Anatomical study of the leaves and evaluation of the chemical composition of the volatile oils from *Psidium guineense* Swartz leaves and fruits

Estudo anatômico das folhas e avaliação da composição química dos óleos voláteis de folhas e frutos de *Psidium guineense* Swartz

Estudio anatómico de las hojas y evaluación de la composición química de los aceites volátiles de hojas y frutos de *Psidium guineense* Swartz

Abstract

*Psidium guineense* Swartz is a bush used in urinary tract diseases, diarrhea, and dysentery. The present study aims to perform the anatomical study of the leaves and evaluation of the chemical composition of the volatile oils from *Psidium guineense* Swartz leaves and fruits. The botanical material was collected in Hidrolândia, Goiás. Anatomical characterization and phytochemical screening of the leaves were performed by conventional methods. Leaf and fruit (green fruits, immature fruits, and ripe fruits) powders were submitted to hydrodistillation in the Clevenger apparatus and the identification of the chemical components of the volatile oils obtained was done by GC-MS. The leaf blade is hypoestomatic with paracytic and anisocytic stomata. Secretory cavities are observed in the central vein, mesophyll, petiole, and young stem. The powder moisture content was 7.4%. The total ash content of the leaf powder was 6.3% and the acid-insoluble ash content was 0.8%. The presence of tannins, flavonoids, and saponins in the leaves were identified. Leaves volatile oil’s majority compounds were 2Z,6E-farnesol (23.1-25.4%), α-copaene (17.7-20.3%), muurola-4,10(1.4) dien-1-β-ol (5.8-6.7%), epi-α-cadinol (5.5-6.3%), and δ-Cadinene (5.0-5.9%). Fruits volatile oil’s majority compounds were 2Z,6E-farnesol (31.9-41.4%), α-copaene (13.3-26.6%), δ-cadinene (5.4-9.8%), γ-himachalene (3.8-6.1%), and cubenol (2.6-6.1%). This is the first report on anatomical study of the leaves, and chemical composition of volatile oils from leaves and fruits of *P. guineense* collected in Hidrolândia, Goiás.

Keywords: Cerrado; Essential oils; Medicinal plants; Myrtaceae.
Psidium guineense Swartz is an arbusto used in diseases of the urinary tract, diarrhea and disenterea. The present study has as objective to realize the anatómico study of the leaves and evaluation of the composition química of the essential oils of the leaves and fruits of Psidium guineense Swartz. The botanical material was collected in Hidrolândia, Goiás. The characterization anatómica and the triagem fitoquímica of the leaves were realized by methods convencionales. The polvos of leaves and fruits (fruits red, fruits immature and fruits mature) were submitted to hydrodistillation in aparrelho of Cleve and the identificação of the components químicos of the essential oils obtained was made by CG-EM. The mineral of the leaf is hipoestomática with estomas paracíclicos and anisocíclicos. Cavidades secretorys are observed on the nervura principal, mesófilo, pecíolo and calé jovem. The teor of umidade of the pó foi de 7,4%. The teor total of cinzas of the pó da folha foi de 6,3% and the teor of cinzas insolúveis in acido foi de 0,8%. Foi identificada a presença of taninos, flavonóides and saponinas nas folhas. The compuestos majoritários do óleo volátil das folhas foram 2Z, 6E-farnesol (23,1-25,4%), α-copaeno (17,7-20,3%), muurola-4,10(14)-di-en-1β-ol (5,8-6,7%), epi-α-Cadinol (5,5- 6,3%) e δ-Cadineno (5,0- 5,9%). The compuestos majoritários of óleo volátil dos frutos foram 2Z,6E-farnesol (31,9-41,4%), α-copaeno (13,3-26,6%), δ-cadinene (5,4-9,8%), γ-himachalene (3,8-6,1%) and cubenol (2,6-6,1%). This is the first report of an anatómico study of the essential oils and composition química of the essential oils of the leaves and fruits of Ps. guineense coletados in Hidrolândia, Goiás.

