented with bacteria from probiotic lactic acid, found values more similar to those observed here.

Anyway, the LAB count shows that the beverages used do not have any influence upon the growth of bacteria of the starter culture and, consequently, upon the characteristics of the cheese in the maturation process. LAB is an important bacterion in cheese technology once it has the ability to improve taste and texture of cheeses due to the incorporation of its metabolites generated during ripening (Souza and Dias, 2017).

3.3 SENSORY ANALYSIS
3.3.1 Consumer profile

The consumer profile was determined with an online questionnaire (Figure 2), which gathered 432 responses. It was observed that among those who answered the questionnaire, 56.4% were female and 43.6% were male. Mean age was 31.95 ± 11.09 years, with 40.6% with college level and 35.3% with post-graduation.

Figure 2. Chart of the consumer profile. The main answers obtained from consumers via an online questionnaire.
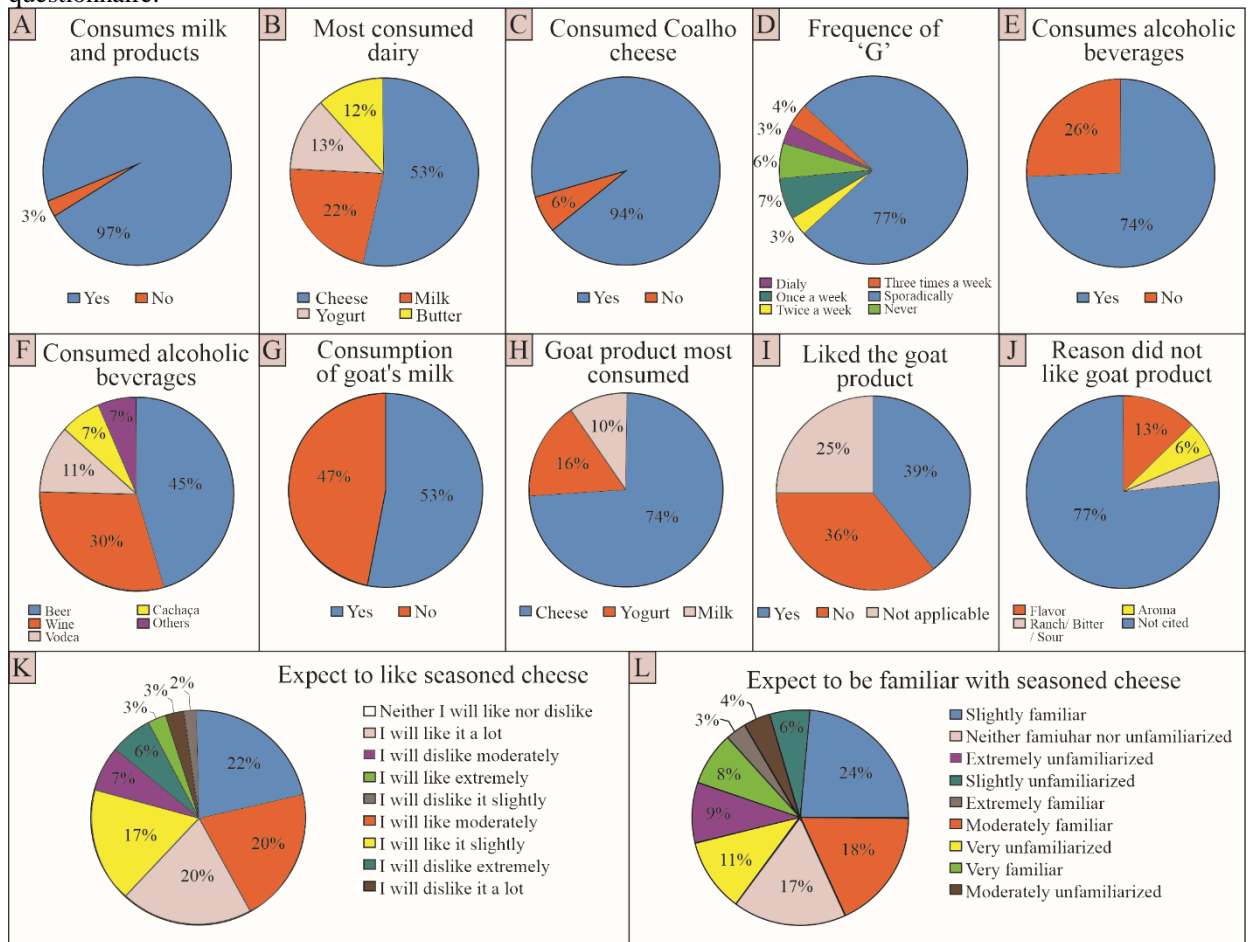
Most of the consumers (72.9%) have income of 1 to 5 minimum wages. 97.4% consume milk and dairy products, 66.8% of which consume daily, and cheese (54.5%) followed by milk (23.7%).

