

Butter oil com adição de extratos vegetais de orégano (*Origanum vulgare* L.) e manjeriço (*Ocimum basilicum* L.): desenvolvimento e caracterização física, química e sensorial

Butter oil with added vegetable extracts from oregano (*Origanum vulgare* L.) and basil (*Ocimum basilicum* L.): development and physical, chemical and sensory characterization

Butter oil con adición de extractos vegetales de oregan (*Origanum vulgare* L.) y albahaca (*Ocimum basilicum* L.): desarrollo y caracterización física, química y sensorial

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Resumo

Este artigo tem o objetivo de descrever uma pesquisa voltada para desenvolver *butter oil* adicionada de extratos vegetais de orégano e manjerição em diferentes concentrações (0,2%, 0,4% e 0,6%), avaliando características químicas, físicas e sensoriais. As amostras de Butter oil com extratos vegetais obteve boa intenção de compra para todos os tratamentos, sendo a amostra com adição de extrato vegetal de manjerição 0,2% a preferida. Para os parâmetros mínimos de qualidade todas as análises se encontraram dentro do permitido na legislação vigente. Os valores de umidade variaram entre 0,010 a 0,044 g 100 g⁻¹, acidez de 0,035 a 0,082 g 100 g⁻¹, índice de peróxido de 0 g 100 g⁻¹ e o extrato etéreo obteve valor de 99,86 g 100 g⁻¹. Foram identificados 30 ácidos graxos por cromatografia gasosa. Conclui-se que o desenvolvimento de Butter oil com adição dos extratos vegetais de orégano e manjerição, teve boa aceitação sensorial atendendo os parâmetros mínimos de qualidade por toda vida útil analisada.

Palavras-chave: Orégano; Manjerição; Ácido graxos; Parâmetro de qualidade.

Abstract

The objective of this study was to develop butter oil with added oregano and basil plant extracts at different concentrations (0.2%, 0.4% and 0.6%) and to evaluate the chemical, physical and sensory characteristics. butter oil samples with plant extracts obtained good purchase intention for all treatments, with the addition of 0.2% basil vegetable extract being preferred. For the minimum quality parameters, all samples were within the allowable legislation. The humidity values ranged from 0.010 to 0.044 g 100 g⁻¹ and acidity from 0.035 to 0.082 g 100 g⁻¹; the peroxide index was 0 g 100 g⁻¹ and the ether extract was 99.86 g 100 g⁻¹. Thirty fatty acids were identified in the butter oil by gas chromatography. It was concluded that the development of butter oil with the addition of oregano and basil plant extracts had good sensory acceptance, meeting the minimum quality parameters throughout the analysed useful life.

Keywords: Oregano; Basil; Fatty acid; Quality parameter.

Resumen

Este artículo tiene como objetivo describir la investigación dirigida a desarrollar *butter oil* agregado con extractos vegetales de orégano y albahaca en diferentes concentraciones (0.2%, 0.4% y 0.6%), evaluando las características químicas, físicas y sensoriales. Las muestras de *butter oil* con extractos de plantas obtuvieron una buena intención de compra para todos los tratamientos, siendo la muestra con la adición de extracto vegetal de albahaca al 0.2% la preferida. Para los parámetros mínimos de calidad, todos los análisis estuvieron dentro de los límites de la legislación vigente. Los valores de humedad variaron de 0.010 a 0.044 g 100 g⁻¹, acidez de 0.035 a 0.082 g 100 g⁻¹, índice de peróxido de 0 g 100 g⁻¹ y el extracto de éter obtuvo un valor de 99.86 g 100 g⁻¹) Se identificaron 30 ácidos grasos por cromatografía de gases. Se concluye que el desarrollo del *butter oil* con la adición de extractos vegetales de orégano y albahaca, tuvo una buena aceptación sensorial cumpliendo los parámetros mínimos de calidad para toda la vida útil analizada.

Palabras clave: Orégano; Albahaca; Ácido graso; Parámetro de calidad.

1. Introduction

Butter oil is a dairy derivative marketed and produced in various parts of the world, being differentiated by the nomenclature of its country of origin. In India, it is called "ghee", in Turkey, it is known as "urfa yağı", in the Middle East, it is called "maslee" or "samn", and in Iran, it is called "roghan" (Atasoy & Türkoğlu, 2010). Usually, butter oil is prepared from cow's milk and can also be obtained from other animal species, such as goat, sheep or camel (Sserunjogi et al., 1998).

Butter oil is defined in MAPA Ordinance No. 146 of March 7, 1996 as being a greasy product obtained from cream or butter by the almost total elimination of water and non-greasy solids (Brasil, 1996). It is the most expensive fat, with a value 6 to 7 times more expensive than that of all other fats and edible vegetable oils (Upadhyay et al., 2018), recognized for its functional, organoleptic and nutritional properties that make this product unique (Gosewade et al., 2017).

