



INFLUENCE OF SEASONALITY ON THE QUANTITY AND COMPOSITION OF ESSENTIAL OIL EXTRACTED FROM BRAZILIAN CHERRY LEAVES (*Eugenia uniflora* L.)

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ABSTRACT

Objective: The objective of this study is to analyze the influence of seasonality on the quantity and composition of the essential oil extracted from Brazilian cherry leaves (*Eugenia uniflora* L.).

Theoretical Framework: In this topic, the main concepts and theories that underpin the research are presented. Essential oil, Brazilian cherry leaves, *Eugenia uniflora* L. stand out, providing a solid basis for understanding the context of the investigation.

Method: Collections took place in adult native trees located in the city of Santa Cruz do Sul, Rio Grande do Sul, Brazil, during the four seasons of the year. After drying, the leaves were homogenized and placed in plastic bags until the oil was extracted by hydrodistillation, in a modified Clevenger Extractor. The components were determined using a chromatograph and mass spectrometer.

Results and Discussion: The results obtained revealed that the seasons directly influence the yield of extracted oil, with the largest quantities obtained in summer and autumn. The main components identified in Brazilian cherry leaves essential oil were curzerene, germacrone, germacrene B and germacrene D.

Research Implications: The practical and theoretical implications of this research are discussed, providing insights into how the results can be applied or influence practices in the field of extracting essential oils from Brazilian cherry leaves (*Eugenia uniflora* L.).

Originality/Value: This study contributes to identifying the influence of seasonality on the amount of essential oil extracted from Brazilian cherry leaves. It also provides the main components identified in the essential oil according to the seasons.

Keywords: Essential Oil, Seasonality, Brazilian Cherry Leaf, *Eugenia uniflora* L.

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INFLUÊNCIA DA SAZONALIDADE NA QUANTIDADE E COMPOSIÇÃO DO ÓLEO ESSENCIAL EXTRAÍDO DAS FOLHAS DE PITANGUEIRA (*Eugenia uniflora* L.)

RESUMO

Objetivo: O objetivo deste estudo é analisar a influência da sazonalidade na quantidade e composição do óleo essencial extraído das folhas de pitangueira (*Eugenia uniflora* L.).

Referencial Teórico: Neste tópico, são apresentados os principais conceitos e teorias que fundamentam a pesquisa. Destacam-se óleo essencial, folhas de pitangueira, *Eugenia uniflora* L., fornecendo uma base sólida para a compreensão do contexto da investigação.

Método: As coletas ocorreram em árvores nativas adultas localizadas na cidade de Santa Cruz do Sul, Rio Grande do Sul, Brasil, durante as quatro estações do ano. Após secas as folhas foram homogeneizadas e acondicionadas em sacos plásticos até a extração do óleo por hidrodestilação, em um Extrator Clevenger modificado. A determinação dos componentes ocorreu em Cromatógrafo e espectrômetro de massas.

Resultados e Discussão: Os resultados obtidos revelaram que as estações do ano influenciam diretamente no rendimento do óleo extraído, sendo as maiores quantidades obtidas no verão e no outono. Já os principais componentes identificados no óleo essencial da folha de pitangueira foram o curzereno, a germacrona, o germacreno B e o germacreno D.

Implicações da Pesquisa: As implicações práticas e teóricas desta pesquisa são discutidas, fornecendo insights sobre como os resultados podem ser aplicados ou influenciar práticas no campo da extração de óleos essenciais das folhas de pitangueira (*Eugenia uniflora* L.).

Originalidade/Valor: Este estudo contribui para identificar a influência sazonalidade na quantidade de óleo essencial extraído das folhas de pitangueira. Fornece ainda os principais componentes identificados no óleo essencial conforme as estações do ano.

Palavras-chave: Óleo Essencial, Sazonalidade, Folha de Pitangueira, *Eugenia uniflora* L.

INFLUENCIA DE LA ESTACIONALIDAD EN LA CANTIDAD Y COMPOSICIÓN DEL ACEITE ESENCIAL EXTRAÍDO DE LAS HOJAS DEL ÁRBOL DE PITANGA (*Eugenia uniflora* L.)

RESUMEN

Objetivo: El objetivo de este estudio es analizar la influencia de la estacionalidad en la cantidad y composición del aceite esencial extraído de las hojas del árbol de pitanga (*Eugenia uniflora* L.).

Marco Teórico: En este tema se presentan los principales conceptos y teorías que sustentan la investigación. Se destaca el aceite esencial, hojas del árbol de pitanga, *Eugenia uniflora* L., brindando una base sólida para comprender el contexto de la investigación.

