plants

MDPI

Review

An Overview of Genus *Malachra* L.—Ethnobotany, Phytochemistry, and Pharmacological Activity

Leonor Cervantes-Ceballos [1,*], Jorge Sánchez-Hoyos [1], Fredys Sanchez-Hoyos [1], Erick Torres-Niño [1], Jairo Mercado-Camargo [1], Amparo Echeverry-Gómez [1], Karick Jotty Arroyo [1], Esther del Olmo-Fernández[2] and Harold Gómez-Estrada [1]

[1] Grupo de Investigación en Química Orgánica Medicinal, Facultad de Ciencias Farmacéuticas, Campus de Zaragocilla, University of Cartagena, Cartagena 130001, Colombia
[2] Departamento de Ciencias Farmacéuticas, Área de Química Farmacéutica, Centro de Enfermedades Tropicales de la Universidad de Salamanca (CIETUS), Instituto de Investigación Biomédica de Salamanca (IBSAL), Facultad de Farmacia, Campus Miguel de Unamuno, Universidad de Salamanca, 37007 Salamanca, Spain
* Correspondence: lcervantesc@unicartagena.edu.co

Abstract: The genus *Malachra* L. belongs to the family Malvaceae. It includes herbs or subshrubs of nine accepted species with approximately thirty synonyms, and it has been widely used in community folk medicine to treat health problems including inflammation, nasal obstruction, leishmaniasis, malaria, childbirth, kidney disorders, fever, respiratory tract diseases, among others. From the genus *Malachra* L., flavonoids, steroids, triterpenes, anthocyanins, leucoanthocyanins, saponins, carbohydrates, phenols, glycosides, and alkaloids have been isolated and identified. Some pharmacological reports have indicated that the genus has antidiarrheal, antiepileptic, antiulcerogenic, antioxidant, anticonvulsant, antiviral, anticancer, antibacterial, anthelmintic, and hepatoprotective properties. However, there have been limited studies of bioactive molecules with pharmacological and biological activities associated with *Malachra alceifolia* Jacq., *Malachra capitata* (L.) L., *Malachra fasciata* Jacq., *Malachra radiata* (L.) L., *Malachra ruderalis* Gürke., *Malachra rudis* Benth., *Malachra helodes* Mart., *Malachra urens* Poit. ex Ledeb. & Alderstam., and *Malachra officinalis* Klotzsch. In this review, we consider the conservation of these species to save the ancestral knowledge of their traditional use in populations, and their pharmacological potential for future studies in search of alternatives for solutions to diseases in humans and animals and tools for the design and search of potential bioactive compounds against infectious and non-infectious agents.

Keywords: *Malachra*; ethnobotany; pharmacological activity

Citation: Cervantes-Ceballos, L.; Sánchez-Hoyos, J.; Sanchez-Hoyos, F.; Torres-Niño, E.; Mercado-Camargo, J.; Echeverry-Gómez, A.; Jotty Arroyo, K.; del Olmo-Fernández, E.; Gómez-Estrada, H. An Overview of Genus *Malachra* L.—Ethnobotany, Phytochemistry, and Pharmacological Activity. *Plants* **2022**, *11*, 2808. https://doi.org/10.3390/plants11212808

Academic Editor: Daniel K. Owens

Received: 4 September 2022
Accepted: 18 October 2022
Published: 22 October 2022

1. Introduction

Various populations of some regions of the world use medicinal plants to cure and prevent their health problems [1]. However, the World Health Organization (WHO) has defined ancestral and traditional knowledge resources obtained from plants, extracts, fractions, or compounds as a primary source for the identification of molecules, substances, or active principles to be used in the development of drugs and phytomedicines for disease prevention [2–4]. Secondary metabolites derived from plant species such as *Taxus brevifolia* (Paclitaxel) [5], *Catharanthus roseus* (Vincristine) [6], *Digitalis lanata* (Digoxin) [7], *Ephedra distachya* (Ephedrine) [8], *Artemisia annua* (Artemisinin) [9], *Salix alba* (acetylsalicylic acid) [10], and *Papaver somniferum* (morphine) [11] have been used as drugs with anticancer, cytotoxic, antimicrobial, analgesic, inflammatory, antiestrogenic, antiallergic, antioxidant, and other activities [12,13]. Note that ancestral and traditional community activities have used medicinal plants for phytotherapy in primary health care and for validation of their ethnopharmacological use [14,15].

There are about 382,000 accepted plant species names in the world [16,17]. The criteria for considering the acceptance, name, and synonyms of a plant species are defined by taxonomic concepts from botanical studies, herbarium specimens, biogeographical, conservation and phylogenomic research, as well as expert observations [18]. About 20% of these names are unresolved, indicating that some included data sources that did not provide any evidence or view on whether or not the name should be treated as accepted, or there were contradictory opinions that could not be easily resolved, leaving ambiguous and unchecked concepts [17].