Consumers are accustomed to the presence of spices in foods, which are mainly used to improve the taste and flavour (Militello et al., 2010). These can be added whole, fresh, dried or as essential oils and isolated extracts (Del Ré & Jorge, 2012).

Extracts are products obtained by cold or hot extraction from products of animal, plant or microbial origin with permissible solvents, according to the Resolution - RDC no. 2, of January 15, 2007, of the Health Surveillance Agency and contain the fixed and volatile aromatic principles corresponding to the respective natural product (Brasil, 2007).

Aromatic herbs have a long history in cooking and are used extensively to add distinctive aromas and flavours to various types of dishes (Sonmezdag et al., 2018), among which are oregano and basil. In addition to being known for exhibiting various health activities, oregano is known to have antimicrobial, antiparasitic, antioxidant, analgesic, anti-inflammatory, antispasmodic, immunostimulant, antimutagenic, nutritional enrichment, and dietary properties (Giannenas et al., 2018); additionally, basil has analgesic, immunostimulant, antiallergic, antispasmodic, anticancer, antimicrobial, antifungal, anti-inflammatory, antiviral, and antiseptic properties, as well as sedative and antioxidant properties (Złotek, 2018).

There is increasing knowledge and concerns about healthier lifestyles, causing consumers to be more aware of their diets and causing food industries to change many ingredients or reduce the burden of health-damaging constituents (Carocho et al., 2016). Thus, vegetables present themselves as an alternative to substitute chemical additives that are harmful to health in addition to presenting several benefits (Souza et al., 2010).

Given the above, the objective of this study was the development and physical, chemical and sensory characterization of butter oil with the addition of different concentrations of plant extracts of oregano (*Origanum vulgare* L.) and basil (*Ocimum basilicum* L.).

2. Materials and Methods

2.1 Obtaining plant extracts

To obtain the plant extracts, oregano (OR) and basil (BS) were commercially acquired. As they have a processing standard and are commonly used by consumers in everyday life, these herbs were used for all further experiments. Plant extracts were obtained by the decoction method. The plant material was crushed with the help of a multiprocessor to obtain a material with a smaller particle size and an increased contact area with the solvent (water), allowing for better extraction of the compounds in the herbs.

For the preparation of the extract, 1 g of herb was used for each 100 mL of distilled water. The extract was prepared on a hot plate, the mixture of plant material and solvent was heated to boiling, and the decoction was maintained for a period of 5 min, ensuring that there was no overflow and loss of material. The mixture remained at rest until cooled and was then filtered under reduced pressure with the aid of a vacuum pump. After filtration, the samples were placed in sterile packaging and stored in an ultrafreezer at -80 °C. The frozen samples were subjected to lyophilization, thus obtaining a plant extract powder.

2.2 Development of butter oil

The butter oil used was prepared from butters commercially acquired in the city of Rio Verde - GO, which were in the form of tablets, without the addition of dyes and sodium chloride, and were of the same brand and same batch.

To obtain butter oil, the butters were removed from their original packaging and placed in beakers, and they were heated at a temperature controlled between 80 °C and 90 °C. Homogenization was performed continuously with the aid of a glass rod so that almost all water was eliminated and non-greasy solids formed. The butter was filtered with a piece of polyester membrane fabric (0.45 µm) so that no material wastage or non-greasy solids passed in the final step. Immediately after filtration, the butter oil samples were placed in previously tared airtight glass jars, and after cooling, the OR and BS plant extracts were incorporated.

2.2.1 Incorporation of plant extracts in butter oil

Plant extracts were incorporated in three different concentrations for each extract (OR and BS), with concentrations of 0.2%, 0.4% and 0.6%. Thus, 7 treatments were generated for analysis: control = butter oil without the addition of an extract; OR 0.2% = butter oil with the addition of 0.2% oregano extract; OR 0.4% = butter oil with 0.4% oregano extract added; OR 0.6% = butter oil with the addition of 0.6% oregano extract; BS 0.2% = butter oil with 0.2% basil extract added; BS 0.4% = butter oil with addition of 0.4% basil extract; and BS 0.6% = butter oil with addition of 0.6% basil extract.

All samples were stored in a BOD chamber (7 °C ± 1 °C) for shelf life control analyses, which were performed on days 0, 60, 120 and 180 after product preparation.

2.2.2 Microbiological analyses

Microbiological analyses were performed to comply with the microbiological criteria defined in Resolution RDC No. 12 of January 2, 2001 (Brasil, 2001), which describes the Technical Regulation on Microbiological Food Standards in topic 8c-(a) butter., milk fat (anhydrous milk fat or butter oil) analyses of coliforms at 45 °C/g, coagulase-positive Staphylococci and Salmonella sp. and Ordinance No. 146, of March 7, 1996, which describes the MAPA (Ministry of Agriculture, Livestock and Supply) Butter Oil Identity and Quality Technical Regulation. Analyses were performed following the methodologies described by the American Public Health Association-APHA (2002).

