Chemical composition and biological action of the Ruta graveolens L. and Ambrosia arborescens: sociocultural incidence.

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*Composición química y acción biológica de **Ruta graveolens L.** y **Ambrosia arborescens**: incidencia sociocultural*

*Composició química i acció biològica de la **Ruta graveolens L.** i **Ambrosia arborescens**: incidència sociocultural*

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ABSTRACT

The study analyzed the biological activity of the secondary metabolites in the fresh plant and the chemical composition of the essential oil of *Ruta graveolens* L. and *Ambrosia arborescens* with pharmacological and medicinal properties. Phytochemical screening was applied using the qualitative analytical method and techniques that identify the organic substance by color change and precipitation.; and the chemical identification of essential oil components by gas chromatography/ mass spectrometer (GC/MS). In *Ruta graveolens* L**.** secondary metabolites stand out: alkaloids, tannins, coumarins as well as saponins and flavonoids; and, in *Ambrosia arborescens* predominate triterpenes, a, ß-hydroxylated quinones and anthraquinones. These last components are important for biological use, pharmacological, conventional medicine and traditional and ancestral medicine. The analysis of the essential oil of *Ruta graveolens* showed the presence of 21 components, highlighting undecanone (39.97/%) and nonanone (38.05%) with pharmacological properties such as anti-inflammatory, fungicide and herbicide; while the essential oil of *Ambrosia arborescens* presented 25 compounds, highlighting zingiberene, <α-> (55%) and shyobunol, (6.04%) of biological and ethnobotanical action and as a bactericide and anthelmintic. Plants and essential oils, due to their composition, biological activity and ancestral bond, are resources that benefit and invigorate the people's culture.

Keywords: chemical composition, biological action, plants and oils, *Ruta graveolens* L., *Ambrosia arborescens*

RESUMEN

El estudio analizó la actividad biológica de los metabolitos secundarios en la planta fresca y la composición química del aceite esencial de *Ruta graveolens L*. y *Ambrosia arborescens* con propiedades farmacológicas y medicinales. Se aplicó tamizaje fitoquímico utilizando el método analítico cualitativo y técnicas que identifican la sustancia orgánica por cambio de color y precipitación; y la identificación química de los componentes del aceite esencial mediante cromatografía de gases/ espectrómetro de masas (GC/MS). En *Ruta graveolens L*. se destacan los metabolitos secundarios: alcaloides, taninos, cumarinas así como saponinas y flavonoides; y, en *Ambrosia arborescens* predominan los triterpenos, a, quinonas ß-hidroxiladas y antraquinonas. Estos últimos componentes son importantes para el uso biológico, farmacológico, la medicina convencional y la medicina tradicional y ancestral. El análisis del

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aceite esencial de *Ruta graveolens* mostró la presencia de 21 componentes, destacando undecanona (39,97/%) y nonanona (38,05%) con propiedades farmacológicas como antiinflamatoria, fungicida y herbicida; mientras que el aceite esencial de *Ambrosia arborescens* presentó 25 compuestos, destacando zingibereno, <α-> (55%) y shyobunol, (6,04%) de acción biológica y etnobotánica y como bactericida y antihelmíntico. Las plantas y aceites esenciales, por su composición, actividad biológica y vínculo ancestral, son recursos que benefician y dinamizan la cultura del pueblo.

Palabra clave*:* composición química, acción biológica, plantas y aceites, Ruta graveolens L., Ambrosia arborescens

RESUM

L'estudi va analitzar l'activitat biològica dels metabòlits secundaris a la planta fresca i la composició química de l'oli essencial de *Ruta graveolens L.* i *Ambrosia arborescens* amb propietats farmacològiques i medicinals. El cribratge fitoquímic es va aplicar mitjançant el mètode analític qualitatiu i tècniques que identifiquen la substància orgànica per canvi de color i precipitació.; i la identificació química dels components d'olis essencials mitjançant cromatografia de gas/espectròmetre de masses (GC/MS). A *Ruta graveolens L.* destaquen els metabòlits secundaris: alcaloides, tanins, cumarines així com saponines i flavonoides; i, a *Ambrosia arborescens* predominen els triterpens, a, quinones ß-hidroxilades i antraquinones. Aquests últims components són importants per a ús biològic, farmacològic, medicina convencional i medicina tradicional i ancestral. L'anàlisi de l'oli essencial de *Ruta graveolens* va mostrar la presència de 21 components, destacant la undecanona (39,97/%) i la nonanona (38,05%) amb propietats farmacològiques com antiinflamatòries, fungicides i herbicides; mentre que l'oli essencial *d'Ambrosia arborescens* va presentar 25 compostos, destacant el zingiberè, <α-> (55%) i el shyobunol (6,04%), d'acció biològica i etnobotànica i com a bactericida i antihelmíntic. Les plantes i els olis essencials, per la seva composició, activitat biològica i vincle ancestral, són recursos que beneficien i dinamitzen la cultura del poble.

