Original scientific paper
UDC 637.352.05:635.71

DEVELOPMENT AND CHARACTERIZATION OF A EWE'S CREAMY CHEESE WITH AROMATIC PLANTS

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Abstract

This work aimed at developing a new dairy product, made of ewe's milk that cannot be used for making the Serra da Estrela cheese (with Protected Designation of Origin) for not filling the exact specifications. In this way are allied economic with environmental advantages. Because this unusable milk represents economic loss for the producers while at the same time increasing the volume of effluents that need treatment, this alternative usage allies economic with environmental advantages.

A total of 19 samples were produced, and these developed creamy cheeses were evaluated according to formulation and conservation properties, and then submitted to a sensory evaluation and finally analysed in terms of physico-chemical microbiological and nutritional properties. The 19 formulations were tested to optimize formulations that would be acceptable in organoleptic terms as well as conservation capacity, under refrigeration, for an observational period of 3 weeks. This essay allowed selecting 5 versions of the product that showed best conservation capacity, which were then submitted to sensory evaluation. The sensory analyses involved two types of tests: descriptive sensory profile and preference test, and the obtained results allowed selecting the 2 best formulations as those most appreciated and with potential for commercialization: a control cheese and one with oregano, which were then analysed. Microbiological analyses were undertaken to verify if the products met the legally established microbiological limits, namely for assessing the presence of coagulase-positive staphylococci (*Staphylococcus aureus*) and *Escherichia coli*. Moisture, protein, lipids, salt and carbohydrates were analysed by Fourier transform near-infrared (FT-NIR) spectroscopy method and antioxidant activity was evaluated by reaction with the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical.

Chemical composition revealed two similar products, but the sample with oregano had higher antioxidant activity as compared with control (70.96 ± 0.36 and 64.99 ± 2.74 mg/L TE, respectively). From the microbiological point of view both products were considered safe, with values of staphylococci and *E. coli* under the applicable regulation limits. In terms of nutritional value, both sample shave high protein content (11.9 and 11.4 g/100 g, respectively for control and sample with oregano) but also high fat (13.9 and 12.3 g/100 g, respectively for control and sample with oregano) while being low in sugars (3.4 and 3.8 g/100 g), fiber (< 1%) or salt (< 1%). Energy of both samples was found to be 186 kcal/100 g for the control and 172 g/100g for sample with oregano.

In conclusion, in nutritional terms the samples could be considered safe High Protein content foods. Moreover, as dairy products contain almost all the essential nutrients, the developed creamy cheeses should be consumed as part of a balanced diet. Finally, the pro-

duction of these products allows the utilization of the milk that otherwise would have to be discarded, so bringing economic profit while at the same time minimizing the need to process it as effluent.

Key words: *Antioxidant activity, Nutrition, Safety, Sensory evaluation, Soft cheese.*

1. Introduction

The food industry tends to promote the emergence of innovations in the food sector and, particularly, the creation of new food products with improved nutritional value and associated with high sustainability. Considering these innovations of great interest for human nutrition worldwide, they make it possible to guarantee nutritional quality associated with food security, that is an increasingly priority in developed and developing countries [1].

The new trends in the search for healthier and more functional foods, bring new challenges into the food industry, forcing companies to be increasingly efficient, researching and developing new food products, combining the demanding needs of consumers, industry and the market, with healthier foods that are better accepted by the general population. In fact, today´s consumers are increasingly aware of the importance of quality and functionality of food products, and a balance must still be found between consumer expectations regarding the product and its positioning regarding the market competitors [2].

The growing concern with environmental preservation and the search for a healthier lifestyle, combined with movements of support for local producers, has driven the expansion of companies aimed at the production and commercialization of regional products, thus gradually changing the eating patterns of regional populations [3]. For the consumer there is an increasing importance in the search for products of local or regional origin and in products of traditional character or image. These may derive from the opposition to globalization and industrialization in the manufacture of food. Within this, movements such as "Slow Food" emerged that advocate the promotion and preservation of local food culture, regional culinary traditions and traditional methods of cultivation, production and even food preparation, thus justifying the demand for local foodstuffs, organic and pesticide-free, instead of food produced in intensive systems [3].