2.2.3 Sensory analysis

Microbiological analyses were performed to ensure the safety of sensory analysis tasters. Sensory analysis was only performed after the results of the microbiological analyses were confirmed to be within the recommended levels by current legislation. Sensory analysis was performed with the affective acceptance test of the ideal scale, assessing the attributes appearance, odour and taste, as can be seen in Table 1.

Table 1. Ideal scale for appearance, odour and taste of butter oil with added vegetable extracts from oregano (*Origanum vulgare* L.) and basil (*Ocimum basilium* L.).

Parameters	Appearance, Odor and Taste
+3	Much better than ideal
+2	Moderately better than ideal
+1	Slightly better than ideal
0	Ideal
-1	Slightly worse than ideal
-2	Moderately worse than ideal
-3	Much worse than ideal

Source: Author (2020).

Approximately 5 g of each sample was served at 5 °C ± 1 °C in trays identified with random three-digit numbers, together with water and bread to clean the palate between samples (Dutcoski, 2011).

To avoid judging fatigue, treatments/samples were not served together, and the sensory analysis was performed in two stages, in which the judge first evaluated 4 treatments (control, OR 0.2%, OR 0.4% and OR 0, 6%) and, after 30 min, evaluated the other 4

treatments (control, BS 0.2%, BS 0.4% and BS 0.6%), also evaluating the purchase intention through a five-point structured scale (1: would certainly buy; 5: would never buy). The evaluated samples were prepared one week before the sensory evaluation, according to the methodology described by Meilgaard et al. (2007).

All the judges signed an informed consent form, as determined by Resolution 196, of October 10, 1996. The project was submitted and approved by the Research Ethics Committee of the Goiano Federal Institute through the Plataforma Brasil Portal according to CAAE process No. 02978018.9.0000.0036.

2.2.4 Evaluation of minimum quality parameters of the butter oil

The moisture and volatility ($\text{g } 100 \text{ g}^{-1}$), fat acidity (%), and peroxide index (meq/kg) analyses were performed, following the AOAC official methodologies (2010), and ether extract ($\text{g } 100 \text{ g}^{-1}$) by the 920.39 AOAC method (2010) to guarantee the meeting of the physicochemical parameters for butter oil that were proposed by the Butter Oil Identity and Quality Technical Regulation described in Ordinance No. 146 (Brasil, 1996).

2.2.5 Fatty acid profile

The fatty acid profile of the control butter oil sample was determined by the acid hydrolysis method outlined in method 996.06 (AOAC, 2010). Methyl ester transformation and fatty acid composition were determined using a Thermo Fisher GC model 12550060 series chromatograph equipped with a TR-FAME 120 $\text{m} \times 0.25 \text{ mm}$ column, ID $\times 0.25$ micron, part number: 260M166L.

The chromatographic conditions used were an initial column temperature of 100 °C for 4 min and a final column temperature of 240 °C at a speed of 3 °C min^{-1} . The injector temperature was 225 °C and that of the detector was 285 °C. The carrier gas used was helium using a 100 $\text{m} \times 0.25 \text{ mm}$ SP2560 capillary column.

2.2.6 Colour of butter oil with plant extract

The colour evaluation was performed with a Konica Minolta portable digital colorimeter (CR400, JAPAN), calibrated according to the illuminance parameters D65 and the reading performed directly on the sample with the beam released by the equipment. The parameters L^* (luminosity), C^* (chroma: saturation) and h_{ab} (hue angle: hue) were obtained

by the equipment and reported in the CIE (Commission Internationale de l'Eclairage) colour space coordinates.

2.3 Statistical Analysis

The results were evaluated by analysis of variance (ANOVA), followed by the Tukey test for comparison of means between samples (5% significance), using Sisvar 5.6 statistical software (Ferreira, 2014).