A large majority already consumed Coalho cheese (93.7%) and consumed it sporadically (77.0%); 63.1% never consumed seasoned Coalho cheese. When questioned about the consumption of alcoholic beverages, 74.2% said they consumed and that the most frequent beverages are beer (61.2%) and wine (40.3%), with sporadic consumption (39.9%) followed by consumption once a week (23.7%).

Regarding the consumption of milk and non-bovine products, 69.1% said they have consumed, 53.1% have already consumed goat milk and 78.6% have already consumed goat milk cheese. When asked whether they liked the milk goat derivative, 39.0% said "yes", 36.0% said "no" and 25.0% were not applicable. Of these, 12.9% did not like the flavor and 5.8% did not like the aroma. These data are in agreement with Correia and Borges (2009), who evaluated the position of consumers against the consumption of goat milk and dairy products in the city of Natal - RN, and observed that

decisive factors for people not to buy goat milk and dairy were the characteristic taste and odor, which cause rejection in non-habitual consumers due to the short chain of fatty acid profile, besides inadequate management conditions, such as the proximity of males and females during the lactation period.

About the expectation of goat cheese seasoned with alcoholic beverages, 21.8% will neither like nor dislike, 23.4% are expected to be slightly familiar with goat dairy products and 22.7% are expected to enjoy the characteristic flavor of goat-derived products moderately. As for the seasoning of cheeses with alcoholic beverages, 21.1% expected to be slightly familiar with this seasoning and 21.6% expected to enjoy moderately the characteristic flavor of alcoholic beverages in cheeses. These data are consistent with what is already described in the literature, since many people are unaware of the goat milk and milk products, mainly due to the lack of the product in markets and the high price of the final product, a result of the commercialization and restricted industrialization that penalizes the activity. The same can not be said of the alcoholic beverages: although 74.2% consume alcohol among the interviewed, 21.1% are expected to be slightly familiar. This response profile may be associated with the fact that the people do not routinely consume goat Coalho cheese. Also, even knowing the alcoholic beverages, its association with goat-derived products is not habitual and for this reason people would not be keen to the taste. Consequently, they are expected to enjoy it moderately (21.6%).

3.3.2 Acceptability and purchase intention

Regarding the profile of tasters who participated in the sensory analysis, of the 158 testers, more than half, 66.3% (106), were female and 31.5% (52) were male. The minimum age of the interviewees was 18 years and maximum age was 69 years, benig an average age of 26 years ± 9.6 years. 12% were 21 and 25 years old, 10% were 23 years old and 6.3% were 18 and 19 years old.

When questioned about the consumption of Coalho cheese, 50% of tasters consume Coalho cheese once a month and approximately 16% consume it once a week. Regarding alcohol consumption, 81.3% of tasters said they consume alcoholic beverages and 17.5% said they do not. Of those interviewed who consume alcoholic beverages, 33.8% reported that they drink alcoholic beverages once a week and 21.9% answered that they do that once a month.