According to the current PDO (Protected designation of Origin) Specifications, Serra da Estrela cheese is the product obtained by slow depletion of the curd, after coagulation of raw ewe's milk from the females of the indigenous authorized breeds Bordaleira Serra da Estrela and Churra Mondegueira, by the action of the natural coagulant obtained from the thistle flower (*Cynara cardunculus* L.), from the geographical area of production of this traditional cheese [4 - 7]. The processing of Serra da Estrela cheese includes the raw milk coagulation followed by maturation, using the three essential raw materials: ewe's milk, thistle flower and salt [8].

Following the objective of creating a new product, it was intended to take advantage of ewe's milk that can't be used for making Serra da Estrela cheese, for not filling the exact specifications, thus bringing economic as well as environmental advantages, allowing minimization of residues while at the same time producing added income by offering the market added value end-products. In addition to this main objective, it is also intended to maintain a certain degree of tradition and rationality to the new product, but innovating and valuing it through improved nutrition. It is expected that the development of a new food, a ewe's creamy cheese based on a regional product, will allow not only to offer a new option to the dairy foods´ market, but also to value its traditional in heritage, associated with typicality and naturalness. In the current gastronomic field, which is increasingly globalized, the elements of tradition are expected to become a selling point while also responding to market expectations [9, 10]. The developed creamy cheese was also characterized and evaluated from a sensory point of view.

2. Materials and Methods

2.1 Product development

The creamy cheese produced is intended to follow a very similar path with the traditional Serra da Estrela cheese, using similar ingredients, but slightly changing the process and ingredients. The product under study was tested with successive formulations and processing methodologies, until achieving a specific type of product: a spread cheese with a creamy, homogeneous and aromatic texture and flavour. After some initial attempts, the process was optimized as follows: 1. The milk, 2.5 L, was pasteurized at 65 ^{0}C for 15 minutes; 2. It was allowed to cool for 1 hour and then heated to 38 ^{0}C; 3. To the milk was added 1.25 g of dried thistle flower and 12.5 g of salt; 4. It was allowed to coagulate for 1 hour at room temperature; 5. After curding, the serum was drained manually; 6. The curd mass was then homogenised in a mixer; 7. The obtained mass was used to produce different types of product according to the desired added ingredients, and also a control sample was used without addition of extra ingredients.

The added ingredients were:

- Locust bean gum (E410), as stabilizer.
- Fusion salts (E450; E451; E452), as texture enhancers.
- Spices and herbs, as flavourings and antioxidants improving shelf life stability: lemon balm, oregano,

saffron, baccharis (*Baccharis trimera*, also known as carqueja).

- Honey, as flavouring and sweetener.

A total of 19 samples were produced (Figure 1), which were then evaluated, namely in terms of main desired characteristics and possible conservation, resulting in five acceptable samples that were then submitted to sensory evaluation. Table 1 shows the formulation of the five most promising samples.

2.2 Shelf life essays

The creamy cheese samples produced were left under refrigeration at a controlled temperature between 4 and 6 ^{0}C for periods of 1, 2 and 3 weeks for follow-up on of their properties and evaluation of stability and conservation capacity. Only the samples that proved to have desired organoleptic characteristics and higher conservation capacity were then taken to the next stage of sensory evaluation.

2.3 Sensorial analyses

The sensory analyses involved two types of tests: descriptive sensory profile and preference undertaken on a total of five versions of the product, that showed best conservation capacity, and whose formulations were presented in Table 1. For this was used a non-trained panel of judges, simulating consumers, but consisting of members with previous experience in discriminative tests. The panel members were 15, aged between 18 and 51 years. This type of panel was used for two types of reasons, on one hand due to limitations in time and financial availability, while on the other hand was intended to simulate the behaviour of common consumers. In fact, presently it is recognized that the gap between trained and consumer panels has greatly diminished [11] in view of certain objectives pursued.