Método: Las colectas se realizaron en árboles nativos adultos ubicados en la ciudad de Santa Cruz do Sul, Rio Grande do Sul, Brasil, durante las cuatro estaciones del año. Luego del secado, las hojas se homogeneizaron y se colocaron en bolsas plásticas hasta extraer el aceite por hidrodestilación, en un Extrator Clevenger modificado. Los componentes se determinaron utilizando un cromatógrafo y un espectrómetro de masas.

Resultados y Discusión: Los resultados obtenidos revelaron que las estaciones influyen directamente en el rendimiento de aceite extraído, obteniéndose las mayores cantidades en verano y otoño. Los principales componentes identificados en el aceite esencial de las hojas del árbol de pitanga fueron curzereno, germacrona, germacreno B y germacreno D.

Implicaciones de la investigación: Se discuten las implicaciones prácticas y teóricas de esta investigación, proporcionando información sobre cómo los resultados pueden aplicarse o influir en las prácticas en el campo de la extracción de aceites esenciales de las hojas del árbol de pitanga (*Eugenia uniflora* L.).



Originalidad/Valor: Este estudio contribuye a identificar la influencia de la estacionalidad en la cantidad de aceite esencial extraído de las hojas de pitanga. También aporta los principales componentes identificados en el aceite esencial según las estaciones.

Palabras clave: Aceite Esencial, Estacionalidad, Hoja de Pitanga, *Eugenia uniflora* L.

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1 INTRODUCTION

Over the years, the search for natural products with functional properties has increased interest in bioactive compounds present in plant-based foods and their co-products (Renard, 2018; Farias *et al.* , 2022; Ferreira *et al.* , 2023). Among the species considered promising is *Eugenia uniflora* L. , popularly known as “pitanga” or “pitangueira”, which belongs to the *Myrtaceae* family (Costa *et al.* , 2013; Mesquita *et al.* , 2017; Lopes *et al.* , 2023), very common in South American countries (Consolini & Sarubbio, 2002; Merwe *et al.* , 2005; Martinez-Correa *et al.* , 2011; Ueda *et al.* , 2023).

In addition to being economically interesting for its fruits due to their exotic character, flavors and aromas, as well as its high pulp yield and nutritional value (Santos *et al.* , 2015; Cipriano *et al.* , 2021), the Surinam cherry is also valued for its leaves. When young, they are pink in color and become shiny dark green as they age (Mesquita *et al.* , 2017). When crushed, the leaves release a very pleasant characteristic odor, with strong fresh and woody notes (Mesquita *et al.* , 2017). They have the advantage of being perennial and continuously available, while the fruits are available for a short period of the year (Kanazawa *et al.* , 2000; Rattmann *et al.* , 2012).

Surinam cherry leaves have excellent economic and pharmacological potential (Queiroz *et al.* , 2015; Figueiredo *et al.* , 2019; Cruz *et al.* , 2022; Silva *et al.* , 2024), with proven medicinal properties in the prevention of some human diseases (Queiroz *et al.* , 2015; Rovedder *et al.* , 2016; Moura *et al.* , 2018). Several studies have shown that oils extracted from Surinam cherry leaves have broad bioactive characteristics that demonstrate antioxidant (Lorenzo *et al.* , 2018; Vargas *et al.* , 2019; Brito *et al.* , 2022; Costa *et al.* , 2020; Santos *et al.* , 2023), antifungal (Santos *et al.* , 2018; Santos *et al.* , 2023); anti-inflammatory (Rattmann *et al.* , 2012; Falcão *et al.* , 2018; Jesus, *et al.* , 2023) and antiviral (Santos *et al.* , 2018) activities. More recently, special attention has also been paid to insecticidal and repellent properties (Lobo *et al.* , 2019; Oliveira *et al.* , 2022; Altoe *et al.* , 2023; Silva *et al.* , 2023).



Essential oils, also called aromatic oils, are highly concentrated extracts, usually extracted from flowers, leaves, roots, and other parts of plants (Aumeeruddy -Elalfi *et al.* , 2018; Cherian *et al.* , 2023; Wu *et al.* , 2023), and have gained great acceptance and scientific interest currently (Xu *et al.* , 2019; Prasad *et al.* , 2022). Their diverse chemical composition extends their therapeutic benefits, covering applications such as antimicrobial, antioxidant, anti-inflammatory, and antiviral properties (Dhifi *et al.* , 2016; Aumeeruddy-Elalfi *et al.* , 2018; Fierascu *et al.* , 2020; Prasad *et al.* , 2022; Shetta *et al.* , 2024).

