Chapter 68

Bioactive compounds of rosemary from the field: a review of the biological effects

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ABSTRACT
The medicinal plants are currently part of the sociocultural scenario in several countries, although their use has been described since the Egyptian peoples. Thus, in their most varied forms of use, medicinal plants play a fundamental role in people's lives, besides being used in the prospection of new molecules with biological action, and can be used as new therapeutic routes in disease treatments. Besides the recognition in popular medicine, research indicates that rosemary (*Baccharis dracunculifolia) can* be an ally for the treatment of numerous diseases due to its biological activities, such as antitumor, antibacterial, antiviral, antifungal, antiprotozoal, anti-inflammatory, antioxidant, immunomodulatory, and analgesic properties. Considering its high pharmacotherapeutic potential, it is important to analyze and compile knowledge about the bioactive compounds of rosemary and its biomedical applications. In this study, a bibliographical survey was carried out in order to collect data and information on the identification and description of the rosemary field bioactives, as well as their biological activities. Thus, some compounds stand out for their actions, such as p-coumaric, caffeic, chrysinic, 3,5-diprenyl-4-hydroxycinnamic, agathic, cuprésic, betuletol, 15-acetoxyisocuprésic, prenylated coumaric, 3,5 and 4,5-dicaffeoylquinic acids. These compounds have important biological actions, responsible for promising researches for innumerous treatments of diseases, with potential antitumor effect for several cell lines, promoting alterations in the cellular metabolism, in the respiratory chain, in the distribution and progression of the cell cycle and in the proliferation of tumor cells.

Keywords: Rosemary from the field, bioactives, biological activity.

1 INTRODUCTION

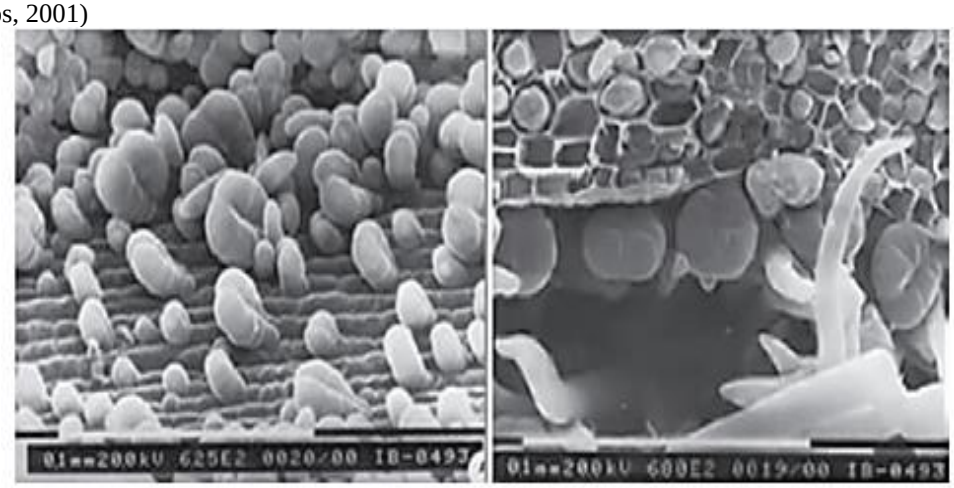
Alecrim do campo, *Baccharis dracunculifolia,* is a dioecious shrub, perennial, with branched woody stem, 3 to 4 meters high, native of the central-western, southern and southeastern regions of Brazil, often in open field areas, cerrado woodland and pastures (VERDI, et al 2005). It is also known by the popular name "vassourinha" due to its use in the production of brooms. It has characteristics of invasive and colonizing plants because it produces a large number of achenes and a high capacity for natural growth. Its

flowering occurs after the rainy season, with a peak in the month of November (BOLDT, 1989; FERNANDES, 1998).

The genus *Baccharis* belongs to the *Asteraceae* family, represented by more than 500 species distributed mainly in Brazil, Argentina, Colombia, Chile and Mexico, occupying regions of higher altitude (VERDI, et al 2005). Many of these species are used in popular medicine to control or treat various diseases, even consumed in the form of teas, or from the essential oil obtained from the leaves, which also have great value for the fragrance industry (Silva Filho, *et al*. 2008).