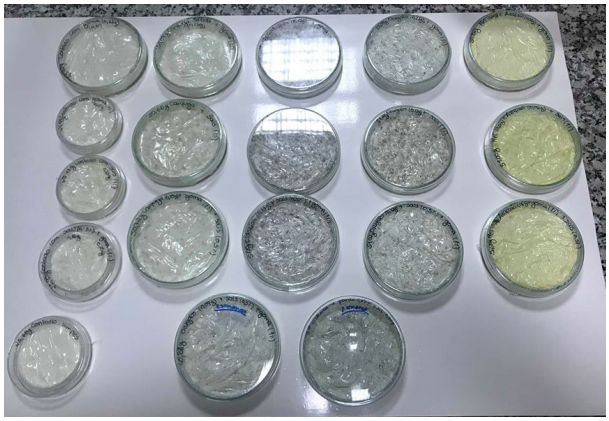

Figure 1. The 19 samples produced before storage under refrigeration

The samples were presented to the judges coded randomly, to avoid any kind of association to the product's characteristics. They were served right after removing from the refrigerator and placed in small plastic odour-free recipients for the judges to evaluate. Deionised water was provided for palate rising in-between the samples. The sensory attributes evaluated were divided into categories. For visual aspect were evaluated the following characteristics: appearance, colour and general aspect. The aroma was evaluated in terms of: aroma to cheese, aroma to herbs, flower aroma, sweet aroma and general appreciation of aroma. Taste was evaluated considering: salty, acid, sweet, bitter, cheese, herbs, flowers and general appreciation of taste. For texture were evaluated the properties: creamy, firm, granulated, soft, juicy, greasy and general appreciation of texture. Also the global appreciation of the samples was assessed and finally the buying intention was assessed. The panellists evaluated the samples individually for each attribute, using a numeric increasing scale for intensity, with values ranging from 1 to 5, being 1 the least and 5 the most perceptible quantification for each attribute.

Also, a preference test was performed, in which the panellists were asked to rate the five products according to their preference regarding the following char-

Table 1. Formulation of the samples selected for the phase of sensory evaluation

Ingredients	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Basic creamy cheese recipe (g)	*345*	*345*	*345*	*345*	*323*
Pasteurized ewe's milk (%)	99.45	99.45	99.45	99.45	99.45
Thistle flower (%)	0.05	0.05	0.05	0.05	0.05
Salt (%)	0.5	0.5	0.5	0.5	0.5
Additional ingredients					
Locust bean gum (g)	1.8	1.8	1.8	3.2	1.8
Fusion Salts (g)	1.0	1.0	1.0	1.6	1.0
Lemon balm (g)		1.8			
Baccharis (g)					0.8
Oregano (g)			0.8		
Saffron (g)				0.4	
Honey (g)				3.2	

acteristics: preference for appearance, preference for taste and general preference. In this case the panellists had to rate comparatively each of the samples on a scale from 1 - less preferred to 5 - most preferred.

2.4 Chemical and microbial analyses

Sensory evaluation allowed narrowing the number of samples from five to only two who were then submitted to further analyses.

In order to assess the pathogenic microbial flora of the creamy cheeses under study (the two samples preferred by "consumers" in the sensory analysis test), microbiological analyses were carried out to evaluate the acceptability of the products with respect to the legally established microbiological limits according to the European Commission Regulation (EC) No 2073/2005. For this, it was undertaken the inoculation of the two samples (sample 1 - basic creamy cheese (Control) and sample 3 - creamy cheese with oregano) in two culture mediums:

- Baird-Parker culture medium, in order to assess the presence of coagulase-positive staphylococci (*Staphylococcus aureus*);
- TBX culture medium, using the surface sowing method, in order to assess the presence of *Escherichia coli*.

Moisture, protein, lipids, salt and carbohydrates were analysed by Fourier transform near-infrared spectroscopy (FT-NIR) spectroscopy method, which is a recently established method and applied in the quality control of all sectors, including food and particularly dairy products [12 - 14]texture, and flavor (rancid and pungent. This method offers a practical alternative to commonly used, more time consuming methods, such as wet method and chromatography techniques. FT-NIR is a non-destructive method, which uses infrared, and does not require the preparation of the sample or dangerous chemicals, providing agility and reliability to the quantitative and qualitative analysis. It is an ideal method for the rapid identification of raw materials, it is reproducible and with low cost per analysis when compared to conventional techniques and it is also a tool capable of performing the quantitative analysis of multicomponents in a precise manner and in a short period of time [15]. In these samples fat, protein, carbohydrates, minerals (including salt) and moisture content were determined by FT-NIR. In all cases the average values of triplicates were considered.