Palavras-chave: Cerrado; Óleos essenciais; Plantas medicinais; Myrtaceae.

1. Introduction

The Cerrado is the most diverse savanna in the world, with 12,700 known vascular plants species, 35% of which are endemic (Forzza et al., 2012; Novaes et al., 2013). The Cerrado has 11 phytophysionomies, divided into forest, savanna, and peasant formations (Coutinho 2006). Myrtaceae family with 211 species occur in the Cerrado and are distributed in 14 genera, highlighting Eugenia L., Myrcia DC. Ex. Guill., and Psidium L. (Novaes et al., 2013).

Psidium guineense Swartz known as "araçá comum", "araçá-azedo", or "araçá-mirim", is distributed in Brazilian States such as Amazonas, Pará, Goiás, Minas Gerais, São Paulo, Mato Grosso, and Ceará (São Paulo, 1978). P. guineense is a shrub up to 6 m, with yellowish-brown coriaceous leaves of elliptical shape and flat central rib. The flowers can be solitary or in dichásiu with white petals (Silva & Mazine, 2016; Peixoto, et al., 2017). The fruit is a globular berry rich in vitamin C with high dispersion capacity, can be consumed in natura or as an ice cream, beverages, and liquors. The pulp is fleshy, white, mucilaginous, sweet, slightly sour, and aromatic and has numerous small seeds (Manica, 2000).

Brazilian folk medicine uses P. guineense to treat urinary tract diseases, diarrhea, and dysentery. Due to its high tannin content, fruit peel can be used in tanneries (Rodrigues & Carvalho, 2001; González, et al., 2005). P. guineense has volatile oils stored in the leaf and fruit secretory cavities (Oliveira, et al., 2014; Silva, et al., 2020).

Scientific studies performed with P. guineense leaves observed neuropharmacological effects in mice as the increase of sleeping time, anticonvulsant action, andalgesic action (Santos, et al., 1996; 1997); anti-nociceptive, anxiolytic and antidepressant activity (Santos, et al., 2020).
The present study aims to perform the anatomical study of the leaves and evaluation of the chemical composition of the volatile oils from *Psidium guineense* Swartz leaves and fruits collected in Hidrolândia, Goiás.

2. Material and Methods

2.1 Plant material

*Psidium guineense* Swartz leaves, green fruits, immature fruits, and ripe fruits were collected in January and February, during the morning and the first day each month in Hidrolândia - GO (786 m, 16° 53’ 59” S and 49° 13’ 29” W). Professor Dr. José Realino de Paula identified the specimen, and a voucher was deposited at the UFG Herbarium, Goiás, Brazil, under code number UFG-67843. The leaves and fruits were dried in an oven with air circulation at 38 °C by 2 days.

2.2 Anatomical study

For the anatomical study, leaves and stems were sectioned and stained with Alcian blue/safranin 9: 1 (Kraus & Arduin, 1997) and histochemical tests Steinmetz and Lugol reagents (Costa, 2001). The photographic recording of the anatomical structures was performed in a photomicroscope (Zeiss-Axiostar plus) with a coupled digital camera (Canon Power Shot G10) using the Axion Vision 4.8 software.

2.3 Phytochemical screening

The moisture analyzer (Ohaus model MB35) determined the moisture content leaf powder (Brasil, 2010). Total and insoluble ash content was determined according to the Brazilian Pharmacopoeia (Brasil, 2019). The phytochemical composition of leaf powder was screened for the presence of anthraquinone heterosides, coumarins, steroids, and triterpenes; starch (Lugol), alkaloids, flavonoid heterosides, saponins heterosides, and tannins (Costa, 2001; Cunha, 2009).