A remarkable aspect is its trichomes in a grouped manner, regularly distributed throughout the limb, which are present in its leaf epidermis. The high volume of secretion of the resinous material is due to the large number of glandular trichomes on its apices, and this resinous material has a varied composition, including flavonoids, aglycones, waxes, fats, terpenes and essential oils characterized by a strong and exotic aroma, produced and stored in the secretory ducts (BERNANDES, et al. 2022).

Figure 1 - Glandular trichomes of *Baccharis dracunculifolia* located on the surface of its leaves, visualized by scanning electron microscopy (Bastos, 2001)



B. dracunculifolia has great interaction with insects, especially *Apis melifera L.* bees, due to its diversity of phenolic compounds. The secondary metabolites of *B. dracunculifolia*, are usually toxic and inhibit the attack of insects, but these bees use it for the production of green propolis as a form of protection for defense of their hive against their own predators (BASTOS, 2011). There are several biological activities of green propolis, such as antimicrobial activity, anti-inflammatory, healing, anesthetic, *anti-Trypanosoma cruzi*, anticarcinogenic, antiviral, anticariogenic and antioxidant. Such biological activities are due to the synergism between its various chemical compounds, mainly phenolic compounds, especially flavonoids and phenolic acids, which are also present in *B. dracunculifolia*. At least 18 identical chemical substances have been identified between propolis and *B. dracunculifolia.*

The use of medicinal plants dates back to ancient Egypt, where there are records of the use of botanical substances to cure a variety of diseases (ABOELSOUD, 2010). Medicinal plants were an

important element in the survival of many ancient and contemporary peoples, in this sense, as an example, in Africa many cases of cancer are treated with medicinal plants, however, these healing processes are not documented, losing this wealth of information (MLILO & SIBANDA, 2022). The understanding and observation of these practices from a scientific point of view has enabled the development of new allopathic substances through the discovery of their active principles, making these ethnobotanical studies increasingly relevant (HEINRICH, 2000).

An example of a medicinal plant that has been used for a long time is *B. dracunculifolia,* which is recognized in popular medicine, with indications for gastric disorders, physical tiredness, inappetence, febrile illnesses, inflammation and diabetes (MELO et al, 2001; MENEZES, 2005), due to its medicinal recognition for its various biological activities, especially with antitumor, antibacterial, antiviral, antifungal, antiprotozoal, anti-inflammatory, antioxidant, immunomodulatory, and analgesic actions (LEMOS et al., 2007; MISSIMA et al., 2007; PAULINO et al., 2008; NAKANISHI et al., 2003). Thus, considering its high medicinal potential, it is important to analyze and compile knowledge about the bioactive compounds of rosemary, its biological activities and its use in health care.

2 METHODOLOGY

The results were obtained through a bibliographical survey, collecting data and information from theses, articles, reports, and books. The research was not restricted to the date of publication, language, or nationality, and the descriptors were consulted in Portuguese, English, and Spanish. In addition to the works indexed in the aforementioned research bases, other works cited in the selected articles were consulted.

The selection criterion for the articles is based on works that identify and describe the bioactive compounds of Alecrim do Campo and its application in various areas of scientific knowledge, mainly focused on compounds that have a biological action. With all the available bibliography, an analysis was made, by means of reading, with the purpose of evaluating the articles pertinent to the proposed objective. The databases listed below were consulted: Pubmed, Google Acadêmico and Scielo. The descriptors were: Alecrim do campo x artepelin c; Artepelin c x cancer; Alecrim do campo x bioactives.

3 RESULTS

The results were obtained after the analysis of the selected articles on the defined criteria, thus, only the compounds with biological importance were described below, and many of the compounds are still unclear about their biological function or do not have enough data for such an analysis.