The results of acceptability test of the sensory attributes related to the acceptance test of goat Coalho cheese seasoned with alcoholic beverages are presented in Table 2.

Table 2. Acceptability and purchase intention of goat Coalho cheeses seasoned with alcoholic beverages.

Treatment	Attributes						
	Appearance	Color	Aroma	Flavor	Texture	Overall Impression	Purchase intention
Control	6.32 ± 2.02^A	6.34 ± 1.98^A	5.90 ± 2.14^A	6.97 ± 2.07^A	7.13 ± 1.86^A	6.82 ± 1.90^A	3.70 ± 1.24^A
T01	6.73 ± 1.81^B	6.87 ± 1.66^B	6.69 ± 1.79^B	5.95 ± 2.29^B	6.38 ± 2.00^B	6.30 ± 1.91^B	3.23 ± 1.23^B
T02	7.65 ± 1.31^C	7.73 ± 1.24^C	6.85 ± 1.77^B	6.08 ± 2.23^B	6.70 ± 1.91^B	$6.54 \pm 1.97^{A, B}$	3.41 ± 1.28^B
T03	7.31 ± 1.38^C	7.37 ± 1.34^C	6.32 ± 1.79^B	5.46 ± 2.26^C	6.33 ± 1.88^B	5.94 ± 1.92^B	2.91 ± 1.27^B
T04	7.55 ± 1.32^C	7.54 ± 1.41^C	6.73 ± 1.62^B	6.47 ± 1.97^B	7.00 ± 1.68^A	6.73 ± 1.77^A	3.42 ± 1.15^B

* Letters indicate significant differences ($p < 0.05$) among samples.
* Purchase intention was evaluated on a structured 5-point hedonic scale, whereas the other attributes were evaluated on a 9-point hedonic scale. T01 = cheese with *cachaça*; T02 = cheese with cocoa honey liquor; T03 = cheese with mead; T04 = cheese with beer.

Among the attributes for acceptability and samples made available to the tasters, the T02 sample had the highest means for appearance (7.65 ± 1.31), color (7.73 ± 1.24) and flavor (6.85 ± 1.77). The control had the highest means for flavor (6.97 ± 2.07), texture (7.13 ± 1.86) and overall impression (6.82 ± 1.90). In general, the cheeses had acceptability between 6 and 7, determining the acceptance between "liked slightly" and "moderately liked". These results were similar to those reported by Silva, Costa and Delfino (2017), who evaluated the acceptability and purchase intention of goat Coalho cheese seasoned with *cachaça* and Souza et al. (2011) with goat Coalho cheese seasoned with cumaru. However, the mean figures for taste acceptability and overall impression were considerably lower, possibly justified by the unfamiliarity of tasters with the combination of beverages and goat-derived products.

This lower acceptability of cheeses seasoned with alcoholic beverages may also be due to the alcoholic content present in cheeses, which may have disguised the flavor of the samples of Coalho cheeses tested. Beverages were added to the preparation of the cheeses to soften the characteristic flavor and odor of goat-derived products, which are reasons for rejection of goat dairy by potential consumers. However, alcoholic taste may have exceeded the ideal for greater acceptability of the cheeses. Nevertheless, in the study of Oliveira et al. (2012), with sensorial analysis of goat Coalho cheese added with bacteria from probiotic lactic acid and without seasoning, the authors obtained lower values, what indicates that the seasoning enhances the acceptance of goat Coalho cheese.

Regarding purchase intention (Table 2), it differed significantly among the samples. The cheese that obtained the highest purchase intention was the control (3.70 ±

1.24) and the lowest was T03 (2.91 ± 1.27). Possibly, this result is due to the alcoholic content of the seasonings, which may have overlaid the taste of the cheeses and was over-felt by the tasters.