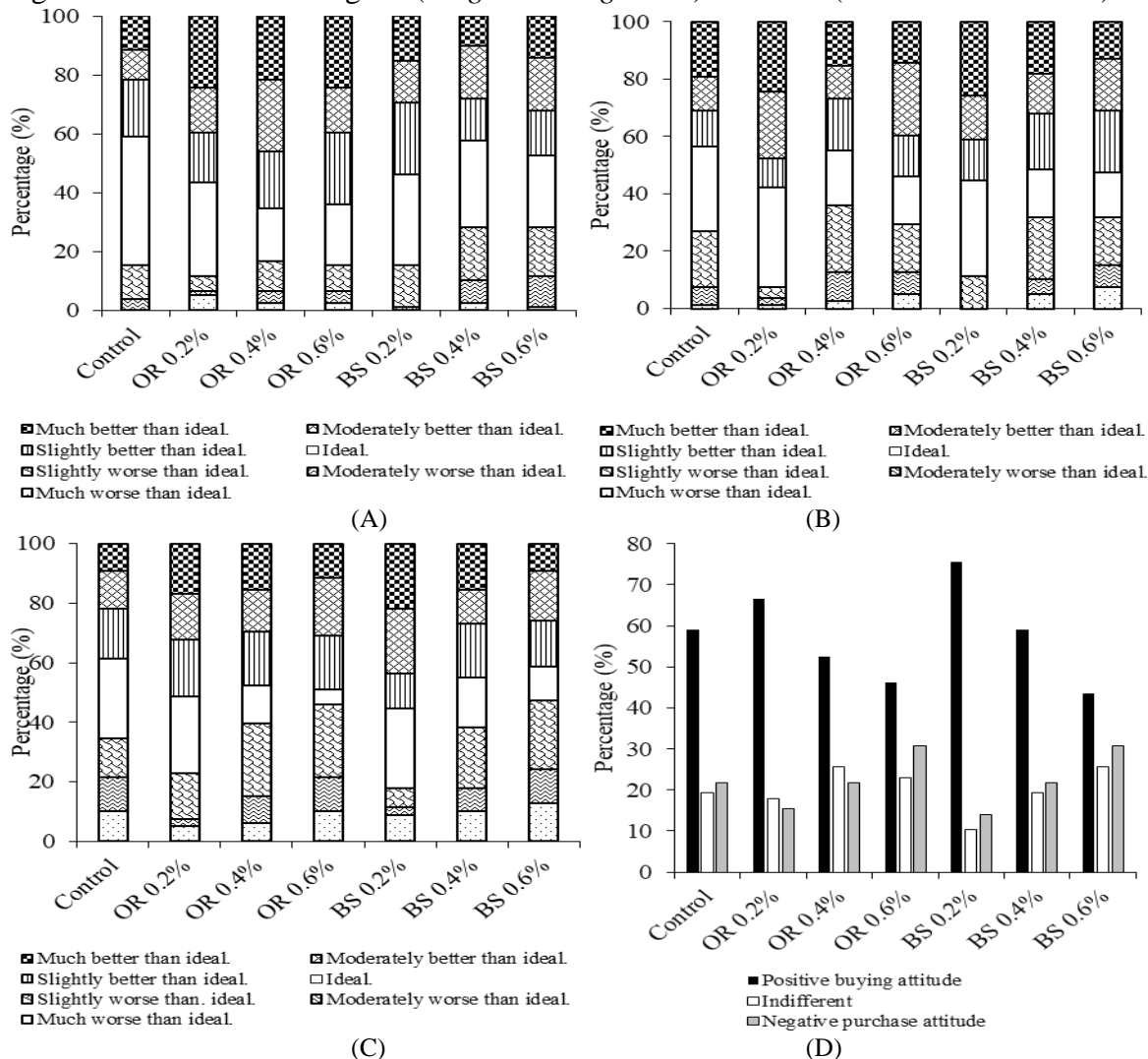
3. Results and Discussion

3.1 Microbiological and sensory analysis

The microbiological values of all butter oil samples were below the maximum values recommended in RDC No. 12 of ANVISA (National Health Surveillance Agency) and Ordinance No. 146 of MAPA. In regard to food handling, there should be sanitary hygienic care in handling, from pre-preparation to the final product, with storage conditions ensuring food safety and, especially, quality.

The sensory analysis was performed with 78 judges, comprising 61 women and 17 men aged between 18 and 47 years with an average age of 23 years. The parameters of odour, appearance and taste were obtained with the ideal scale, as can be seen in Figure 1.

Figure 1 - Ideal scale for appearance (A), odour (B) and taste (C) and positive attitude, indifferent attitude and negative attitude of purchase intention (D) of butter oil with added vegetable extracts from oregano (*Origanum vulgare* L.) and basil (*Ocimum basilium* L.).



Note: Control = butter oil without the addition of an extract; OR 0.2% = butter oil with the addition of 0.2% oregano extract; OR 0.4% = butter oil with 0.4% oregano extract added; OR 0.6% = butter oil with the addition of 0.6% oregano extract; BS 0.2% = butter oil with 0.2% basil extract added; BS 0.4% = butter oil with addition of 0.4% basil extract; and BS 0.6% = butter oil with addition of 0.6% basil extract. Source: Author (2020).

In Figure 1 (A), we can observe the results obtained for the appearance aspect of the samples. In the appearance of the samples, 29.49% of the tasters evaluated the control sample as ideal, and for the OR 0.2% sample, 34.62% of the tasters evaluated it as ideal, followed by 24.36% who evaluated it as being much better than ideal. The OR 0.4% sample scored 19.23% as ideal and 17.95% as slightly better than ideal, and 25.64% of tasters rated OR 0.6% as moderately better than ideal.

For the BS samples, that with 0.2% BS was ideal for 33.33% of the tasters, followed by 25.64% that classified it as much better than ideal; for BS 0.4%, 21.79% of the tasters marked it as slightly worse than ideal, followed by 19.23% who classified it as slightly better

than ideal, and 21.79% of the tasters rated BS 0.6% as slightly better than ideal, followed by 17.95% who classified it as moderately better than ideal.