3.1 EXTRACTION AND COMPOSITION OF THE ROSEMARY FIELD OIL EXTRACTS

After analyzing the data, it is evident that the composition of the extracts and oil from *B. dracunculifolia* depends on the geographical region (FERRONATTO et al., 2007). As well as the extraction methods, which in this case the use of supercritical fluids for the extraction of active compounds from vegetative matrices has shown to be a potential technology, presenting advantages over extraction with common solvents, such as the possibility of being able to manipulate the selectivity of the solvent in the process. It is one of the most advantageous technologies when it is aimed to supply high purity products, without solvent residues and with excellent sensorial properties, preserving the therapeutic and nutritional qualities of the extract (SUTTER et al.1994). The main disadvantage of the supercritical extraction (SCS) process is the high cost of the equipment.

There is a great phytochemical variety of chemical constituents with biological activity in *B. dracunculifolia*, characterized by the accumulation of sesquiterpenes, monoterpenes, diterpenes, triterpenes and flavonoids (AGOSTINI et al., 2005). Fukuda et al. (2006) isolated from rosemary leaves compounds such as the phenolic monoterpenes thymol and limonene and the sesquiterpenes espatulenol and nerolidol.

B. dracunculifolia also presents several phenolic acids, such as caffeic, p-coumaric (4-hydroxycinnamic acid), 3-prenyl-p-coumaric (drupanin), 3,5-diprenyl-4-hydroxycinnamic (Artepillin C) and 4'-methoxy-3,5,7-trihydroxyflavone (canferide) (ALENCAR et al., 2005, PARK et al., 2004). These phenolic compounds are secondary metabolites that contain hydroxyl and aromatic rings, in simple or polymer forms. The presence of such compounds has been widely studied for their pharmacological activities and inhibition of lipid oxidation and fungal proliferation (PIANTINO, 2008).

Many studies have been carried out in order to obtain the composition of extracts of rosemary from the field and, thus, Piantino (2004) performed an analysis of 5 extracts, obtained by ESC, in order to identify the chemical compounds. The sample characterization is fundamental in the process of screening the compounds and obtaining important data regarding the general composition of molecules present in the extracts (Table 01).

Table 1: Compounds obtained in the extracts of *Baccharis dracunculifolia* (Adapted: Piantino, 2004)

[M-H]	NOME	EXTRATOS
163	ácido o-coumárico	A, E
177	3-metoxi-4-hidroxicinamaldeido	B
179	ácido caféico	A
229	ácido 2,2-dimetil-2H-1-benzoprano-6-propenóico	C, D, E
231	ácido 3,4-dihidroxi-5-prenilcinâmico	A
233	viscidona	B
247	ácido 3,4-dihidroxi-5-prenilcinâmico	A
253	crisina	A, B, D, E
255	prinocembrina	B, C, D, E
285	canferol	A, B, C, D, E
297	ácido 2,2-dimetil-8-prenil-2H-1-benzopirano-6-propenóico	C, D, E
299	ácido 3,5-diprenil-4-hidroxicinâmico (artepelin C)	A, B, C, D, E
301	diidrocanferida	A, B
315	ácido 3-hidroxi-2,2-dimetil-8-prenil-2H-1-benzopirano-6-propenóico	A, B, C, D
317	ácido agatálico	D
319	ácido cupréssico	A, E
329	betuletol	A, C, D, E
333	ácido agático	D
347	15 metil éster do ácido agático	C
361	ácido 15-acetoxi-cupréssico	A, D, E
363	ácido 3-prenil-4-diidroxicinâmico	A, B, C, D, E
447	ácido (E)-3-(-4-hidroxi-3-[(E)-4-(2,3-diidrocinamoiloxi)-3-metil-2-butenil]-5-prenil-fenil)-2-propenóico	C, D, E
515	ácido dicafeoilquínico	A, B

A: extrato etanólico

B: extrato metanólico

C: extrato obtido por ESC (50°C, 300 bar)

D: extrato obtido por ESC (50°C, 300 bar + 5% (m/m) de co-solvente etanol)

E: extrato obtido por ESC (50°C, 300 bar + 5% (m/m) de co-solvente aceto de atila)