2.4 Volatile oils

Healthy leaves, green fruits, immature fruits, and ripe fruits were collected from ten different individuals in January and February, triturated immediately before volatile oil extraction, and 90g of the powder submitted to hydrodistillation in a Clevenger-type apparatus for 2 h. After drying with anhydrous Na2SO4, the oils were stored in glass vials at a temperature of -18 °C until further analysis. Each experiment was performed in triplicate. The composition of the volatile oils was analyzed using a Shimadzu GC/MS-QP5050A fitted with a fused silica SBP-5 (30 m × 0.25 mm I.D.; 0.25 µm film thickness) capillary column (composed of 5% phenylmethyl polysiloxane). The following temperature program was used: the temperature was raised from 60-240 °C at a rate of 3 °C/min and then to 280 °C at a rate of 10 °C/min, ending with 10 min at 280 °C. The carrier gas (helium) had a flow rate of 1 mL/min, and the split mode had a ratio of 1:20. The injection port was set at 225 °C. The operating parameters for the quadrupole mass spectrometer were as follows: the interface temperature was set to 240 °C and the electron impact ionization to 70 eV, with a scan mass range of 40-350 m/z at a sampling rate of 1 scan/s. The components were identified by comparison of the retention indices of the components to those of C9–C28 n-alkanes and comparison of the mass spectra with literature data (Van Den Dool & Kratz, 1963, Adams, 2007).

3. Results

3.1 Anatomic study

The foliar blade of *P. guineense* is hypoestomatic with paracytic and anisocytic (Figure 1A) stomata in paradermic section. The epidermis on both sides present cells with straight to slightly curved walls (Figure 1B). In the transversal section, it has uniestratiﬁed epidermis on the adaxial surface and hypodermis with two layers of cells, and uniestratiﬁed epidermis covered
by thick cuticle on both sides (Figure 1D) and unicellular trichomes (Figure 1C). The mesophyll is dorsiventral, present palisade parenchyma with two cell layers, and lacunae parenchyma with four to five cell layers (Figure 1D). Secretory cavities are present in the lacunous parenchyma (Figure 1D). A vascular bundle with the extension of the sheath is observe (Figure 1D).

**Figure 1** – **A, B** - Leaf blade Paradermic section. **A**- Paracytic (arrow) and anisocytic stomata (arrowhead) show in the abaxial face – **B**- Adaxial face. **C-D** - Transversal section of the mesophyll. **C**. unicellular trichomes. **D**. Secretory cavities are present in the lacunous parenchyma and cuticle on both sides (arrowhead). **Be** - Sclerenchymatous sheath. **CS** - Secretory cavity. **Cu** - Cuticle. **Ep** - Epidermis. **PL** - Lacunous parenchyma. **PP** - Palisadic parenchyma.

The main rib, in cross-section, has a plane-convex shape (Figure 2A). The epidermis is uniestratified coated by cuticle (Figure 2C), observing the presence of simple trichomes (Figure 2B). After the epidermis, there are about three to four layers of collenchyma cells (Figure 2D). The cortical parenchyma has from eight to ten layers of cells with secretory cavities (Figure 2F) and idioblasts containing druse-type crystals (Figure 2E). The vascular bundle is bicolateral with an arch shape surrounded by a range of sclerenchymatous sheath cells ranging from one to seven layers that emit projections between cells from the external and internal xylem to the phloem (Figure 2D). In the external phloem, idioblasts cells containing prismatic crystals are presented (Figure 2E).
Figure 2 - A, B, C, D, E, F- Principal rib transverse sections. A- General aspect. B. Simple trichomes. C. Detail of the epidermis coated by cuticle, collenchyma and cortical parenchyma. D. Vascular bundle detail. E. Idioblast cells containing prismatic crystals. F. Cortical parenchyma with secretory cavity CS- Secretory cavity. CD - Crystal druse. CO - Collenchyma cells. CP - Polyhedral crystal. Cu - Cuticle. Ep - Epidermis. Es - Sclerenchymatous sheath. Fl - phloem. PC - Cortical Parenchyma Xi - Xylem.