One of the most popular methods used to evaluate the antioxidant activity of specific extracts or compounds, is based on the reaction with the radical (DPPH, 2,2-diphenyl-1-picryl-hydrazyl): DPPH• + AH → DPPH-H + A•. In its radical form, DPPH absorbs at a wavelength of 515 nm, while its reduced form does not have this capacity. The DPPH molecule is characterized as a stable free radical due to the displacement of the unpaired electron throughout the molecule. This relocation gives this molecule a violet colour. This test is based on measuring the antioxidant capacity of a given substance in sequestering the DPPH radical by reducing it to hydrazine. The DPPH solution used had and absorbance of 0.700. To a tube were added 0.1 mL of sample and 2 mL of DPPH solution previously prepared and then the tube was placed in a dark place at room temperature for 30 minutes. A blank was used by replacing the sample with 0.1 mL of distilled water. The absorbance was measured at a wavelength of 515 nm. The calibration curve was obtained with different concentrations of Trolox [16, 17].

2.5 Nutritional labelling

A nutritional evaluation was carried out based on the ingredients used for each product and considering their contributions in terms of nutrients and energy according to the Nutritional Table of the Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA) (Lisbon, Portugal), which is based on the calculation method EuroFIR, and applicable European Regulations for calculation of energy and salt.

For the two samples of creamy cheese preferred by "consumers" in the sensory analysis test a nutritional evaluation was carried out based on the centesimal composition determined by FT-NIR spectroscopy method. For calculation of the energy content of creamy cheeses Atwater general factor system was used. Saturated lipids and fibre were obtained based on the ingredients used and according to the Nutritional Table of the Instituto Nacional de Saúde Doutor Ricardo Jorge (INSA) (Lisbon, Portugal). To establish serving size we used the Portuguese current legislation: Grupo de Trabalho Porções - GTP, Guia Orientativo para o Estabelecimento de Porções para a Rotulagem Nutricional [18].

3. Results and Discussion

The 19 formulations tested produced creamy ewe's cheeses with variable characteristics and an initial screening was made based on appearance, texture, aroma and taste, and the possible influence of the ingredients used and their concentrations. After 1 week it was observed that all samples were well preserved. Nevertheless, different characteristics were observed. The control sample (basic recipe only with milk, thistle and salt) showed a genuine flavour to ewe's milk. The control with 0.5% locus bean gum had a better texture while the control with 1% fusion salts was too hard, and the same happened for control with 0.5% salts. The samples with oregano and 1% gum showed an adequate texture and a pleasant taste, but the sam-

ple with oregano and 1% salts did not present an acceptable texture. The baccharis was found to give a pleasant taste to the cheese. The samples with saffron and honey have an intense colour (Figure 2), and when containing gum, presented an improved texture.

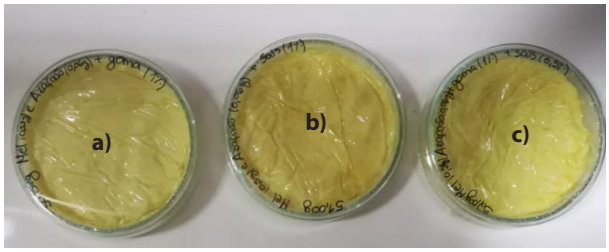

Figure 2. Samples with saffron and honey after 1 week: (a) 1% gum; (b) 0.5% salts; (c) 1% gum + 0.5% salts

Generally, after 1 week it was found that 1% gum provided the best texture while the salts showed a negative impact on texture, turning the products too firm and also with a non-positive impact on taste. Nevertheless, it was found that 1% gum and 0.5% salts worked best on the sample with saffron and honey.

After 2 weeks it was observed that some samples when opened presented a fermented smell, indicative of some fermentation process, which was not intended to happen in this type of product. Still, after a short time this odour faded and the samples with lemon balm and oregano presented a pleasant texture and flavour (Figure 3).

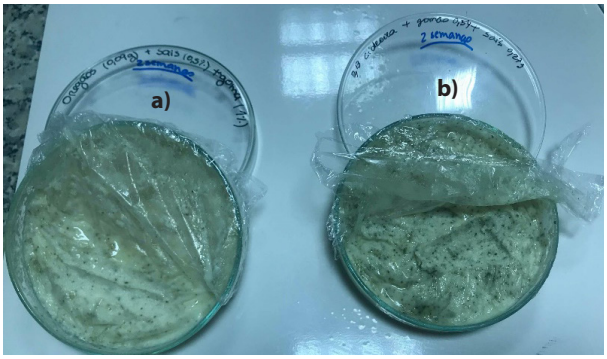

Figure 3. Samples with oregano (a) and lemon balm (b) after 2 weeks

The samples which proved to have better organoleptic characteristics and higher preservation capacity during an observational period of 3 weeks were those whose formulation was presented earlier in Table 1 and in summary they consist of the basic cheese (with locust bean gum and fusion salts), and incorporating lemon balm, oregano, saffron and honey or baccharis. These samples were then submitted to sensoria analysis.