3.2 BIOACTIVES EXTRACTED FROM ROSEMARY FROM THE FIELD

After the identification of the compounds, biological tests are necessary to create a sequence of data that will allow science to conduct research on the applicability of bioactives in human health, as well as in other areas that can benefit from these promising compounds. Thus, we will present some of these compounds that have a high therapeutic potential or biological action. The biological actions of the following active ingredients have been described:

p-coumaric acid

The p-coumaric acid ($C_9H_8O_3$) is a phenolic compound, being an end product of plant metabolism, a source of glucose like most plant metabolites (ANDREASEN, 2001; MANACH, 2004; GARRAIT, 2006). Some biological activities were identified after treatment with p-coumaric acid, one of them being interference in the cell cycle of CaCO-2 (human colon adenocarcinoma) cells (G2/M phase) (JANICKE et al. 2011). Modulation of the mitochondrial respiratory chain following treatment with p-coumaric acid was evaluated, with the results showing interference with mitochondrial metabolic function. (JANICKE et al. 2005). Some research indicates that the esters derived from p-coumaric acid (methyl, ethyl and isopropyl

p-coumarate), present biological activities such as depigmenting, antioxidant, antitumor, anti-inflammatory, anti-adipogenic and antimicrobial activities (PEREIRA, 2017).

Caffeic Acid

The caffeic acid (3,4- dihydroxycinnamic acid) is derived from hydroxycinnamic acid, which associated with quinic acid gives rise to chlorogenic acid, forming the phenolic group of caffeoylquinic acids (SOARES, 2002; MURAD, 2013; Clifford, 1979). A study with caffeic acid demonstrated inhibition of proliferation of a human Hepatocarcinoma (HepG2) by blocking the expression of matrix metallopeptidase 9 (MMP-9) through inhibition of the NF-kB transcription factor protein complex (CHUNG et al., 2004). Other studies demonstrate that caffeic acid showed accumulation of cells in G0 and G1 phases (MURAD, 2013), potential induction of apoptosis in human myeloid leukemia (K562) cells (Chen et al. 2001), reduction of inflammatory markers β-catenin, nitric oxide synthase (iNOS), cyclin D1 expression and gradual increase of pro-apoptotic marker Bax (Ng, 2011). Studies suggest that the apoptotic activity of caffeic acid may depend on proliferative inhibition of the cell or modulation of cell signaling pathways (MURAD, 2013)

Crisina

Chrysin (5,7-dihydroxyflavone) (C15H10O4) is a flavonoid, consisting of two fused rings, A and C, and a phenyl ring, B, attached to the second position of the C ring, shares the structure of a common flavone, with an additional hydroxyl group at the fifth and seventh position of the A ring (MANI & NATESAN, 2018). It can be present in several types of honeys, propolis, mushrooms and some plants such as Passiflora coerulea (BORGES et al., 2015; CIFTCI et al., 2010; KALOGEROPOULOS et al., 2013). Chrysin has several pharmacological effects and biological activities, such as antioxidant, anti-inflammatory, anticancer, antiviral and neuroprotective activities.(BORGES et al., 2015; GOES et al., 2018; MANI & NATESAN, 2018; SOUZA et al., 2015)

3,5-diprenyl-4-hydroxycinnamic acid (Artepelin C)

3,5-Diprenyl-4-hydroxycinnamic acid ($C_{19}H_{24}O_3$), known as Artepelin C, is a phenolic compound derived from p-coumaric acid and cinnamic acid, and is a major component and secondary metabolite of *Baccharis dracunculifolia* . It consists of two prenyl groups (branched unsaturated aliphatic radical 3-methyl-but-2-en-1-yl.) attached to the metasites (C_3 and C_5) of the phenyl ring. (LIU, 2022)

It was demonstrated in in *vitro* and *in vivo* studies that Artepelin C possesses pharmacological effects, such as antioxidant, anti-inflammatory, antimicrobial, anti-diabetic, anti-tumor, neuroprotective, gastroprotective and immunomodulatory effects . In addition, it showed cytotoxic effect and growth in tumor cells was significantly inhibited when treated in human and murine tumor cells *in vitro* and *in vivo*,

such as human melanoma (SK-MEL), murine melanoma (B16-F10), human leukemia cell (K562), murine hepatocellular carcinoma (Hepa1c1c17). After Artepelin C treatment, there was suppression of tumor growth in addition to an increase in the proportion of CD4/CD8 T lymphocytes and in the total number of T helper cells. Artepelin C activates the immune system and has direct antitumor activity. In addition, some studies relate Art-C as a potent exogenous antioxidant molecule in free radical scavenging and reduction activities (BESERRA,2021).