For the appearance of the samples, it was observed that negative parameters were highlighted in the samples that contained higher concentrations of plant extracts (OR 0.4% and 0.6% and BS 0.4% and 0.6%). The samples evaluated as slightly worse than ideal, moderately worse than ideal and much worse than ideal, when grouped with the values obtained from the appearance of the product, could be correlated with the addition of plant extracts since after the process of freeze-drying, these extracts interfered with the appearance of the butter oil, and the higher concentrations intensified the colour, and the tasters possibly associated butter oil with similar products.

In Figure 1 (B), the values obtained for the odour of the butter oil samples with the addition of OR and BS plant extracts are shown. Evaluating the odour of the samples, 43.59% of the tasters classified the control sample as ideal, followed by 32.0% for OR 0.2%, 17.95% for OR 0.4%, 20.51% for OR 0.6%, 30.77 for BS 0.2%, 29.49% for BS 0.4%, and 25.64 for BS 0.6%.

The OR 0.6% and BS 0.2% samples showed similar results, with 24.36% of the tasters that judged the samples to be slightly better than ideal, 17.95% of the tasters judged that the BS 0.4% samples and BS 0.6% were moderately better than ideal, and 24.36% of tasters stated that OR 0.2% and OR 0.6% were much better than ideal.

For the odour criteria of the samples, it can be observed in Figure 1 (B) that the positive parameters were higher than the negative parameters. Such acceptability was attributed to the addition of the plant extracts to the butter oil, which were the main factors responsible for such characteristics due to their aromatic compounds, and because they are extracts from commonly used and known herbs, their recognition and acceptability is greater.

After assessing the appearance and odour, the tasters tried the samples and evaluated for taste. Figure 1 (C) shows the values of the taste parameter of the butter oil samples containing OR and BS plant extracts. Evaluating the taste parameter, it was highlighted that the most concentrated samples (OR 0.4% and 0.6% and BS 0.4% and 0.6%) obtained significant values for the slightly worse than ideal parameter, which correlates with the appearance data that presented this same result. Evaluating butter oil with the addition of OR and BS plant extracts, the BS 0.2% sample was rated as ideal by 26.92% of the tasters, and 21.79% of the tasters rated this sample as either moderately better than ideal or much better than ideal, being the favourite sample among the sensory panel in terms of taste.

One factor to be evaluated is whether the samples with a higher extract concentration had a residual bitter taste. In foods and beverages, this bitter taste is often the result of the presence of phenolic compounds, e.g., naringenin or intensely bitter flavanones (Alexander et al., 2019), which were present in the samples of plant extracts from OR and BS.

When spices are added or sourced, such as plant extracts that contribute to health activities due to the structural characterization of the present compounds, in addition to adding to the aroma and flavour of a product, a satisfactory sensory result is obtained.

In Figure 1 (D), one can observe butter oil's buying attitude with the addition of OR and BS plant extracts, which was separated into a positive buying attitude that included the rating "certainly would buy", "probably would buy" the indifferent attitude, and the negative attitude included "probably not buy" and "never buy". It can be observed that the values of positive buying attitude predominated in all treatments, having values greater than the sum of the percentage of an indifferent attitude together with a negative buying attitude, and, in some cases, this value up was greater than twice the sum.

For the negative attitude of purchase, it was observed that the OR 0.6% and BS 0.6% samples had the highest rejection rates, which correlated with the taste of the samples and the larger volume of extract because they presented a bitter residual taste due to the presence of phenolic compounds with this characteristic. Considering that the difference in the treatments is the concentration of the extracts added in the butter oil samples, it can be said that the product had an overall positive buying attitude.

3.2 Minimum quality parameters and fatty acids

Table 2 shows the values obtained for the moisture content of the butter oil samples with the addition of plant extracts that were performed on day 0; for samples with a low water moisture content. The analysis was performed only on the first day.

Table 2. Moisture content of butter oil with added vegetable extracts from oregano (*Origanum vulgare* L.) and basil (*Ocimum basilium* L.).

Treatments*	Moisture (g 100 g ⁻¹)**
Controle	0.010 ^b ± 0.000
OR 0.2	0.039 ^a ± 0.010
OR 0.4	0.010 ^b ± 0.000
OR 0.6	0.044 ^a ± 0.005
BS 0.2	0.010 ^b ± 0.000
BS 0.4	0.010 ^b ± 0.000
BS 0.6	0.023 ^b ± 0.006

*Control = butter oil without the addition of an extract; OR 0.2% = butter oil with the addition of 0.2% oregano extract; OR 0.4% = butter oil with 0.4% oregano extract added; OR 0.6% = butter oil with the addition of 0.6% oregano extract; BS 0.2% = butter oil with 0.2% basil extract added; BS 0.4% = butter oil with addition of 0.4% basil extract; and BS 0.6% = butter oil with addition of 0.6% basil extract. **Mean value with standard deviation. Means followed by the same letter, lowercase in the same column, do not differ among themselves by the Tukey test at 5% probability. Source: Author (2020).