In the test for evaluation of the sensory profile, the panellists were asked to rate each of the samples according to different characteristics, addressing properties related with visual aspect, aroma, taste and texture. The evaluation was made on a scale varying from 1 to 5, in which the value 1 represented the least perceptible quantification for each attribute and the value represented the highest. The results obtained were expressed as mean scores of the different panellists and are presented in Figures 4 to 7 by groups of characteristics. Regarding visual aspect, shown in the graph of Figure 4, samples 1 and 5 got the highest values, around 4 for all characteristics evaluated: appearance, colour, general aspect and a general appreciation of visual aspect. For samples 2, 3 and 4, the mean values ranges from 3 to 4, which are also acceptable. This reveals that the appearance of the five samples evaluated was considered fair to good.

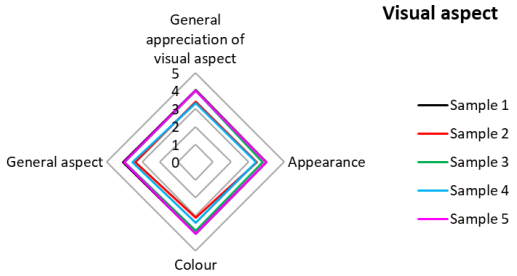

Figure 4. Descriptive sensorial evaluation for visual aspect (sample 1: basic, sample 2: with lemon balm, sample 3: with oregano, sample 4: with saffron and honey, sample 5: with baccharis)

In what concerns the aroma properties (Figure 5), the samples were not as uniform as for visual aspect, and very noticeable differences were encountered, particularly for properties like aroma to herbs and to flowers.

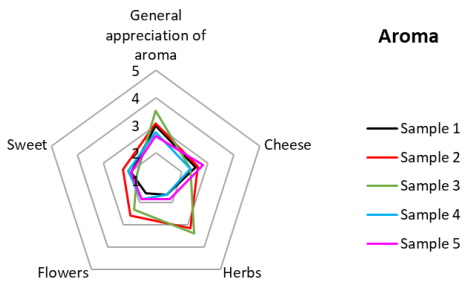

Figure 5. Descriptive sensorial evaluation for aroma (sample 1: basic, sample 2: with lemon balm, sample 3: with oregano, sample 4: with saffron and honey, sample 5: with baccharis)

Samples 2 and 3 got values considerably higher than the other samples for aroma to herbs (values higher than 3 while for other sample they were lower than 2) and also values higher for aroma to flowers, although in this case the difference was not so intense. These results indicate that in general these creamy cheeses did not present a very intense aroma, not even to cheese, which is strange since it is expected that by using ewe's milk the aroma would be intense. Nevertheless, because this type of product did not suffer any kind of

maturation the aroma did not develop, as it happens in the case of the Serra da Estrela Cheese, made with the same milk [19 - 21]. On the other hand, the results indicated that the use of specific ingredients might have a very positive impact on taste, like the use of lemon balm or oregano, which confer an intense aroma to herbs and to flowers. Nevertheless, a difference was encountered in these two samples, because in the case of sample 3 (oregano), having an intense aroma to herbs and flowers resulted in a higher score for general appreciation of aroma while for sample 2 (lemon balm) the influence on the general appreciation of aroma was not so strong.

Figure 6 presents the results obtained for the organoleptic properties related with taste, and again visible differences were encountered between the samples submitted to the sensorial analysis. While the attribute taste was more intense in sample 1, consisting only of the basic cheese with gum and fusion salts added, was least intense for 2 and 4, including lemon balm or saffron and honey, which indicates that the addition of these ingredients to some extent neutralizes the cheese flavour. Additionally, the use of lemon balm and oregano allow intensifying the taste to herbs, with high values for this attribute (3.7 and 3.1, respectively for samples 3 and 2). The general appreciation of taste was rated similarly for samples 1 and 3 (control and oregano), with average scores of 3.6 and 3.5, respectively, slightly higher than samples 2 and 5, and with sample 4 getting the lowest score (2.8).