Agactic acid

Agatic acid is an acid that is part of the diterpene class (C H_{2032}) characteristic of the oily resin of coniferous species, and can be found in the digestive tract of ruminants after consumption of pine needle. (DEMETZOS, 2001; ZEGGIO, 2016; LEE et al., 2003). In the literature, agacic acid has been reported to be abortive in mammals due to the rapid conversion of isocuprésic acid to agacic acid that can occur in the system, elevating concentrations in plasma (SOUSA, 2018; GARDNER et al., 2010; WELCH et al., 2012). Study by Banskota et al. (2001) demonstrate that the acid in question has hepatoprotective activity and demonstrated greater anti-helicobacter pylori action compared to 27 other compounds in the study by Zeggio et al. (2016).

Cuprésic acid

Cupréssic acid is a labdane-type diterpene (C H_{2032}) present in Rosemary of the Field (*B. dracunculifolia*), Brazilian Propolis and Geopropolis (SANTINI et al. 2019; CARDOZO et al., 2015). Bankova et al. in 1996 isolated some components with microbial activity from propolis, among them four labdane-like diterpernos, including cuprésic acid. This antimicrobial activity was mainly due to the polar and phenolic compounds in propolis (FUNARI, 2005). A study by WOO et al. (2011) evaluated and demonstrated cytotoxic potential of cupréssic acid in lung Adenocarcinoma, ovarian cancer, colon and melanoma.

Betuletol

Betuletol (C H O_{17147}) is a characteristic component of rosemary and propolis (PIANTINO, 2004; RUBIO, 2006). Studies show that the compound exhibits potent cytotoxic activity in human myeloid leukemia cells (K562), acting as apoptotic inducers by activation of the extrinsic caspase-8 pathway (RUBIO et al. 2006). The study was accompanied by the appearance of DNA fragmentation and cleavage of the DNA polymerase repair enzyme, inducing cell cycle arrest in the G2/M phase (RUBIO SÁNCHEZ et al. 2006).

15-acetoxy-cuprésic acid

15-Acetoxyisocuprésic acid is an acid that is part of the diterpene class (C H_{2032}) and is natural from the oily resin of some conifer species (DEMETZOS, 2001; ZEGGIO, 2016). A study elucidated by Bankova et al (1996) demonstrated that 15-Acetoxy-Cuprésic acid exhibits antibacterial activity through the labdanes isolated from the carboxyl group at C-19 and the hydroxyl group C-15, and exhibits hepatoprotective activity (ZEGGIO, 2016; BANSKOTA et al., 2001).

3-prenyl-4-dihydroxycinnamic acid

It is a prenylated coumaric acid found in both Rosemary in the Field and in Brazilian Propolis (PEREIRA, 2002). Research indicates that the compound has antiprotozoal activity, especially against Trypanosoma cruzi (PINTO et al., 2011).

Diphfeoilquinic acid

The 3,5 and 4,5-Dicaffeoylquinic acid (C H O_{252412}) were first isolated by Miketova et al. (1999) and are formed by the chemical reaction between a quinic acid with two caffeic acid molecules, by esterification. According to Clifford (1979), they are part of a group of chlorogenic acids and stand out for their neuroprotective potential, reducing oxidative stress associated with neurodegenerative diseases (SILVA et al., 2009). Studies show that dicafeoilquinic acid has activity against STIs, such as HIV-1, HIV-2 and Herpes, as well as hepatoprotective, antibacterial and antihistamine potential (KIM et al.,2005).