The petiole, in the transversal section, presents a plane-convex shape (Figure 3A) with uniestratified epidermis covered by a cuticle (Figure 3B and 3F). It presents a unicellular trichomas tectores. Below the epidermis, a collenchyma with three to four cell layers (Figure 3B) followed by cortical parenchyma with 10 to 12 cell layers, some presenting amyloplasts (Figure 3C). Secretory cavities (Figure 3B) and cells with points (Figure 3D) are observed in the cortical parenchyma. The vascular bundle is
bicolateral with a revolute arch shape (Figure 3E). It presents medullary parenchyma with cells of different sizes. Druse-like crystals are observed in the cortical parenchyma and medullary parenchyma and prismatic crystals in the phloem (Figure 3E).

Figure 3 - A, B, C, D, E, F - Cross-sections of petiole. A. Overview of the petiole. B. Secretory cavities in the cortical parenchyma. C. Cortical parenchyma presenting amyloplasts. D. Secretory cavity, cells with points and druse-like crystals in the cortical parenchyma. E- Vascular bundle detail. F. Unistratified epidermis covered by a cuticle (Steinmetz). A, B, C, D, E- Alcian blue/safranin. Am - Amyloplasts. CS- Secretory cavity. CC - Collenchyma cells. Cr – Crystal. Cu – Cuticle. Ep - Epidermis. Fl – Phloem. PC - Cortical parenchyma. Pm – Parenchyma medullary. Tr – Trichome Xi- Xylem.

The young stem, in cross-section, has an oval shape (Figure 4A) and is delimited by a unistratified epidermis coated with cuticle (Figure 4B) and numerous unicellular trichomes (Figure 4C). The cortical parenchyma contains about eight to nine cell layers, presenting secretory cavities Figures 4B and 4C). In the vascular bundle a phloem is observed followed by medullary parenchyma with isodiametric cells of varying sizes. Presence of idioblasts containing druses in the cortical and medullary parenchyma and prismatic crystals in the phloem.
3.2 Total ash content, acid-insoluble ash content, and phytochemical screening

The powder moisture content was 7.4%. The total ash content of the leaf powder was 6.3% and the acid-insoluble ash content was 0.8%. The qualitative presence of tannins, flavonoids, and saponins in the leaves were identified.

3.3 Volatile Oil

The volatile oil yield from *P. guineense* leaves varied from 0.05 to 0.06% and 93.5 to 99.7% compounds were identified. The analysis resulted in the identification of 31 components (Table 1), which were 0.5% to 1.2% monoterpenic hydrocarbons, 46.2% to 50.0% sesquiterpenic hydrocarbons, 40.2% to 50.4% sesquiterpenic oxygenates, 1.9% to 2.6% phenylpropanoids and 0% to 0.2% ketone. The major compounds were 2Z,6E-farnesol (23.1-25.4%), α-copaene (17.7-20.3%) (Figure 5), muurola-4,10(1.4) dien-1-β-ol (5.8-6.7%), and epi-α-cadinol (5.5-6.3%).

For the fruits, the yield of volatile oil varied between 0.03-0.5% and 96.8 to 100% compounds. The analysis resulted in the identification of 34 components were identified, being 0% to 0.2% monoterpenic hydrocarbons, 30.6% to 56.1% sesquiterpenic hydrocarbons, 43.0% to 66.2% oxygenated sesquiterpenes and 0.4% to 1.0% phenylpropanoids. The major ones

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**Figure 4** - A. The general appearance of the young stem in the transversal section (polarized light), B, C, D, E Transversal sections of young stem. B. Secretory cavities in the cortical parenchyma. C. Unicellular trichomes. D. Vascular bundle detail. CS- Secretory cavity. CD- Crystal drusa. Cp- Polyhedral crystal. Cr – Crystal. Cv- Vascular exchange. Ep - Epidermis. Fl- Phloem. Fv- Vascular bundle. PC- Cortical parenchyma. Pm- Parenchyma medullary. Tr – Trichome. Xi - Xylem

Source: Authors.
being 2Z,6E-farnesol (31.9-41.4%), α-copaene (13.3-26.6%), δ-cadinene (5.4-9.8%), γ-himachalene (3.8-6.1%), and cubenol (2.6-6.1%) (Table 1).