Paraules clau*:* composició química, acció biològica, plantes i olis, Ruta graveolens L., Ambrosia arborescens

INTRODUCTION

Aromatic and medicinal plants have been used by humans for hundreds of years as ingredients in food, beverages, cosmetics, pharmacology and agriculture; in the treatment of infectious, inflammatory diseases and other ailments. They are necessary to obtain compounds with biological properties, especially essential oils (EO)[1] which are toxic if the permitted dosage is exceeded. In the pharmaceutical industry they are used as antioxidants, antibacterials, antifungals, virals, parasitics, with relevance in aromatherapy as relaxants (anxiety and depression) and in traditional popular medicine[2].

Ruta graveolens, with a strong, penetrating smell and magical powers, is rich in essential oils with medicinal and agrochemical application predominantly aliphatic ketones, but lacks significant amounts of terpenes[3]; has a spore inhibitory effect and is used as whitefly repellent in agriculture[4,5].

It is stimulating, antispasmodic, irritating, abortifacient, and is used for the treatment of cough, colic, and flatulence; the leaf is used in amenorrhea, menorrhea and colics; headache, muscle pain, bronchitis, arthritis and the oil is considered antispasmodic, antiepileptic, emmenagogue, rubefacient, with a great toxic potential[6]. It is a protector against DNA strand break and mutagenesis and induces the elimination of an amide group of the anti-apoptotic protein Bcl-xL in human brain cancer cells, but not in normal B and T lymphocytes[7].

Used ancestrally in traditional medicine and transmitted orally by generations (sociocultural syndrome) for its use for cultural curses, in rituals of spiritual cleansing and protection (evil eye, fright, colds), bad dreams and ceremonies[8]. In solution with alcohol and camphor, rue or frame is used in healing drinks (infusion), for cleaning the house (as an insect repellent), keeping away bad energies (envy), decay, tiredness and fatigue (lack of strength or energy)[9].

Ambrosia chamissonis, native to California, is endemic to maritime habitats[10] represented by six species including *A. arborescens*[11] with a common name marco, marku, altamisa or artemisa in Ecuador, Peru, Bolivia and Colombia of the Andean region between 2000 and 3500 meters above sea level. It is useful in traditional medicine, as a potential relief for COVID symptoms, against Ae. Aegypti larvae; in curing ailments, as anti-inflammatory, a remedy for the lack of appetite, as insecticide for fleas, lice, flies and other insects, anti-parasite treatment (Ascaris lumbricoides worms) and for embalming corpses[12,13,14]. With an antibacterial, antiparasitic, emollient and analgesic effect to reduce inflammatory diseases and conditions[15], it prevents malaria, it is anthelmintic, antispasmodic and regulates menstruation[16]; the most promising bioactivities of sesquiterpenes in *Ambrosia* are antiproliferative and antiprotozoal[17]; which are crude extracts for reproductive control of teleogin ticks *Rhipicephalus*.

Ruta graveolens L. and *Ambrosia arborescens*, from the ethnobotanical point of view, are linked to daily life that uses them in cleansing and against envy (sociocultural emotions) as common practices of the Andean peoples of America in "rural sector and urban environments"[19,20]. They are also used for psychosomatic diseases with general symptoms that produce dizziness and drowsiness, in "traditional medicine for bad air (disease affecting rural populations)[21]. Due to their chemical composition, they are important in traditional medicine and for pest and disease control, in urban and peri-urban agriculture.

They are used as natural remedies such as antivirals, anti-inflammatories, for strengthening the immune system or respiratory diseases treatments[22] they integrate sustainable activities for environmental balance,

economy and well-being of people[23] that supports the development of the rural sector, without neglecting research to massify its use in the population considering that many countries such as "Mexico, where 90 percent of the population has used them"[24].

These plants are primary use materials in the treatment of conditions in populations that do not have adequate access to health services, articulating biomedical with ancestral medicine[25]. The rural population uses medicinal plants as the main alternative for health care[26], and as a social and economic contribution in activities that promote sales, generate jobs, combat rural poverty, and strengthen sociocultural and religious values with health practices in local communities[27,28,29,30]. They have served to make people fall in love, reassure, congratulate and accompany millions of people around the world for the ancestral knowledge they represent[31,32].