Hu et al. (2011) demonstrated the antiproliferative effect of 3,5-dicaffeoylquinic acid against adenocarcinoma cells by inducing cell cycle arrest in G0/G1 phases. Another study that demonstrated proliferative inhibition ability in HT-29 human colon adenocarcinoma cells through the apoptosis induction pathway (PUANGPRAPHANT et al., 2011). Also, in another study, the modulatory potential in the cell death mechanism of dicafeoilquinic acid was evaluated, and this acid promoted increased expression of Bax, Bcl-2, activation of caspase-8 and cleavage and activation of caspase-3 (MURAD, 2013).

3.3 BIOLOGICAL ACTIVITY OF ROSEMARY FIELD BIOACTIVES

After the identification studies of the bioactive compounds of rosemary, numerous biological properties have been tested and recognized as a potential source for the treatment of diseases and even applied to agriculture and industry. Some compounds extracted from field rosemary have significant antimicrobial action, being used for infection control, a case of great concern within the medical scenario (JACOBY et al, 2010; MAULDIN et al., 2010; WHO, 2019). These compounds have a key role in prospecting new therapies and also ways of hospital bacterial control, due to the high rates of therapeutic resistance to microorganisms and the resistance factors that are transferred, a major consequence of

mismanagement in hospital infection control that has allowed the spread of bacteria to community settings (WHO, 2019; Monteiro K.S. 2019).

The antibacterial potential of the essential oil of Rosemary of the Field (*B. dracunculifolia)* is related to damage to the structure and functionality of the membrane of bacteria, due to the accumulation of this lipophilic oil in the lipid bilayer of the cytoplasmic membrane, increasing its permeability.(MOUSSAOUI; ALAOUI, 2016; JYOTHI; SESHAGIRI, 2012; MONTEIRO K.S. 2019).

The antioxidant activity present in plant extracts have great importance in reducing lipid oxidation in plant and animal tissues. When incorporated into human food, it reduces the risk of developing pathologies such as arteriosclerosis and cancer (Namiki, 1990; Ramarathnam et al., 1995). This activity has been attributed to its oxido-reduction properties, playing an important role in the adsorption or neutralization of free radicals (BASILE et al., 2005). Phenolic antioxidants are able to inhibit the oxidation of various substrates, from simple molecules to complex biosystems, through two mechanisms that act both in the initiation and propagation stages of the oxidative process (SHAHIDI et al., 1992; NAMIKI, 1990; SIMIC, 1994).

The antioxidant activity of essential oils is attributed to the presence of phenolic compounds, such as flavonoids (polyphenols) and non-flavonoids (simple phenols or acids) that act as hydrogen donors to the free radical, originating a stable radical, due to the aromatic ring resonance presented by these substances (SILVA, 2011; Monteiro K.S. 2019; PIANTINO, 2008, COSTA G.M.B.A. 2016). The presence of these phenolic compounds in plants has been studied for inhibiting lipid oxidation and fungal proliferation (COSTA G.M.B.A. 2016).

The anti-inflammatory activity of phenolics from field rosemary was tested by FLORÃO et al. (2012), who suggested that the use of the essential oil of *B. dracunculifolia* may be beneficial in the intervention of immune disorders associated with inflammatory conditions (COSTA G.M.B.A. 2016). Pimentel et al. (2005) showed that the phenolic compounds with the highest anti-carcinogenic potential for colon, esophagus, lung, liver, breast, and skin neoplasms were 3,4',5'-trihydroxystilbene (resveratrol) and 3,4- dihydroxycinnamic acid (caffeic acid).

Resveratrol (3,4',5'-trihydroxystilbene) is a polyphenol produced by a wide variety of plants that is part of the set of phytoalexins, substances produced in response to exogenous stimuli, among them, ultraviolet radiation, mechanical damage or by microbial/animal attack (FRÉMONT, 2000; MOMESSO, ROBERTA GRAP, et al.). Resveratrol can be used in the prevention of tumor development (PERVAIZ, 2004), acting through the inhibition of the arachidonic acid cascade, metabolic route that induces the formation of tumors, and the inhibition of protein kinase mediator in tumor progression (STEWART, J. R, 2000). Other studies reveal that this phenolic compound could induce the apoptosis of cells, acting as an antiproliferative agent (RATNA, W. N. 2002; SCHNEIDER, Y. 2000). The presence of Resveratrol in the Cell Cycle plays in the cells to remain in the S Phase (MORENO, 2009).