Table 1 - Percentage of chemical compounds of volatile oils from *Psidium guineense* leaves and fruits collected in Hidrolândia-Goiás, Brazil, in 2020.

| Chemical compounds          |  | Leaves | Green fruit | Immature fruit | Ripe fruit |
|-----------------------------|---|--------|-------------|----------------|------------|
|                             |  | Jan    | Feb         | Jan            | Feb        | Jan    | Feb |
| Hepten-2-one 6-methyl-5     |  | 985    | 984         | 0.2*           | 0          | 0      | 0    |
| 1,8-Cineole                 |  | 1031   | 1028        | 1.2            | 0.5        | 0      | 0    |
| 2-(1Z)-propenyl Phenol      |  | 1150   | 1158        | 1.1            | 2.1        | 0.9    | 0.9  |
| Hydrocinnamyl acetate       |  | 1368   | 1367        | 0.8            | 0.5        | 0      | 0    |
| α-Copaene                   |  | 1376   | 1372        | 17.7           | 20.3       | 26.6   | 17.8 |
| β-Funebrene                 |  | 1414   | 1415        | 2.3            | 1.8        | 1.5    | 0.9  |
| α-Humulene                  |  | 1454   | 1449        | 0.8            | 0.7        | 0.6    | 0    |
| E-β-Farnesene               |  | 1456   | 1456        | 0.7            | 0.6        | 0.6    | 0.5  |
| 9-epi-E- Caryophyllene      |  | 1466   | 1465        | 0              | 0          | 0      | 0    |
| γ-Gurjunene                 |  | 1477   | 1472        | 1.0            | 1.4        | 1.0    | 0.9  |
| γ-Himachalene               |  | 1482   | 1484        | 4.9            | 5.1        | 6.1    | 4.7  |
| β-Selinene                  |  | 1490   | 1490        | 4.1            | 4.3        | 5.8    | 4.3  |
| α-Muurolène                 |  | 1500   | 1497        | 1.7            | 2.1        | 1.8    | 1.3  |
| β-Bisabolene                |  | 1505   | 1506        | 0              | 0          | 0      | 0    |
| α-Cuprenene                 |  | 1505   | 1512        | 0              | 2.0        | 0      | 0    |
| δ-Amorphene                 |  | 1512   | 1510        | 1.5            | 0          | 1.7    | 1.3  |
| δ-Cadinene                  |  | 1523   | 1520        | 5.0            | 5.9        | 9.8    | 6.6  |
| Zonarene                    |  | 1529   | 1529        | 0              | 0.5        | 0      | 0    |
| α-Calacorene                |  | 1545   | 1539        | 0.5            | 1.0        | 0      | 0    |
| E-Nerolidol                 |  | 1563   | 1562        | 3.0            | 2.6        | 1.7    | 3.3  |
| β-Copaen-4-α-ol             |  | 1590   | 1582        | 1.1            | 0.9        | 0      | 0    |
| Carotol                     |  | 1599   | 1598        | 1.6            | 1.4        | 0      | 0    |
| Globulol                    |  | 1587   | 1590        | 0              | 0          | 0      | 0    |
| Ledol                       |  | 1602   | 1607        | 0.7            | 1.0        | 0      | 0    |
| Compound                          | KI   | RI  | Jan | Feb | ∗all | Source |
|----------------------------------|------|-----|-----|-----|------|--------|
| Muurola-4,10(14)-dien-1β-ol      | 1631 | 1624 | 6.7 | 5.8 | 0    | 0.05   |
| α-Acorenol                      | 1631 | 1624 | 0   | 0   | 1.7  | 0.06   |
| Muurola-4,10(14)-dien-1β-ol      | 1631 | 1624 | 0   | 0   | 0    | 0.04   |
| Zonarene                        | 1528 | 1529 | 0   | 0   | 1.7  | 0.04   |
| Caryophylla-4(12),8(13)-dien-5α-ol | 1640 | 1631 | 0.8 | 0.6 | 0    | 0.03   |
| epi-α-Cadinol                   | 1640 | 1637 | 6.3 | 5.5 | 2.7  | 0.03   |
| α-Muurolol                      | 1646 | 1642 | 2.1 | 1.9 | 0.5  | 0.03   |
| Cubenol                         | 1646 | 1649 | 0   | 5.0 | 2.6  | 0.03   |
| Cadalene                        | 1676 | 1670 | 0   | 0.5 | 0    | 0.03   |
| 2E,6Z-Farnesal                  | 1684 | 1670 | 0   | 0   | 0    | 0.03   |
| α-Bisabolol                     | 1685 | 1682 | 0   | 0   | 0    | 0.03   |
| 2Z,6E-Farnesol                  | 1723 | 1723 | 25.4| 23.1| 31.9 | 0.03   |
| 2E,6E-Farnesal                  | 1740 | 1741 | 0.4 | 0.4 | 0    | 0.03   |
| 2E,6E-Farnesal                  | 1740 | 1741 | 0   | 0   | 0.7  | 0.03   |
| 2E,6E-Farnesol                  | 1742 | 1738 | 0   | 0   | 0    | 0.03   |
| β-Bisabololenal                 | 1767 | 1769 | 0.8 | 0.9 | 0    | 0.03   |
| 2E,6E-Methylfarnesoate          | 1784 | 1783 | 0   | 0   | 0    | 0.03   |
| 2Z,6E-Farnesyl acetate          | 1846 | 1841 | 1.1 | 1.3 | 1.2  | 0.03   |
| Ketone                          | 0.2  | 0   | 0   | 0   | 0    | 0.03   |
| Phenylpropanoid                  | 1.9  | 2.6 | 0.9 | 0.9 | 0.9  | 0.03   |