The more the properties of these plants are used and their application justified, the greater the possibility of offering new products to the community. The study highlights the value of chemical components and biological action of *Ruta graveolens* L. and *Ambrosia arborescens* for their application in medicine, industry and agriculture as resources to value traditional medicine and the sociocultural importance for the conservation of ancestral knowledge of the community.

MATERIALS AND METHODS

The review and validation of the scientific information on the plant species *Ruta graveolens* L.) and *Ambrosia arborescens*, the extraction, composition, biological action of its essential oils and sociocultural impact, reinforce the information for analysis and application in future research (Figure 1).

The plants were obtained between altitudes of 2200 to 2500 meters above sea level (masl) in the rural areas of Ibarra and Otavalo, cities of the province of Imbabura. The phytochemical screening was carried out using the qualitative analytical method with techniques that identify the presence or absence of secondary metabolites in the plant species by color change or precipitation for each organic substance.

The identification of secondary metabolites for: alkaloids, saponins, tannins, flavonoids, triterpenes, steroids, quinones (acid-base), hydrolyzed α-β quinones, pigments, naphthoquinones and coumarins for the evaluation of the potential biological, pharmacological, cosmetic and medicinal properties was carried out in the laboratories of the Catholic University of Ibarra. The extraction of essential oils was carried out at 50 masl in the laboratory of the Faculty of Agricultural Sciences of the University of Guayaquil. For cost, efficiency and ease of operation, the steam entrainment method (water-steam distillation equipment) with cohobation (return of condensed liquid from the water) to the extractor body was used (Quezada et al, 2022). For the extraction process of the volatile components, 7 kilograms of fresh raw material of each plant species were used with 4 liters of water at a boiling temperature of 99±1°C for 120 minutes. Meanwhile, the identification of the phytochemical components was carried out by gas chromatography coupled to a mass detector (GC-MS) in the instrumental analysis laboratories at the Universidad Técnica Particular de Loja.

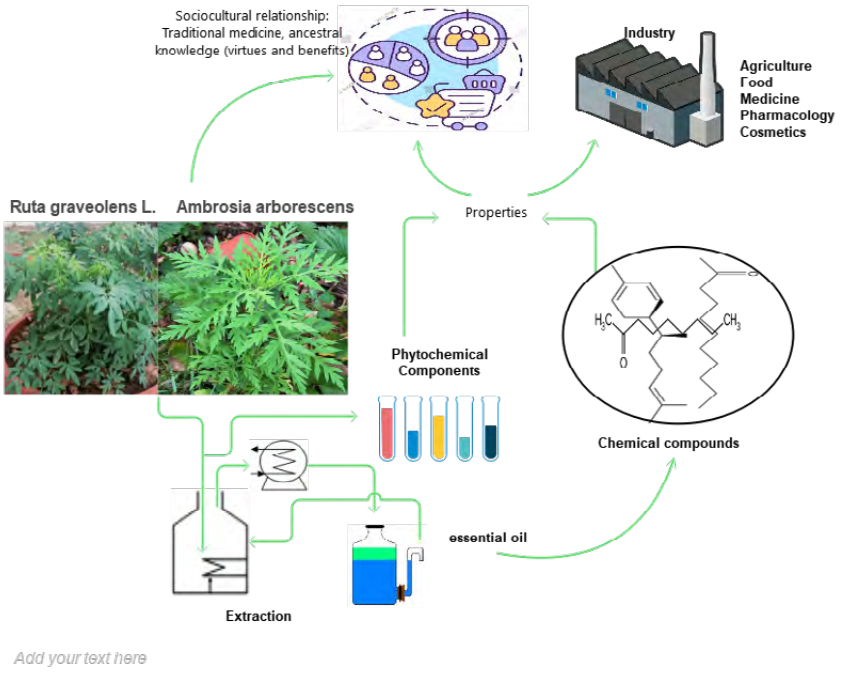


Figure 1. *Components of Ruta graveolens L. y Ambrosia arborescens supported by ancestral knowledge.*

RESULTS AND DISCUSSION

3.1 Photochemical screening

Photochemical screening of *Ruta graveolens* L. and *Ambrosia arborescens* (Table 1) shows the presence of alkaloids, tannins and coumarins; *Ruta* has saponins and flavonoids and, *Ambrosia*, is rich in triterpenes.

Alkaloids have biological and pharmacological use; natural phytochemicals that provide protection to the plant, they are antivirals, and are important for drugs with different medicinal properties as viable sources of potent antitumor compounds[34,35], anticancer, antimalarial, antiarrhythmic and antiviral[36,37].