The values obtained ranged from 0.010 g 100 g⁻¹ for the control and 0.044 g 100 g⁻¹ for OR 0.6%, and OR 0.2% did not differ significantly from OR 0.4%, but both differed from the other treatments. All the results obtained were within the limits allowed by Ordinance No. 146/1996, as the sample humidity can be up to 0.2 g 100 g⁻¹.

Table 3 shows the values of the oleic acid acidity index during the life of the butter oil with OR and BS plant extracts. The acidity values ranged from 0.035 to 0.082 g 100 g⁻¹ during the service life. Moreover, the oleic acid titratable acidity values obtained were in accordance with current legislation (Ordinance No. 146/1996) for this type of product, which is a maximum of 0.4 g 100 g⁻¹.

Table 3. Acidity index of butter oil with added vegetable extracts from oregano (*Origanum vulgare* L.) and basil (*Ocimum basilium* L.), during storage at 7 °C ± 1 °C for 180 days.

Treatments*	Acidity content (g of oleic acid 100 g ⁻¹)**			
	0 day	60 days	120 days	180 days
Control	0.042 ^b ±0.006	0.082 ^a ±0.024	0.042 ^b ±0.007	0.045 ^b ±0.01
OR 0.2%	0.045 ^a ±0.008	0.055 ^a ±0.001	0.040 ^a ±0.002	0.0375 ^a ±0.01
OR 0.4%	0.050 ^{ab} ±0.001	0.055 ^a ±0.003	0.035 ^c ±0.005	0.040 ^{bc} ±0.05
OR 0.6%	0.050 ^{ab} ±0.002	0.055 ^a ±0.004	0.042 ^{bc} ±0.004	0.037 ^c ±0.02
BS 0.2%	0.050 ^b ±0.001	0.060 ^a ±0.002	0.035 ^c ±0.002	0.037 ^c ±0.02
BS 0.4%	0.050 ^{ab} ±0.006	0.052 ^a ±0.003	0.037 ^{bc} ±0.005	0.035 ^c ±0.02
BS 0.6%	0.052 ^a ±0.004	0.055 ^a ±0.003	0.040 ^b ±0.002	0.040 ^b ±0.01

*Control = butter oil without the addition of an extract; OR 0.2% = butter oil with the addition of 0.2% oregano extract; OR 0.4% = butter oil with 0.4% oregano extract added; OR 0.6% = butter oil with the addition of 0.6% oregano extract; BS 0.2% = butter oil with 0.2% basil extract added; BS 0.4% = butter oil with addition of 0.4% basil extract; and BS 0.6% = butter oil with addition of 0.6% basil extract. **Mean value with standard deviation. Means followed by the same letter, lowercase in the same column, do not differ among themselves by the Tukey test at 5% probability. Source: Author (2020).

Butter oil is a high-lipid product that must contain a minimum value of 99.70 g 100 g⁻¹ fat, and the ether extract value found in the present work was 99.86 g 100 g⁻¹. The result obtained was above that recommended by current legislation for this type of product.

Peroxides are the first compounds formed during the oxidation of fatty acids that may occur during food processing and storage or during the use of oils and fats, such as during frying (Granato & Nunes, 2016). These oxidation reactions are a degradation process that occurs in oils and fats and causes the loss of nutritional and sensory qualities.

It is important to avoid the development of unpleasant flavours in dairy products; exposure to natural light promotes a catalytic effect, and this degradation depends on the wavelength of the light involved, and the intensity and time that this product will be exposed to a certain light may be beyond that of natural light. The fluorescent light used in refrigerators may promote these degradation reactions and end up developing unpleasant flavours (Cruz et al., 2016).

For the peroxide index analysis, where it is possible to verify substances resulting from lipid oxidation, the values obtained for all days of analysis of the useful life were 0%. Self-oxidation can occur by three process mechanisms, involving the reaction of oxygen with unsaturated fatty acids that initially forms free radicals and, later, peroxides and their decomposition products; photooxidation involves the direct reaction of oxygen in the presence of light with unsaturated fatty acids and the enzymatic action of lipoxygenases, which are able to catalyse molecular oxygen addition to polyunsaturated fatty acids, forming hydroperoxides (Granato & Nunes, 2016).

An industry concern is lipid self-oxidation in dairy products. Among these prominent problems is the need for low-temperature refrigeration of butter oil, and the factors that influence oxidative deterioration are storage temperature, thermal treatment, and homogenization, among others (Cruz et al., 2016).

There are several ways to protect lipids from oxidation, including the use of light- and oxygen-barrier packaging and low temperatures, and the most commonly used method is the use of additives that inhibit oxidation, i.e., antioxidants (Granato & Nunes, 2016).