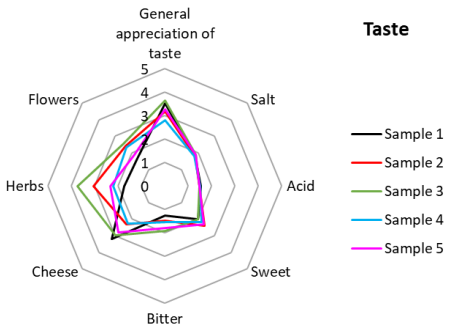

Figure 6. Descriptive sensorial evaluation for taste (sample 1: basic, sample 2: with lemon balm, sample 3: with oregano, sample 4: with saffron and honey, sample 5: with baccharis)

Texture assumes a high importance in this type of product that is intended as a creamy cheese, easily spreadable, but maintaining integrity, smoothness and consistency. These properties are highly dependable on the formulation, processing conditions and storage [22,23]. Figure 7 shows the results of the classifications given by the panellists to attributes considered important for this product: creaminess, firmness, granules, softness, juiciness, greasiness and general appreciation of texture.

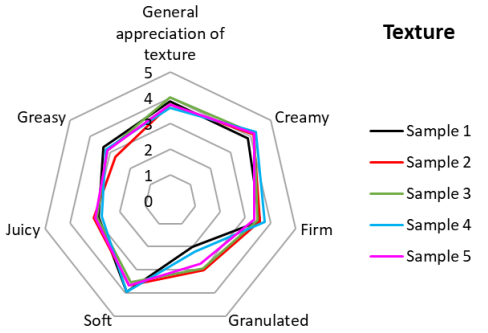

Figure 7. Descriptive sensorial evaluation for texture (sample 1: basic, sample 2: with lemon balm, sample 3: with oregano, sample 4: with saffron and honey, sample 5: with baccharis)

All the samples were very similarly classified as to most of the characteristics evaluated, with visible differences for granules and greasy. Samples 1 and 4 (control and saffron and honey) were considered less granulated as compared with the others, while sample 2 (lemon balm) was less greasy than all others. In general the samples were considered soft but firm and creamy, which are desired attributes for this product, and the general appreciation of texture was about 4 for all samples evaluated.

Figure 8 shows the overall evaluation of the samples, taking in consideration all the attributes evaluated in the descriptive sensorial evaluation, as well as an additional question formulated aimed at assessing whether the panellists would buy this product or not.

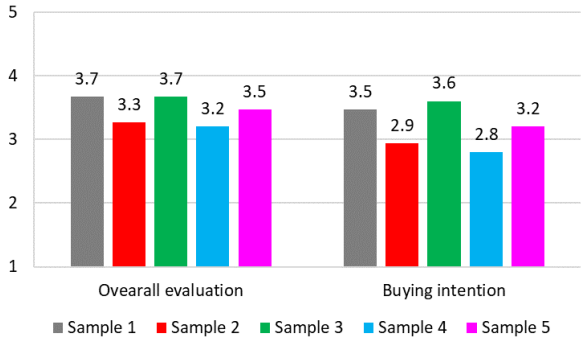

Figure 8. Overall sensory evaluation and buying intention (sample 1: basic, sample 2: with lemon balm, sample 3: with oregano, sample 4: with saffron and honey, sample 5: with baccharis)

The results indicated that samples 2 and 3 (control and with oregano) were more appreciated (average score of 3.7), being also those with highest scores regarding the buying intentions (3.6 and 3.5, respectively for samples 3 and 1. Samples 2 and 4 were the least preferred and not so interesting for the consumer. These results seem to indicate that samples 1 and 3 might be a good option to launch this product in the market in the future.

In the preference test the panellists were asked to order the five samples by preference, on a scale of 1 (prefer less) to 5 (prefer more), and the results are shown in Figure 9.