When analyzing the results obtained in the ideal scale (JAR) (Table 3), all samples presented values close to 3, indicating that the sensorial attributes were within the ideal for all samples. Among treatments, the control sample was the one that differed significantly from the others regarding acid taste, alcoholic flavor and aroma, white color and consistency, presenting lower values than the ideal for the first two attributes and ideal value for the latter. The highest values were for T01 (3.49 ± 0.88) and T02 (3.51 ± 0.86) in acid taste, T03 (3.22 ± 0.95) in acid flavor and T01 (3.39 ± 0.97) in alcoholic flavor. The lowest value was for the control for alcoholic aroma (2.35 ± 0.96) and alcoholic flavor (2.28 ± 0.87), indicating that the tasters were able to distinguish the sample that did not contain alcoholic seasoning.

Table 3. Results of the JAR analysis for goat Coalho cheeses seasoned with alcoholic beverages.

Treatment	Aroma			
	Acid	**Alcoholic**	**Fruity**	**Caprine**
Control	2.83 ± 0.83^A	2.35 ± 0.96^A	2.56 ± 0.99^A	2.94 ± 1.05^A
T01	3.20 ± 0.83^B	3.17 ± 0.91^B	2.64 ± 0.84^A	2.73 ± 0.90^A
T02	3.28 ± 0.80^B	2.99 ± 0.97^B	2.69 ± 0.87^A	2.96 ± 0.82^A
T03	3.33 ± 0.85^B	3.22 ± 0.95^B	2.73 ± 0.95^A	2.92 ± 0.81^A
T04	3.13 ± 0.71^B	3.02 ± 0.82^B	2.68 ± 0.92^A	2.92 ± 0.79^A

Treatment	Taste			
	Sweet	**Acid**	**Salty**	**Sour**
Control	3.05 ± 0.90^A	2.72 ± 0.72^A	2.76 ± 0.78^A	0.77 ± 0.84^A
T01	2.45 ± 0.92^B	3.49 ± 0.88^B	3.02 ± 0.69^B	3.08 ± 0.97^B
T02	2.70 ± 0.87^B	3.51 ± 0.86^B	3.11 ± 0.72^B	3.19 ± 0.86^B
T03	2.61 ± 0.87^B	3.44 ± 0.96^B	2.98 ± 0.77^B	3.13 ± 1.05^B
T04	2.77 ± 2.57^B	3.37 ± 0.75^B	3.07 ± 0.66^B	3.16 ± 0.82^B

Treatment	Flavor			
	Fruity	**Maltado**	**Alcoholic**	**Caprine**
Control	2.73 ± 0.96^A	2.56 ± 0.84^A	2.28 ± 0.87^A	2.99 ± 0.91^A
T01	2.66 ± 0.84^A	2.91 ± 0.93^B	3.39 ± 0.97^B	2.90 ± 0.88^A
T02	2.68 ± 0.91^A	2.98 ± 0.92^B	3.16 ± 1.07^B	2.96 ± 0.85^A
T03	2.77 ± 0.92^A	3.04 ± 0.92^B	3.35 ± 1.08^B	2.97 ± 0.79^A
T04	2.70 ± 0.90^A	2.94 ± 0.90^B	3.20 ± 0.95^B	2.99 ± 0.81^A

Treatment	Color			
	White	**Yellow**	**Orange**	**Brown**
Control	2.88 ± 0.84^A	3.00 ± 0.95^A	2.34 ± 1.02^A	2.39 ± 0.99^A
T01	3.04 ± 0.76^B	2.76 ± 0.96^A	2.41 ± 0.96^A	2.49 ± 0.98^A
T02	3.35 ± 0.77^B	2.54 ± 0.90^A	2.35 ± 0.93^A	2.41 ± 0.96^A