Due to the wide variety of the contained fatty acids, the taste of milk fat is superior to that of other fats, and the flavour and organoleptic properties dairy products are attributed to the fat, as it is responsible for the taste of foods and has an important role in defining texture and consistency characteristics (Cruz et al., 2016).

Thirty fatty acids were identified by gas chromatography, and those with values above 1% can be observed in the second column of Table 4.

Table 4. Fatty acid profile of butter oil control.

Fatty acid	(%)	(Dorni et al., 2018)	(Cruz et al., 2016)
Palmitic acid (C16:0)	36.52	39.13	27
Myristic acid (C14:0)	13.44	11.81	14
Oleic acid (C18:1n9c)	13.01	23.19	28
Stearic acid (C18:0)	8.93	13.89	13
Lauric acid (C12:0)	4.42	2.81	5
Capric acid (C10:0)	4.12	1.87	3
Butyric acid (C4:0)	3.81	0.22	3
Caproic acid (C6:0)	3.15	0.30	2
Caprylic acid (C8:0)	1.96	0.47	1
Palmitoleic acid (C16:1n7)	1.89	1.86	3
Myristoleic acid (C14:1)	1.68	0.95	-
Pentadecanoic acid (C15:0)	1.30	-	-
Linoleic acid LA (C18:2n6c)	1.02	2.00	1

Source: Author (2020).

In the third column, the values found by Dorni, Sharma, Saikia, & Longvah (2018) can be observed. These authors evaluated ghee in their work by determining the fatty acid profile of edible oils and fats consumed in India, and in the fourth column, the values of the main fatty acids reported by Cruz et al. (2016) are cited.

The fatty acid profile analysis showed that the major compounds of the butter oil samples were palmitic acid (36.52%), myristic acid (13.44%) and oleic acid (13.01%). As seen in Table 4, there were some fatty acid variations between the present study with those reported by Dorni et al. (2018) and Cruz et al. (2016), some of which may occur in relation to extrinsic and intrinsic factors, such as climate, seasonality of the time the milk was collected, livestock feed, animal breed, etc.

The following fatty acids were found with values below 1%: undecanoic acid (C11:0), 10-pentadecenoic acid (C15:1), margaric acid (C17:0), elaidic acid (C18:1n9t), linolelaidic acid (C18:2n6t), gamma-linolenic acid (GLA, C18:3n6), alpha-linolenic acid (LNA, C18:3n3), araquamic acid (C20:0), cis-11-eicosenoic acid (C20:1n9), heneicosanoic acid (C21:0), cis-8,11,14-eicosatrienoic acid (C20:3n6), arachidonic acid (AA, C20: 4n6), behenic acid (C22:0), and 5,8,11,14,17-EPA (C20:5n3).

The omega-3 and Omega-6 fatty acids were found to be 0.36 and 1.57 g 100 g⁻¹, respectively, which are the two essential fatty acids for humans. The recommendation of the United Nations Food and Agriculture Organization (FAO) and the World Health Organization (WHO) is that the daily intake of saturated fatty acids does not exceed 10% of the total energy value.

Deficiencies in these fatty acids lead to a number of symptoms and disorders, including liver and kidney abnormalities, reduced growth rates, decreased immune function, depression and skin dryness (Patent No. US 2019/0216762 A1, 2019). Substances present in foods, such as linoleic acid derivatives, ω -3 family members and polyunsaturated fatty acids, show evidence that they act on the modulation of inflammatory processes (Cruz et al., 2016).

According to Ayurveda (which is an oriental medical philosophy that was developed in the Indian subcontinent thousands of years ago), butter oil prevents various diseases and imparts longevity to humans. It has also been used to treat certain diseases, including allergies, respiratory diseases, and skin diseases, sometimes combined with some herbs (Dorni et al., 2018).

Table 5 shows the colour analysis values for the brightness parameter of the samples in the sample lifetime. Only the BS 0.4% sample differed significantly from day 0 to day 60. From day 60 to day 120, only the control and OR 0.2% samples maintained the same brightness value; from day 120 to 180, the control treatment and OR 0.6% did not present significant differences. Analysing the colour data from first and last analyses, only BS 0.2% and BS 0.4% showed no significant differences.

All treatments did not differ significantly from day 0 to day 60 except for the OR 0.2%, BS 0.2% and BS 0.4% samples. From day 60 to day 120, the OR 0.6%, BS 0.2%, BS 0.4% and BS 0.6% samples maintained the same shade value; from day 120 to 180, the OR 0.2% and OR 0.6% samples showed no significant difference in shade. When comparing the results from the first day of analysis with those of day 120, only BS 0.4% showed no statistically significant difference.

Table 5. Luminosity of butter oil with added vegetable extracts from oregano (*Origanum vulgare* L.) and basil (*Ocimum basilium* L.), during storage at 7 °C ± 1 °C for 180 days.