Different factors that influence the chemical compositions of essential oils include species , climatic conditions, soil conditions, fertilization, genotype, production mode, harvesting seasons, and extraction procedure (Milojević *et al.* , 2013; Nair *et al.* , 2022; Yazici & Sevgili, 2024). Surinam cherry leaves are known to be a rich source of essential oils (Franco, *et al.* , 2023; Silva *et al.* , 2023), but with distinct chemical compositions according to the different seasons of the year, changing between the wet and dry periods (Costa *et al.* , 2009; Cipriano *et al.* , 2021). Therefore, the objective of this study is to analyze the influence of seasonality on the quantity and composition of the essential oil extracted from Surinam cherry leaves (*Eugenia uniflora* L.) .

2 MATERIALS AND METHODS

The study was developed with the collection of branches and leaves of 8 adult native Surinam cherry trees (*Eugenia uniflora* L.) located in the area of the Central Campus of the University of Santa Cruz do Sul - UNISC, city of Santa Cruz do Sul, Rio Grande do Sul, Brazil (-29.696279, -52.439603). The climatic data of the day and time of collection, such as temperature, relative humidity (%) and precipitation on the day, were obtained by consulting the website of the National Institute of Meteorology (INMET) of the Ministry of Agriculture, Livestock and Food Supply at the automatic station of Rio Pardo/RS (-29.872222 , -52.381944).

The collection took place in the afternoon, at the end of July and October 2022 and January and April 2023, which corresponds to the middle of the winter, spring, summer and autumn seasons, respectively. Pruning shears were used for cutting, and immediately after the cut branches and leaves were packaged in plastic packaging, the material being immediately sent to the Laboratory of Processing of Foods of Plant Origin, located in Block 51, room 5104 of the University of Santa Cruz do Sul, for selection and subsequent drying. The selection was carried out on a classification table (Figure 1), where only the leaves were separated for drying and extraction, and the diseased and damaged parts, other plants and foreign materials were



removed.

Figure 1

Sorting table.



The leaves separated from the branches were placed on trays in a Macanuda Fruit Dehydrator, model DMS.M.EG (Figure 2), with heating and ventilation, maintaining the temperature between 38 °C and 45 °C, until humidity was below 3%.

Figure 2

Tray fruit dehydrator with already sorted pitangueira leaves.



To determine the moisture content in the leaves, the rapid method was used using a



moisture analyzer with infrared heating, in equipment from Gehaka, model IV3100, as shown in Figure 3. After drying, the leaves were homogenized and stored in plastic bags until extraction.

Figure 3

Gehaka moisture analyzer.



The essential oil extraction was carried out by hydrodistillation, in a modified Clevenger-type glass system (Santos; Braz-Filho; Castro, 2015), being adapted with a round-bottom flask with a capacity of 2,000 ml, with heating maintained at the minimum temperature necessary for boiling, coupled to a refrigeration system to maintain the condensation water between 9 °C and 14 °C (Figure 4).

Figure 4

Modified Clevenger extractor.





For extraction, approximately 100g of dry leaves were weighed and placed in the flask, then 1 liter of water was added and the system assembled. The heating of the blanket was turned on at maximum power until boiling began, then reduced to approximately 80% of maximum power and kept boiling for two hours (Figure 5).

Figure 5

Oil extraction.



After the extraction was complete, the distilled product (oil) (Figure 6) was separated from the water and then weighed. The oil content in grams of oil per kg of leaf was calculated on a dry basis and on a wet basis of the plant material. The extracted oil was sent to the Phytochemistry Laboratory, located in Block 11, room 1124 of the University of Santa Cruz do Sul, for determination of the oil components by gas chromatography coupled to mass spectrometry in an Agilent equipment, Model MSD5977B (Figure 7).



Figure 6

Essential oil (yellow color).



Figure 7

Chromatograph and mass spectrometer – Phytochemistry Laboratory.



3 RESULTS AND DISCUSSIONS

The collections of branches and leaves of the Surinam cherry trees were carried out on 07/21/22 (winter), 10/27/22 (spring), 01/31/23 (summer) and 04/26/23 (autumn). The climatological data of the collection days are presented in Table 1. During this period, the La Niña phenomenon was active, which causes drought in the southern region of Brazil (Agrosmart, 2024; Inmet, 2023).



Table 1

Climatological data from collection days.

Station	Collection date	Collection period	Temperature (° C)	Relative Humidity (%)	Precipitation per day (mm)
Winter	07/21/2022	afternoon	24.6	71	0
Spring	10/27/2022	afternoon	26.8	52	0
Summer	01/31/2023	afternoon	32.4	47	0
Fall	04/26/2023	afternoon	21.9	82	6.4

Source: INMET, 2024.