Treatment				
T03	3.09 ± 0.71^B	2.67 ± 0.90^A	2.41 ± 0.96^A	2.45 ± 0.95^A
T04	3.18 ± 0.65^B	2.72 ± 0.90^A	2.36 ± 0.93^A	2.37 ± 0.95^A
Treatment	**Texture**			
	Consistency	**Adhesiveness**	**Hardness**	**Chewiness**
Control	3.25 ± 0.82^A	3.04 ± 0.79^A	3.13 ± 0.80^A	3.06 ± 0.79^A
T01	2.94 ± 0.79^B	2.96 ± 0.74^A	2.97 ± 0.76^A	3.02 ± 0.75^A
T02	$3.09 \pm 0.75^{A, B}$	3.06 ± 0.71^A	3.00 ± 0.71^A	3.09 ± 0.73^A
T03	$3.07 \pm 0.81^{A, B}$	3.01 ± 0.72^A	3.13 ± 0.76^A	3.07 ± 0.84^A
T04	$3.02 \pm 0.78^{A, B}$	2.99 ± 0.70^A	2.94 ± 0.77^A	3.05 ± 0.75^A

* Letters indicate significant differences ($p < 0.05$) among samples.
T01 = cheese with *cachaça*; T02 = cheese with cocoa honey liquor; T03 = cheese with mead; T04 = cheese with beer.

Analyzing data of CATA (Board 1), the terms that best define the samples according to the tasters are soft, white and bright for the control; white, alcoholic taste and acid taste for T01; white, soft and color homogeneity for T02; white, alcoholic and bright for T03; white, bright and soft for T04. These results are in agreement with the instrumental analysis, which characterized the cheese as whitered and with lower values for the TPA attributes. Softness was a characteristic observed by tasters in all samples through CATA, being more predominant in the control, T02 and T04 samples. Of these, the sample that was best correlated with the perception of tasters was T04, which instrumentally obtained the lowest values of hardness among the treatments. Moraes et al. (2018) also find the CATA profile similar to the one in the present study, with the white color and softness as the characteristics most frequently indicated by the tasters.

Board 1. CATA result

Treatment	Most frequent terms (number of markings)
Control	Soft (86); White (82); Bright (79); Consistent (76); Coalho cheese aroma (69); Coalho cheese flavor (62); Yellow (52); Caprine flavor (47); Buttery flavor (46).
T01	White (102); Alcoholic flavor (86); Acid taste (75); Soft (72); Consistent (64); Bright (62); Alcoholic aroma (61); Color homogeneity (49); Acid aroma (46); Coalho cheese aroma (46).
T02	White (121); Soft (87); Color homogeneity (85); Bright (73); Alcoholic flavor (69); Consistent (69); Acid taste (64); Humid (48); Melting in the mouth (48).
T03	White (104); Alcoholic flavor (91); Bright (74); Color homogeneity (68); Acid taste (67); Soft (62); Consistent (61); Alcoholic aroma (60); Acid aroma (50); Coalho cheese aroma (44).
T04	White (116); Bright (90); Soft (86); Color homogeneity (80); Alcoholic flavor (70); Acid taste (63); Coalho cheese aroma (62); Consistent (61); Humid (48); Alcoholic aroma (47).

T01 = cheese with *cachaça*; T02 = cheese with cocoa honey liquor; T03 = cheese with mead; T04 = cheese with beer.

For the Principal Components Analysis (PCA), Cronbach's alpha coefficient calculated for the variables of the questionnaire was 0.841. Cronbach's alpha value was considered sufficient for the validation of the collection instrument. Thus, the main components can be evaluated by extracting the eigenvalues and percentage of the

explained variance. In addition, Kaiser-Meyer-Olkin test (KMO) obtained a value of 0.72, highlighting the adequacy of the factor analysis method to the data collected.

From the eigenvalues and graphs generated, the treatments obtained three components as the main responsible for the variability of the samples. In addition, through the Principal Components Analysis, it was possible to determine the main variables that interfere in each sample (Figures 3 and 4).