Treatments*	Color – Luminosity (L*)**			
	0 day	60 days	120 days	180 days
Control	54.96 ^b ±4.49	56.02 ^b ±3.35	64.87 ^{ab} ±6.28	71.16 ^a ±11.85
OR 0.2%	54.22 ^b ±2.83	52.31 ^b ±2.08	50.99 ^b ±8.31	66.28 ^a ±3.28
OR 0.4%	51.59 ^c ±2.75	52.65 ^c ±2.74	59.74 ^b ±0.88	68.52 ^a ±1.12
OR 0.6%	51.06 ^b ±1.43	51.09 ^b ±3.03	57.06 ^a ±5.61	59.57 ^a ±1.48
BS 0.2%	56.14 ^{ab} ±2.51	52.28 ^b ±2.26	60.82 ^a ±3.26	53.63 ^b ±3.38
BS 0.4%	51.93 ^b ±1.13	47.64 ^c ±2.77	60.38 ^a ±2.02	51.30 ^b ±2.24
BS 0.6%	46.65 ^c ±1.78	47.18 ^c ±1.00	59.11 ^a ±1.25	52.50 ^b ±2.22

Treatments*	Color – Chroma (C*)**			
	0 day	60 days	120 days	180 days
Control	26.75 ^a ±1.92	23.05 ^a ±0.95	24.25 ^a ±2.40	28.48 ^a ±12.27
OR 0.2%	24.66 ^a ±0.52	20.30 ^b ±0.81	21.26 ^b ±1.97	26.40 ^a ±1.11
OR 0.4%	21.99 ^b ±1.15	20.04 ^c ±1.40	22.40 ^b ±0.42	26.16 ^a ±0.22
OR 0.6%	21.88 ^a ±0.87	18.32 ^c ±0.52	20.17 ^b ±1.23	20.91 ^{ab} ±0.50
BS 0.2%	22.89 ^a ±0.55	20.49 ^b ±0.74	22.14 ^a ±0.96	21.85 ^a ±1.03
BS 0.4%	22.29 ^a ±1.11	17.75 ^c ±0.96	20.61 ^b ±0.75	18.29 ^c ±0.56
BS 0.6%	20.77 ^a ±1.44	17.30 ^c ±0.54	21.54 ^a ±0.56	19.19 ^b ±0.66

Treatments*	Color – Hue (H*)**			
	0 day	60 days	120 days	180 days
Control	102.47 ^b ±0.36	106.19 ^a ±0.71	99.75 ^c ±0.89	96.94 ^d ±0.77
OR 0.2%	97.97 ^a ±0.51	99.34 ^a ±1.30	94.54 ^b ±1.65	95.79 ^b ±0.21
OR 0.4%	95.62 ^b ±0.75	97.20 ^a ±1.27	95.00 ^b ±0.43	92.59 ^c ±0.63
OR 0.6%	98.95 ^a ±0.63	95.88 ^b ±1.07	95.68 ^b ±1.12	96.30 ^b ±0.65
BS 0.2%	97.46 ^a ±0.35	97.53 ^a ±1.26	96.32 ^a ±0.61	94.38 ^b ±0.93
BS 0.4%	91.98 ^b ±0.69	93.59 ^{ab} ±1.81	94.83 ^a ±0.44	92.65 ^b ±0.40
BS 0.6%	95.36 ^a ±0.72	89.05 ^b ±0.81	89.71 ^{bc} ±0.45	88.41 ^c ±0.43

*Control = butter oil without the addition of an extract; OR 0.2% = butter oil with the addition of 0.2% oregano extract; OR 0.4% = butter oil with 0.4% oregano extract added; OR 0.6% = butter oil with the addition of 0.6% oregano extract; BS 0.2% = butter oil with 0.2% basil extract added; BS 0.4% = butter oil with addition of 0.4% basil extract; and BS 0.6% = butter oil with addition of 0.6% basil extract. **Mean value with standard deviation. Means followed by the same letter, lowercase in the same line for each parameter, do not differ among themselves by the Tukey test at 5% probability. Source: Author (2020).

Table 5 shows the colour analysis values for the chroma-saturation parameter during the useful life. All treatments differed significantly from day 0 to day 60, except for the control sample. From day 60 to day 120, only the control sample and OR 0.2% maintained the same chroma value; from day 120 to 180, the control treatment, OR 0.6% and BS 0.2% showed no significant difference. Analysing the first to the last analysis, only OR 0.4%, BS 0.4% and BS 0.6% showed a significant difference.

Table 5 also shows the values of the color analysis for the Hue parameter - hue in its useful life. It is observed that all treatments presented yellow tint (angle close to 90 °), this

characteristic is the result of the presence of carotenoid pigments present in milk fat, which is the raw material for butter.

4 Conclusion

The development of butter oil with added plant extracts obtained good sensory acceptance, with an BS 0.2% concentration being preferred, followed by OR 0.2%. In accordance with the quality parameters required for this type of food, the butter oil produced during the execution of this work met all requirements pre-established by current legislation. It is suggested that in future work the quantification of bioactive compounds present in plant extracts be carried out.

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