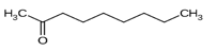
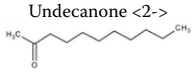
Tannins are used in biological activity in cosmetology and pharmaceuticals as an antioxidant, antibacterial, antifungal, antimalarial, anticancer, antioxidant, antimicrobial, anti-inflammatory with dermatological effects[38,39] and coumarins with antioxidant effect and bactericidal, fungistatic properties and efficient activity as insecticides due to their toxicity[40,41].

Saponins have antifungal, anti-inflammatory, antimicrobial, and antioxidant effects[42]. Flavonoids are used as a natural antioxidant[43,44]. Triterpenes have antioxidant, anti-inflammatory properties effective against arthritis[45] and pharmacological, antiproliferative and cytotoxic effects[46,,47]. Flavonoids possess biological properties, with anti-inflammatory, antioxidant, antiviral, antimicrobial, anticancer, cardioprotective, and neuroprotective[48] and fungal properties with biological functions in plants (against herbivores, ultraviolet radiation, and pathogens) and countless pharmacological activities[49].

Table 1. *Phytochemical constituents of Ruta graveolens and Ambrosia arborescens*

Parameter	*Ruta graveolens L*	*Ambrosia arborescens*
Alcaloids	**yes**	**yes**
Saponins	**yes**	**X**
Tannins	**yes**	**yes**
Flavonoids	**yes**	**no**
Triterpens	**no**	**yes**
Steroids	**no**	**no**
Quinons	**no**	**no**
Quinones a, ß –hydroxylated	**no**	**yes**
Pigments	**yes**	**yes**
Naphthoquinones y/o Antraquinones	**no**	**yes**
Coumarins	**yes**	**yes**

Table 2. Chemical Composition of Ruta graveolens Oil

Nº Peaks	Tr (min)	% Area	IRC	IRT	Chemical compound
1	9,21	0,42	988	988	Octanone <2->
2	15,07	38,05	1088	1090	Nonanone <2-> 
3	15,75	0,48	1100	1100	Nonanal <n->
4	16,70	0,46	1115	1124	Chrysanthenone
5	17,75	0,80	1132	1138	Geijerene
6	21,42	1,99	1191	1190	Decanone <2->
7	24,27	0,68	1235	1238	Hexyl (2E)-butanoate
8	27,33	3,12	1281	1285	Pregeijerene: $C_{12}H_{18}$
9	28,00	39,97	1292	1293	Undecanone <2-> 
10	28,93	0,30	1308	1305	Undecanal
11	31,73	1,05	1381	1388	Dodecanone <2->
12	33,25	0,97	1412	1400	Dodecanal
13	36,90	1,82	1471	1471	Dauca-5,8-diene
14	37,90	0,75	1497	1495	Tridecanone <2->
15	44,56	0,58	1671	1674	Hydroxydiphenyl methane <2->
16	48,55	1,05	1813	--	No Identificado
17	51,44	1,44	1942	1941	Callitrisin
18	51,90	2,45	1965	1959	Hexadecanoic acid: $C_{16}H_{32}O_2$
19	53,16	0,60	2041	2045	Canellal
20	54,72	1,20	2177	--	No Identificado
21	57,45	1,82	2445	--	No Identificado
100,00					

Tr= Retention time, IRC= Calculated retention rate, IRT= Tabulated retention rate

3.2 Chemical composition of essential oils

Ruta graveolens

Essential oil obtained with a yield of 0.2%, 21 components were identified with the dominant presence of undecanone (39.97%) and nonanone (38.05%), used in foods (flavors and fragrances) for biological and industrial functions for insecticides, fungi, pheromones, and antibacterial against E. coli[50,51]. Insect repellent, larvicide, antimicrobial, antiandrogenic, antidepressant, antihyperglycemic, antihyperlipidemic, anti-inflammatory, antitumor, and cytotoxic in human cancer cell lines[52], antifungal, antibacterial, repellent, and antioxidant[53,54], preservatives in food, and cosmetic matrices[55]. Pregeijerene (3.12%) as an antibacterial, anticancer, and repellent[56]. Hexadecanoic acid (2.45%) anti-inflammatory, hypocholesterolemic, nematicide, pesticide, antiandrogenic, and hemolytic properties of palmitic acid[57].

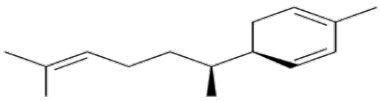
Other studies on essential oils from R. graveolens fruits found 43 components, ketones (2-nonanone and 2-undecanone). Monoterpenes (acyclic, phenolic, monocyclic and bicyclic); as well as sesquiterpenes (β-caryophyllene, α-caryophyllene, and manoyl oxide)[58].