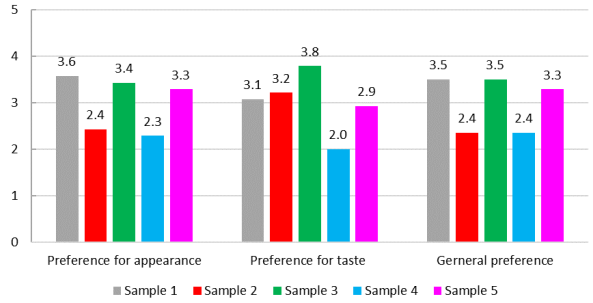

Figure 9. Results of preference test (sample 1: basic, sample 2: with lemon balm, sample 3: with oregano, sample 4: with saffron and honey, sample 5: with baccharis)

Regarding the preference for appearance, the sample rated highest was sample 1 (control) followed by sample 3 (with oregano) and closely by sample 5 (with baccharis), respectively with average scores of 3.6, 3.4 and 3.3. On the other hand, samples 2 and 4 (with lemon balm and with saffron and honey) were not much appreciated in terms of appearance. Interestingly, the results of preference for taste were slightly different with sample 3 getting the highest average score (3.8), indicating that the addition of oregano positively influenced taste, more than the other ingredients. Sample 4 got by far the lowest average score (2.0) confirming that the mixture saffron and honey did not function as nicely as it would have been expected. Regarding the general preference, the ratings of the panellists were almost identical to those of the preference for appearance, which indicates that the first visual impression counts more than the actual taste. In this way, samples 1 and 3 were clearly indicated as those with highest possibility for success in the marketing of this type of ewe's creamy spread cheese, thus confirming what had already been observed in previous sensory assessments.

The samples that were best rated in the sensorial analyses were those considered more viable, and therefore those were the ones who were submitted to a more detailed physico-chemical analyses and nutritional labelling. Table 2 presents the results of the evaluation of macronutrients by FTIR, as well as antioxidant activity evaluated by spectroscopic method using DPPH radical. It also shows the results of the microbiological analyses performed.

The results show that both samples are relatively similar in what concerns the chemical composition, with sample 3 (oregano) showing just slightly lower fat and protein but higher moisture, lactose and dietary minerals' content, although with lower salt. This type of cheese was made from ewe's milk, and therefore its composition differs than that of similar products, the quark cheese made of cow or goat milks [24, 25]. In fact, the fat content in ewe's milk is much higher when compared with cow milk, for example Vianna *et al.*, [26] textural and sensory parameters of these products. For each trial (n=3 reported values of fat content of 3.5% and 5.8%, respectively for cow and ewe's milk.

Regarding the antioxidant properties (Table 2), it was found that the addition of oregano increased antioxidant activity from 64.99 mg/L TE to 70.96 mg/L TE, which was one of the initial goals, thus contributing for increased bioactivity and also better preservation trough the antioxidant capacity. Oregano contains interesting amounts of carvacrol, which has demonstrated biological activity both *in vitro* and also in food. For this reason, oregano and carvacrol have been accepted as food additives and flavourings in the United States [27, 28]. Among the health properties of oregano is its strong anti-bacterial and anti-fungical activities, due to its essential oil, which is rich in carvacrol and thymol [29]. Additionally, oregano had proven potential for retarding lipidic oxidation, which is beneficial in case of this product [30 - 33].

Table 2. Chemical and microbiological properties of the samples selected after sensory evaluation

Composition	Sample 1 (Control)	Sample 3 (Oregano)
Moisture (%)	67.55 ± 0.08	69.03 ± 0.03
Carbohydrates, Lactose (%)	3.40 ± 0.09	3.84 ± 0.06
Fat (%)	13.09 ± 0.06	12.33 ± 0.02
Protein (%)	11.88 ± 0.04	11.41 ± 0.06
Ashes (%)	2.55 ± 0.01	2.63 ± 0.01
Salt (%)	0.90 ± 0.03	0.83 ± 0.01
Antioxidant properties		
Percentage Inhibition (%)	70.55 ± 3.11	77.33 ± 0.41
Antioxidant activity (mg/L TE)[1]	64.99 ± 2.74	70.96 ± 0.36
Microbiological essays		
Staphylococci (CFU/g)[1]	2.0x10[1]	6.0x10[1]
***Escherichia coli* (CFU/g)**	< 10	< 10

[1]Expressed in Trolox equivalents (TE); [2]Colony-forming units (CFU).