| Category                        |       |     |     |     |      |        |
|----------------------------------|-------|-----|-----|-----|------|--------|
| Sesquiterpene hydrocarbons       | 50.0  | 46.2| 56.1| 38.3| 45.4 | 30.6   |
| Oxygenated sesquiterpenes        | 40.2  | 50.4| 43.0| 59.7| 53.0 | 66.2   |
| Hydrocarbon Monoterpenes         | 1.2   | 0.5 | 0   | 0   | 0    | 0.2    |
| Total identified (%)             | 93.5  | 99.7| 100.0| 98.9| 99.3 | 97.4   |
| Yield (%)                        | 0.05  | 0.06| 0.04| 0.04| 0.03 | 0.03   |

KI: Kovax index; RI: retention index; Jan: January; Feb: February; ∗all the number of the constituents are expressed in percentage.

Source: Authors.
4. Discussion

In the present study, unistratified adaxial epidermis with double layer of hypodermis, palisadic parenchyma with 2 layers of cells, numerous unicellular trichomes, paracytic, and anisocytic stomata were observed while Silva, et al. (2007) observed only paracytic stomata in the abaxial epidermis of *P. guineense* and only one layer of cells in the palisadic parenchyma. According to Brewer, et al. (1991), the trichomes may be responsible for water retention on the leaf surface by retaining water droplets, improving the photosynthetic process by allowing greater opening of the stomata. Secretory cavities containing volatile oils and crystals in forms of druses described in the leaves and young stem in this study were also described by Oliveira (2015), being a common feature of Myrtaceae species (Metcalfe & Chalk 1979).

The determination of moisture in herbal drugs is important in quality evaluation. Water excess produces unwanted chemical reactions and microbial contamination. Total ash and acid-insoluble ash in high levels indicates impurities like non-organic materials and silica (Alves, et al., 2010; Brasil, 2019). Official compendia have not established parameters for *P. guineense*. However, limit values for moisture are 12.0% and total ash 9.0 % for *P. guajava* powder (Brasil, 2019). *P. guineense* powder of the leaves displayed values of 7.4% moisture, 6.3% total ash, and 0.8% acid-insoluble ash. Tannins, flavonoids, and saponins were also identified in the leaves. These compounds were also described in the methanolic extract of *P. guineense* leaves from India by Sruthi, et al. (2019), alongside coumarins, terpenoids, and quinones.