4 DISCUSSION

After the analyses, the therapeutic and pharmacological potential of field rosemary (*B. dracunculifolia*) due to the presence of the most varied chemical constituents extracted from the resinous material of the plant leaf, including the secondary metabolites flavonoids, aglycones, waxes, fats, terpenes, essential oils and phenolic compounds, which provide antioxidant, anticancer and antimicrobial bioactivities. (COSTA G.M.B.A. 2016; FUNARI & FERRO, 2006; BAG et al, 2012; MONTEIRO K.S. 2019)

The extraction of the essential oil and resinous material was done by different processes, among the most used are steam distillation, hydrodistillation, extraction by organic solvents and supercritical fluid extraction (NAVARRETE et al., 2011). His extraction by the method with supercritical carbon dioxide proved to be one of the most effective extraction processes, presenting advantages over other methods with common solvents, such as the possibility of being able to manipulate the selectivity, providing products with high purity, preserving the therapeutic qualities of the extracted oil. (PIANTINO C.R. 2008; SUTTER et al.1994)

The first phytochemical study performed with the aerial parts of *Baccharis dracunculifolia* was carried out by Bohlmann et al. (1981), who isolated and identified the phenylpropanoids drupamine, baccharin and artepelin C. Then, some secondary metabolites were identified in the leaves by high performance liquid chromatography analysis, showing the presence of the phenylpropanoids coumaric acid and ferulic acid, besides the flavonoids kanferol, apigenin, isosacuranetin, pinocembrin, chrysin, galangin and kanferide (Park et al, 2002). Studies went on to report the presence of narigenin, isosacuranetin, aromadendrin-4'-methyl ether, acacetin C

Ferracini et al. (1995) studied the essential oil from leaves and flowers of seven species of Baccharis, obtained by hydrodistillation and identified in B. dracunculifolia 10 monoterpenes, highlighting β-pinene (3.76%) and limonene (4.65%), and 21 sesquiterpenes, of which spatulenol (2.58%), δ-cadinene (5.07%), β-caryophyllene (5.40%), β-selinene (9.90%) and (E)-nerolidol (20.80%) were the most abundant components. Loyaza et al. (1995) investigated the composition of oil from B. dracunculifolia, harvested in Bolivia and identified 53 components by gas chromatography coupled with a mass detector (GC-MS) analysis, with a yield of 0.16 to 0.32% (v/w), of which the majority components are germacrene, δ-cadinene and β-pinene, with contents of 4.96%, 12.97% and 17.23% respectively. Weyerstahl et al. (1996) identified over 100 compounds in the oil of B. dracunculifolia. This oil was composed of 19% monoterpene hydrocarbons, 2% oxygenated monoterpenes, 38% sesquiterpene hydrocarbons, and 35% oxygenated sesquiterpenes. This author mentions that the yield of oil obtained by distillation is between 0.5 and 1%.

5 CONCLUSION

From the bibliographical survey in the search banks (Pubmed, Google Academic, and Scielo), the bioactive compounds of rosemary from the field were identified and described, as well as their biological activities. Some compounds, such as p-coumaric, caffeic, chrysinic, 3,5-diprenyl-4-hydroxycinnamic, agathic, cuprésic, betuletol, 15-acetoxyisocuprésic, prenylated coumaric, 3,5 and 4,5-dicaffeoylquinic acids, stood out for their promising biomedical actions for the treatment of several diseases.

Thus, it is evident the therapeutic potential of rosemary (*B. dracunculifolia*) in several areas due to its effects, among which stand out the antitumor, antimicrobial, anti-inflammatory, and antioxidant activity. Being that, the factor for the success of the Rosemary of the Field are its phenolic compounds highlighted in the review, such as flavonoids and phenolic acids that demonstrate to have caused interferences in the cell cycle of several tumor lineages, as well as in their metabolic functioning, inhibiting their proliferation by inducing apoptosis and modulating the cell signaling pathways.

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