In what concerns the results of the microbiology analyses performed, and considering limits established in the European Commission Regulation (EC) No 2073/2005 of 15 November 2005 [34] on microbiological criteria for foodstuffs, it was found that both samples stay within safe values both for Staphylococci and *E. coli* (CFU/g). The coagulase-positive staphylococci include not only *Staphylococcus aureus* but also

Table 3. Nutritional information of the samples selected after sensory evaluation

Nutritional information	Sample 1 (Control)		Sample 3 (Oregano)	
	Per 100 g	Portion of 25 g	Per 100 g	Portion of 25 g
Energy (Kcal / KJ)	186 / 780	47 / 195	172 / 720	43 / 180
Carbohydrates (g)	3.4	0.85	3.8	0.95
Of which sugars (g)	3.4	0.85	3.8	0.95
Protein (g)	11.9	3.0	11.4	2.9
Lipids (g)	13.9	3.5	12.3	3.0
Of which saturated (g)	8.9	2.2	8.9	2.2
Fibre (g)	0.002	0.0	0.04	0.01
Salt (g)	0.90	0.23	0.83	0.21

S. intermedius and *S. hyicus*, and some strains from each of these species are known to produce enterotoxin, and cause food-borne disease in humans [35, 36]. Staphylococcal enterotoxins, are short, water-soluble, extracellular proteins, which act on certain receptors situated in the intestinal wall, and can cause food poisoning [37]. Milk production animals can act asymptomatic carriers of verotoxin-producing *E. coli* (VTEC). Contaminated raw milk and dairy products constitute potential sources of outbreaks caused by E. coli. VTEC can cause human infections, in some cases with light effects (like a simple diarrhoea) but in other cases potentially dangerous (such as hemolytic uremic syndrome and hemorrhagic colitis. It is established that infective dose of VTEC is less than 10 bacteria in the case of susceptible individuals, and for that reason it must not be present in dairy products, like cheese [38].

Nutrition labelling is considered a relevant component of public health policies [39]. Portugal has mandatory legislation on food labelling and requires or recommends that nutrition information be listed both on 100 g of product and on a serving size basis [40]. Table 3 shows the nutritional information for 100 g of product and on a serving size portion for both products, control and oregano creamy cheese.

Lactose was the main carbohydrate present in low levels in both products. It is a natural non-fermentable sugar so it is not cariogenic and is not harmful to teeth. Additionally, lactose has interesting nutritional properties, such as relatively low sweetening power, calorific value and glycaemic index. It also has dietary fibre-like and prebiotic properties and enhances the absorption of calcium and magnesium [41]. In both products protein content provides more than 20% of the energy value (25.6% for control and 26.5% for oregano cheeses). Thus a claim that creamy cheeses are high in protein could be added [42]. The high level of saturated fat present in 100 g of product might be considered a negative aspect. Nevertheless, this saturated lipids are found to be mostly medium-chain triglycerides (MCTs) which are the most beneficial type of saturated fat [43]. Lima *et al.*, [44], also reported a positive association between healthy lipid indices and the consumption of Serra da Estrela Cheese, of which the developed creamy cheeses are a derivation. The energy provided by a portion of 25 g is practically the same regardless of the sample. As dairy products contain almost all the essential nutrients, creamy cheeses preferred in sensorial analyses should be consumed as part of a balanced diet in order to promote growth and maintain health.

4. Conclusions

- In the present work some attempts were made to develop a creamy cheese from ewe's milk original form the geographic area of PDO Serra da Estrela Cheese, which would present desirable organoleptic characteristics and acceptable conservation. Different formulations were tested and five were selected to carry out the sensory evaluation, which is turn allowed selecting two as those best rated by the panellists and with best commercial potential. These were the control cheese and the cheese with oregano.

- Physico-chemical analysis revealed a high similarity between both products and microbial analysis confirmed counts of Staphylococci and *E. coli* within the regulated limits for human safety.

- Nutritional evaluation highlighted high protein contents but also saturated fat in both products, nevertheless the energetic value per serving size is relatively low and the consumption of these products should be considered. Moreover, oregano creamy cheese presented increased antioxidant activity, which could be associated with a more positive impact in human health.

Acknowledgement

This work is funded by National Funds through the FCT - Foundation for Science and Technology, I.P., within the scope of the project Ref[a] UIDB/00681/2020. Furthermore, we would like to thank the CERNAS Research Centre and the Polytechnic Institute of Viseu for their support.

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