Ambrosia arborescens

With the sample obtained of essential oil at 0.015% yield, it contains 25 components, highlighting the presence of zingiberene (55.91%), a "terpenic compound that acts as an antibacterial, anti-inflammatory, antifungal"[59,60,61].

Other components such as: terpinole (4.16%), curcumene (3.26%) that act as a repellent and insecticide[62]; limonene (2.51%) is a monoterpene hydrocarbon, defensive for herbs, used in traditional medicine as an antimicrobial[63,64,65] and antifungal and in diseases that affect the oral cavity, such as caries, periodontal disease,

Table 3. Chemical Composition of Ambrosia arborescens oil

Nº Peaks	Tr (min)	% Area	IRC	IRT	Chemical compound
1	5,44	0,67	901	906	Santolina triene
2	6,59	1,62	928	932	Pinene <α->
3	9,08	2,32	985	988	Myrcene: $C_{10}H_{16}$. (7-Methyl-3-methylene-1,6-octadiene)
4	9,88	1,20	1002	1002	Phellandrene <α->
5	10,86	0,89	1018	1020	Cymene <ρ->
6	11,10	2,51	1022	1024	Limonene: $C_{10}H_{16}$. (1-Metil-4-(1-metiletenil)-ciclohexeno)
7	11,39	2,39	1027	1026	Cineole <1,8> $C_{10}H_{18}O$
8	12,74	1,25	1050	1054	Terpinene <γ->
9	14,34	4,16	1076	1086	Terpinole:<α>: 4-Methyl-1-(1-methylethyl)-1,3-cyclohexadiene
10	15,36	1,26	1093	--	No Identificado
11	34,01	1,25	1424	1417	Caryophyllene <(E)->
12	36,96	55,91	1484	1493	Zingiberene <α-> 
13	37,09	3,26	1487	1479	Curcumene <ar->. $C_{15}H_{22}$
14	38,20	0,98	1504	1505	Farnesene <(E,E)-α->
15	38,62	2,21	1514	1522	Cadinene <δ->. $C_{15}H_{26}$
16	40,51	1,96	1560	1557	Silphiperfol-5-en-3-ol A
17	41,03	1,50	1573	1574	Germacrene D-4-ol
18	41,40	0,82	1581	1590	Globulol
19	42,02	0,40	1596	1594	Carotol
20	43,18	1,44	1630	1630	Muurola-4,10(14)-dien-1-β-ol
21	43,55	0,56	1641	1638	Cadinol <epi-α->
22	43,63	0,54	1643	1640	Muurolol <epi-α->
23	44,01	1,63	1655	1652	Cadinol <α->
24	45,22	6,04	1691	1688	Shyobunol. $C_{15}H_{26}O$
25	48,96	3,23	1827	--	No Identificado
100,00					

Tr= Retention time, IRC= Calculated retention rate, IRT= Tabulated retention rate

and candidiasis[66]; myrcene (2.32%) monoterpene used as a flavoring and flavoring in foods with antioxidant, anti-aging, anti-inflammatory, and analgesic properties[67]; cineole (2.39%) with pharmacological potential with analgesic action and anticancer, anti-inflammatory and antimicrobial properties[68]; and, cadinene (2.21%) sesquiterpene "insect toxin in cotton plants as an antifungal, antimicrobial, and antibacterial action[69,70].

The analyzed components of *Ruta graveolens y Ambrosia arborescens* (phytochemical analysis of the plant and essential oils) justify the importance of these plants, rooted and promoted in the sociocultural heritage of urban and rural peoples, to be used in traditional medicine.

CONCLUSIONS

The evaluated plant species have secondary metabolites, in *Ruta graveolens* alkaloids, saponins, tannins, flavonoids and coumarins stand out; while, in *Ambrosia*, alkaloids, tannins, triterpenes and coumarins predominate; with important properties for industry and application in rural medicine, which strengthens the interaction of nature with people within the culture of the peoples.

In the essential oils of the plant species *R. graveolens*, components such as nonanone and undecanone with antibacterial capabilities prevail; and, in *Ambrosia arborescens,* zingiberene predominates, with important antibacterial and antifungal action.

The more the properties of *Ruta graveolens L.* and *Ambrosia arborescens* chemical components, biological action (medicine, industry and agriculture) and the sociocultural relationship in traditional medicine are put into practice, the greater the possibility of offering new products to the community.

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