Table 2 shows the moisture values of the leaves at the time of harvest, which vary between different collections, a result that is reflected in the variation in the results of grams of oil obtained per kilogram of leaf, when calculated on a wet basis.

Table 2

Wet leaf moisture at collection.

Collection date	Collection period	Temperature (° C)	Relative humidity (%)	Precipitation per day (mm)	Leaf moisture (%)
07/21/2022	afternoon	24.6	71	0	53.12
10/27/2022	afternoon	26.8	52	0	51.63
01/31/2023	afternoon	32.4	47	0	54.17
04/26/2023	afternoon	21.9	82	6.4	59.18

Table 3 presents the results of the quantity of oil obtained, expressed on a dry basis and on a wet basis.

Table 3

Amount of oil obtained.

Station	Collection date	g oil / kg leaf	
		Dry Base	Wet Base
Winter	07/21/2022	2,937	1,380
Spring	10/27/2022	2,164	1,047
Summer	01/31/2023	6,369	2,934
Fall	04/26/2023	5,048	2,061

The results obtained demonstrate that summer and autumn were the seasons in which the highest amounts of oil per leaf weight were obtained, with the amount obtained in summer being almost 3 times greater when compared to spring. During spring, the trees had many leaves and fruits, which may be a cause for the reduction in the amount of oil in the leaves. Becker *et al.* (2017) obtained a yield of oil from the Surinam cherry tree leaf in the extraction process of 0.65% (6.5 g of oil per kilogram of leaf) in a collection carried out during the month of February 2015 (summer), in São Lourenço do Sul, RS, presenting a result, for the same time of year, very



close to that obtained in the present study.

Silva (2017) obtained an average yield of 0.51% (5.1 g of oil per kilogram of leaf) of oil in the extraction of pitangueira leaves collected between September 2015 and March 2016, in the municipality of Santa Helena de Goiás, located in the southwest of the state of Goiás. Zotti (2012) in his work extracted the oil from the pitangueira after drying at different temperatures of leaves collected on a rural property located in the north of the state of Rio Grande do Sul, in the region of Santa Cecília do Sul and obtained quantities of oil that varied between 3.6 ml and 5.6 ml of oil per kilogram of dry mass.

Table 4 presents the results of the main components of the essential oil obtained, by season. The main components identified in the essential oil of the pitangueira leaf were curzerene, germacrene, germacrene B and germacrene D. In the summer, there was a decrease in the amount of curzerene present and the identification of the alpha-chamigrene component, which was only identified in this season. Costa (2018) quantifies in his work the components curzerene, germacrene B and germacrene as the components in greatest quantity in the oil extracted from *Eugenia uniflora* L. from leaves collected in the Amazon region.

Table 4

Main components of oil.

Component	Relative area (%)			
	Winter	Spring	Summer	Fall
Curzereno	27.90	29.95	12.05	20.54
Germacrona	8.40	16.68	6.97	9.82
Germacreno B	6.51	5.45	7,16	4.42
Germacreno D	8.39	-	6.41	-
cis-beta-Ocimene	6.74	8.03	10.96	13.67
alpha-Chamigrene	-	-	27.56	-

The Ministry of Health (2015) states that for essential oil extracted by hydrodistillation, the components quantified in the greatest quantity were curzerene and germacrene B. The curzerene concentrations determined in essential oils from different locations show great variations, such as values of 34.8% in Goiás, 85.1% in Minas Gerais and 19.7% in Nigeria (Chang *et al.* , 2011). Comparing the composition of pitangueira essential oil obtained in various locations in Brazil and Nigeria, it can be concluded that the composition of the essential oil and the concentrations of the components are very complex and that the variability may be due to the biotypes and environmental factors of each region (Costa *et al.* , 2009 *apud* Chang *et al.* , 2011).



4 CONCLUSION

This study analyzed the influence of seasonality on the quantity and composition of the essential oil extracted from the leaves of Surinam cherry (*Eugenia uniflora* L.). The results showed that the seasons directly influence the yield of the extracted oil. The largest amounts of oil per leaf weight were obtained in summer and autumn, and in summer the amount was almost 3 times greater when compared to spring. Regarding the composition, the main components identified in the essential oil of Surinam cherry leaves were curzerene, germacrone, germacrene B and germacrene D.

Essential oils are volatile substances that can be extracted from various plants and have a wide range of uses, often unknown to society. This research can contribute as a source of information to spark interest and possible development of the essential oil production chain. The bioactive characteristics that demonstrate antioxidant, antifungal, anti-inflammatory and antiviral activities, in addition to insecticidal and repellent properties, make the essential oil from the leaves of the Surinam cherry a productive potential yet to be explored.

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