From the Principal Components Analysis (Figure 3), the control sample was the one that obtained the best result considering the attributes of acceptability and purchase intention, indictaed by the higher means that this treatment obtained. Among the treatments with seasoning, goat Coalho cheese seasoned with beer was the sample that showed greater acceptability and purchase intention. That is due to the fact that the tasters are more accustomed to drinking beer, as shown in the consumer profile. Thus, among the seasoned cheeses, the one of better acceptability was T04 followed by T02. Both samples were more influenced by texture, aroma, taste, overall impression and purchase intention.

Figure 3. PCA plot illustrating the results of the Principal Components Analysis of the acceptability and purchase intention of the samples of Coalho cheeses analyzed.
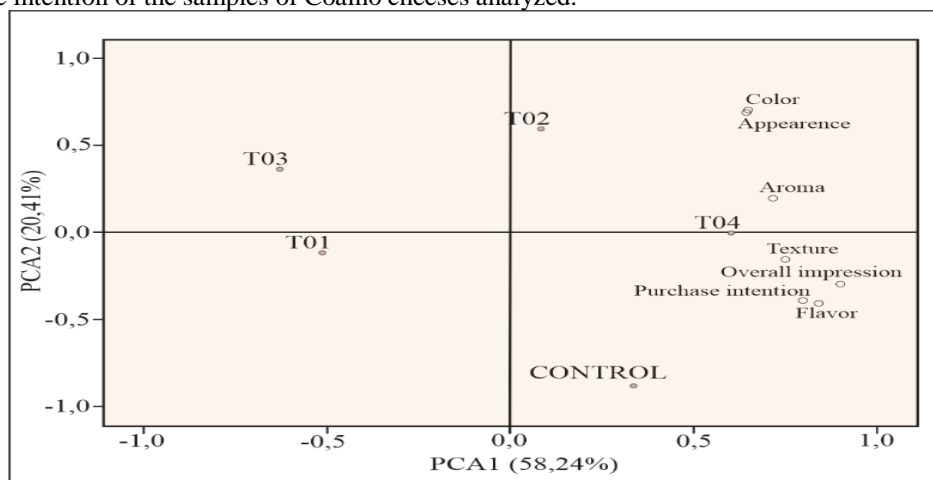

According to the PCA analysis for the JAR scale (Figure 4), the characteristics of the cheeses that most contributed to acceptability and purchase intention results were observed. T02, T03 and T04 samples were the most influenced by white color and alcoholic aroma and flavor. This behavior highlights the perception of the tasters regarding the seasonings, once they were able to distinguish them accurately in relation to the control. Of the samples that had lower acceptability, T01 and T03, this result was due to the sour and acid taste, alcoholic aroma and flavor, sweet taste and fruity aroma,

which according to the Principal Components Analysis, were the characteristics that most negatively influenced these samples.

Characteristics of texture and color, by representation of PCA, did not significantly influence the samples. This result is in agreement with the JAR analysis, since it presented a profile close to the ideal for color and texture characteristics and above the ideal for flavor and alcohol aroma, which greatly influenced the analyses with less acceptability described. In addition, the color that stands out closest to the samples is the white color, which corroborates the results of instrumental color and CATA responses, showing that seasoned goat Coalho cheeses have predominantly white color.