In volatile oil from *P. guineense* leaves collected in Ceará State, Brazil, Neto, et al. (1994) found as major components 1.8-cineole (40.5%), β-eudesmol (19.5%) and α-pinene (13.9%). Tucker et al. (1995) determined as the main components of the leaves volatile oil in Mexico, β-bisabolene (13.18%), α-pinene (12.85%) and Z-nerolidol (5.50%). Spathulenol (80.71%) was the main component of the volatile oil, followed by 2Z,6E-farnesol (3.65%) and γ-terpineol (1.91%) in Mato Grosso do Sul (Nascimento, et al., 2018). Peralta-Bohórquez (2011), in Mexico, identified in the fruits volatile oil the components ethyl butyrate (30.3%), ethyl hexanoate (23.8%), β-caryophyllene (3.3%) by headspace solid phase extraction and β-caryophyllene (8.6%), while butanol (7.4%) and ethyl butyrate (7.4%) when obtained by distillation extraction.

**Figure 5** - Chemical structure of the major components of *Psidium guineense* volatile oil leaves **A.** 2Z,6E Farnesol. **B.** α-Copaene.

Source: Pubchem (2021a, b).
2Z,6E-farnesol belongs to the class of organic compounds known as sesquiterpenoids. These terpenes are constructed by three consecutive isoprene units (HMDB, 2021). Su, et. al. (2015) described the antimicrobial activity of 2Z-6E farnesol by microdilution broth method using minimum inhibitory concentration against *Aspergillus niger* (500 μg/mL), *Bacillus cereus* (62.25 μg/mL), *Candida albicans* (31.25 μg/mL), *Enterobacter aerogenes* (62.25 μg/mL), *Escherichia coli* (62.5 μg/mL), *Klebsiella pneumoniae* (125 μg/mL), *Pseudomonas aeruginosa* (125 μg/mL), *Staphylococcus aureus* (31.25 μg/mL), *S. epidermidis* (31.25 μg/mL), and *Vibrio parahaemolyticus* (500 μg/mL). The anticancer potential was tested on three human cancer cell lines: HT-29 (human colon), J5 (human hepatocellular carcinoma), and A549 (human lung adenocarcinoma). 2Z-6E farnesol reduced the viability 50% of HT-29, J5, and A549 cells at 10.6, 36.8, and 26.8 μg/mL, respectively.

α-Copaene belongs to the sesquiterpenoid class (HMDB, 2021b). Rodrigues, et al. (2018) observed antileishmanial activity of α-copaene in vitro, reducing viability by 50% for *Leishmania amazonensis* and *L. infantum* at the concentration of 17.2 and 11.4 μg/mL, respectively.

The chemical composition of the volatile oil of *P. guineense* showed component variation due to the studies being made in different regions, with different temperatures, pluviometric indexes, altitudes, type of soil, and incidence of ultraviolet rays (Gobbo-Neto & Lopes, 2007). According to Sangwan, et al. (2001) the volatile oils production depends on physiological, biochemical, metabolic and genetic aspects of the plant, and may suffer environmental and molecular modulations elucidating the chemical variations of volatile oils.

Due to the small size of the fruit, the amount of volatile oil obtained was low, a fact that represented a limitation of the study.

5. Conclusion

Anatomical studies, moisture content and total and insoluble ash in this study contribute to the quality control of plant raw material. Phytochemical screening is important to observe classes of molecules with possible biological activity. In this context qualitative presence of tannins, flavonoids, and saponins in the leaves were observed.

Leaves and fruits volatile oil’s majority compounds were 2Z,6E-farnesol and α-copaene. This is the first report on anatomical study of the leaves, and chemical composition of volatile oils from *P. guineense* leaves and fruits collected in Hidrolândia, Goiás.

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