Figure 4. PCA plot illustrating the results of the Principal Components Analysis.
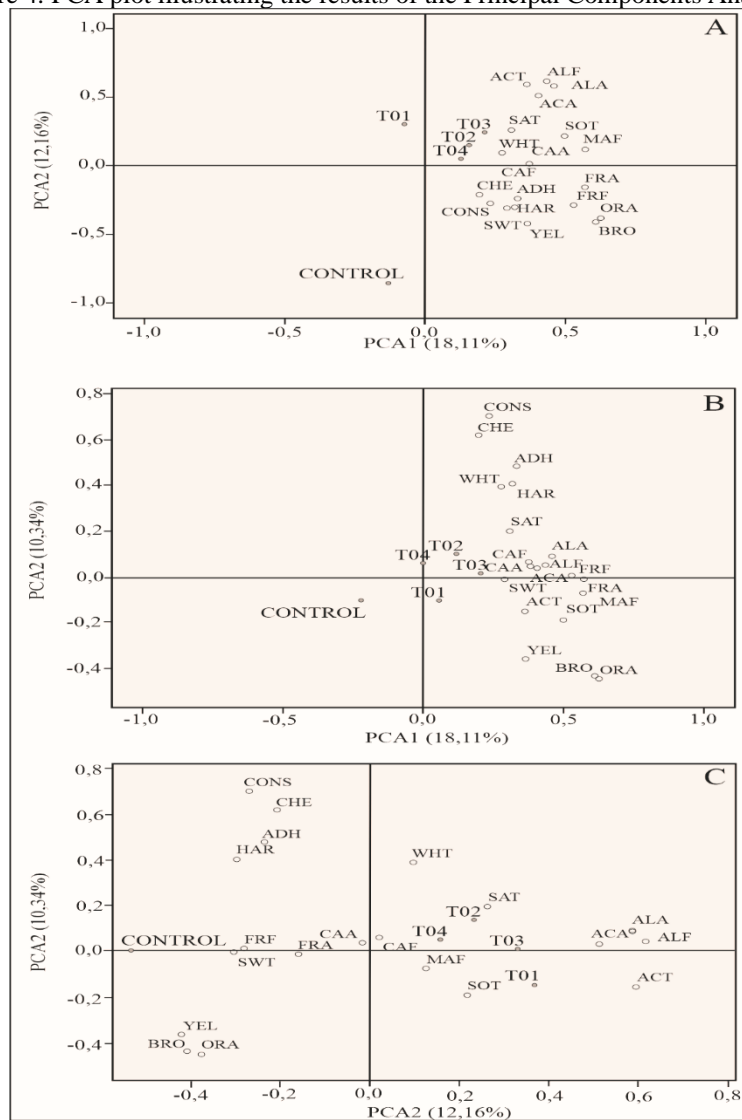
ACA = Acid aroma; ALA = Alcoholic aroma; FRA = Fruity aroma; CAA = Caprine aroma; SWT = Sweet taste; ACT = Acid taste; SAT = Salty taste; SOT = Sour taste; FRF = Fruity flavor; MAF = Malty flavor; ALF = Alcoholic flavor; CAF = Caprine flavor; WHT = White; YEL = Yellow; ORA = Orange; BRO = Brown; CONS = Consistency; ADH = Adhesiveness; HAR = Hardness; CHE = Chewiness.

4 CONCLUSIONS

The seasoning of cheeses with alcoholic beverages influences the physicochemical, bacteriological and sensorial characteristics of the cheeses. However, it does not characterize them against the values recommended in their technical regulation.

Consumers' expectation of boiled goat cheese seasoned with alcoholic beverages is in the mood for and will not be disgusted. They are expected to be slightly familiar with goat dairy products and are thus expected to moderately enjoy the characteristic flavor of goat-derived products. As for the seasoning of cheeses with alcoholic beverages, they are expected to be slightly familiar with this seasoning and are expected to moderately enjoy the taste of alcoholic beverages in cheeses.

Among the treatments evaluated, the control had the best acceptability and purchase intention, a result that is associated to the alcoholic content present in seasoned cheeses. All treatments were close to the ideal by JAR and the white and soft characteristics were the most highlighted by the tasters of the sensory analysis, what is in agreement with the results of instrumental color and texture. According to the PCA analysis, acid aroma, alcohol aroma, acid taste and alcoholic flavor were the characteristics responsible for the lower acceptability of seasoned cheeses versus control. Among seasonings, the samples with cocoa honey liquor and beer obtained the best results, indicating that alcoholic seasoning is a way of diversifying goat Coalho cheese in the dairy market with still good acceptability towards potential consumers.

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Declaration of Competing Interest

The authors declare that the research was conducted without any commercial or financial relationship that could be constructed as a potential conflict of interest. All authors read and approved the final manuscript.

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