Malachra L. is an accepted genus that belongs to the Malvaceae family and contains seventeen known species, with only nine accepted species including *Malachra alceifolia* Jacq., *Malachra capitata* (L.) L., *Malachra fasciata* Jacq., *Malachra radiata* (L.) L., *Malachra ruderalis* Gürke., *Malachra rudis* Benth., *Malachra helodes* Mart., *Malachra urens* Poit. ex Ledeb. & Alderstam [16], and *Malachra officinalis* Klotzsch [17]. However, only eight species of the genus *Malachra* L. are ambiguous and unchecked [7] wih some reports of botanical descriptions, ethnobotanicals, phytoconstituents, pharmacological, and biological activities. Therefore, some species names of the genus *Malachra* L. are currently unchecked, ambiguous, and awaiting taxonomic scrutiny: *Malachra lobata* L., *Malachra texana* A. Gray., *Malachra triloba* [Desf.], *Malachra rosea* Hoffmanns., *Malachra digitata* C. Presl., *Malachra urticifolia* C. Presl., *Malachra viminea* Fisch. ex Steud., and *Malachra plumosa* Desr. [8]; to date, there are no reported descriptions such as those mentioned above [18,19].

The life form of the *Malachra* L. genus is a herb or subshrub present in terrestrial substrate [19]. Regarding geographical distribution, the genus *Malachra* L. genus is native to approximately fifty countries in tropical and subtropical America and West Africa, and has been introduced in some regions of the United States, India, and Asia [20]. Colombia and Brazil are biodiverse countries that harbor most of the Earth's species of the genus *Malachra* L. and high numbers of endemic species including *Malachra alceifolia* Jacq., *Malachra capitata* (L.) L., *Malachra fasciata* Jacq., *Malachra radiata* (L.) L., *Malachra ruderalis* Gürke., and *Malachra rudis* Benth. are distributed in almost all the territories. In Colombia, there are few studies on the conservation status according to the categories and criteria of the International Union for Conservation of Nature and Natural Resources (IUCN) and biological and pharmacological potentials [21].

The genus *Malachra* L. contains phytoconstituents isolated from whole plant, leaf, stem, flowers, and root, fresh or dried, flavonoids [22]; compounds of phenolic acids [23,24]; phytosterol [24,25]; fatty acid derivative [26]; alkaloids, tannin [27,28]; and dipeptide [29,30]. The phytoconstituents are molecules necessary for plant survival, but also contribute to the prevention of many infectious and non-infectious diseases. Several communities in these countries use these traditional plants for treating ailments such as inflammation, clogged nose [1], leishmaniasis [31], malaria [32,33], kidney disorder, fever [34], diseases of the respiratory tract [35], and during childbirth, and therefore, have become one of the best medicinal alternatives for these communities.

The species in the genus *Malachra* L. are frequently reported as weeds, in pastures and rangelands, and usually serving as food for livestock [36]. In addition to this, they fulfill functions of vital importance to the ecosystem, and they are a source of food for various species of butterflies, as well as a great repository for the larvae of the same [37]. At an ecosystemic level, the species in this genus are considered to be primarily for the regeneration processes of intervened ecosystems since they favor the succession processes of other species in these ecosystems [38].

In this review, we organize the ethnobotanical, phytochemical, biological, pharmacological, and toxicological information of plants belonging to the genus *Malachra* L., to analyze the state-of-the-art of the genus and to highlight the pharmacognostic potential of molecules extracted from these plants, organic extracts, and fractions as potential sources of new drugs and for the development of innovative medicines.

2. Material and Methods

This review was conducted using the Preferred Reporting Items for Systematic Review (PRISMA) guidelines for systematic reviews. First, in accordance with the PICO method of the PRISMA guidelines for data selection, a scientific question was posed with the following heading: P: genus *Malachra* L. in the family Malvaceae, I: Included species, C: accepted, ambiguous, and unchecked species, O: taxonomy, botanical descriptions, geographical distribution, phytochemistry, ethnobotany, pharmacological, and biological activities of species. Followed by the search strategy: ((*Malachra* [Title/Abstract])) OR, Search: (Taxonomy [MeSH Terms]) AND (genus *Malachra* [Title/Abstract])) AND (Taxonomy [Title/Abstract]) OR (*Malachra* species [Title/Abstract])) AND (*Malachra* species, ethnobotanical [Title/Abstract])),OR (*Malachra* species [Title/Abstract]) AND (*Malachra* species, phytoconstituents [Title/Abstract]) AND (*Malachra* species, ethnobotanical [Title/Abstract]) AND (*Malachra* species, pharmacological activity [Title/Abstract]) AND (*Malachra* species, biological activity [Title/Abstract]); the type of search: new; databases: Medline, Latin America & Iberia; Platforms: PubMed accessed on 10 January 2022 (https://pubmed.ncbi.nlm.nih.gov/, accessed on 1 March 2022), ScienceDirect accessed on 10 January 2022 (www.sciencedirect.com, accessed on 1 March 2022), Scopus accessed on 10 January 2022 (www.scopus.com, accessed on 1 March 2022), and Scielo accessed on 10 January 2022 (www.scielo.org, accessed on 1 March 2022); search date range: unlimited; Language Restrictions: none. Different inclusion and exclusion criteria were considered. The inclusion criteria used were as follows:

1. Websites where the names of the species mentioned in this review have validated geographic distribution, and are recognized as taxonomic and botanical World Plants (www.worldplants.de), including World Flora Online (WFO) (http://www.worldfloraonline.org/, accessed on 1 March 2022), World Checklist of Vascular Plants (WCVP) (https://wcvp.science.kew.org/, accessed on 1 March 2022), Plants of the World Online (https://powo.science.kew.org/, accessed on 1 March 2022), Catálogo de plantas y líquenes de Colombia (http://catalogoplantasdecolombia.unal.edu.co/, accessed on 1 March 2022), Tropicos (https://www.tropicos.org/home, accessed on 1 March 2022), Tramil (https://www.tramil.net/es, accessed on 1 March 2022), Angiosperm Phylogeny (http://www.mobot.org/MOBOT/research/APweb/, accessed on 1 March 2022), and Global Biodiversity Information Facility (https://www.gbif.org/, accessed on 1 March 2022).

2. Articles, abstracts, and university repositories with descriptions of phytoconstituents using clear methodology for obtaining extracts, fractions, compounds, and plant part used.

3. Articles, abstracts, and university repositories with pharmacological and biological descriptions using clear methodology in the evaluation of doses, concentrations, biological models used, and controls.

The exclusion criteria were those studies that did not meet criteria one, two, and three.

There were fifteen bibliographic registers identified in the database; records deleted eight (congress abstract six, taxonomic website version not updated one (http://www.theplantlist.org/, accessed on 1 March 2022), article without pharmacological description one); articles evaluated for eligibility eight; articles accepted for the study seventy-nine; flora microsites accepted nine; graduate work four.

3. Taxonomy the Genus *Malachra*

According to World Flora Online, the genus *Malachra* L. belongs to the family Malvaceae, the group of angiosperms with the largest accepted name reports, including 14,539 scientific species names, 4465 accepted species names, and 245 genera [39]. The botanical characteristics of this family describe its growth as shrub, tree, herb, liana/vine, subshrub, aquatic, terrestrial, hemiepiphytic, and rupicolous [17,40]. The genus *Malachra* L. has nine species with accepted names and prolific taxonomic synonyms with adjusted morphological descriptions [17]. However, in the Flora World website *Malachra officinalis* Klotzsch., is accepted, whereas in other flora websites such as https://powo.science.kew.org/, https://wcvp.science.kew.org/, and https://www.tramil.net/es, (accessed on 1 March 2022), this species is not accepted (Tables 1 and 2). There is no information on this species provided in this review due to its limited studies.

Table 1. Taxonomic name status of species in the genus *Malachra* L.

Genus	Species	Scientific Name Status		
		Accepted	Ambiguous	Unchecked
***Malachra* L.**	*Malachra alceifolia* Jacq.			
	Malachra capitata L.			
	Malachra digitata C.Presl.			
	Malachra fasciata Jacq.			
	Malachra helodes Mart.			
	Malachra lobata L.			
	Malachra officinalis Klotzsch.			
	Malachra plumosa Desr.			
	Malachra radiata L.			
	Malachra rosea Hoffmans.			
	Malachra ruderalis Gürke.			
	Malachra rudis Benth.			
	Malachra texana A.Gray.			
	Malachra triloba [Desf.]			
	Malachra urens Poit. ex Ledeb. y Alderstam.			
	Malachra urticifolia C.Presl.			
	Malachra viminea Fisch. ex Steud.			

Table 2. Taxonomic synonyms for species of the genus *Malachra* L.

Genus	Species	Taxonomic Synonyms
***Malachra* L.**	***Malachra alceifolia* Jacq.**	*Malachra alceifolia* var. *alceifolia*
		Malachra alceifolia var. *conglomerata* (Turcz.) Hochr.
		Malachra alceifolia var. *rotundifolia* (Schrank) Gürke.
		Malachra conglomerata Turcz.
		Malachra hispida Sessé & Moc.
		Malachra rotundifolia Schrank.
		Urena capitata var. *alceifolia* (Jacq.) M. Gómez.
	***Malachra capitata* L.**	*Malachra heptaphylla* A. St.-Hil.
		Malachra heptaphylla Fisch.
		Malachra mexicana Schrad.

	Malachra palmata Moench.
	Malachra velutina Triana & Planch.
	Sida capitata L.
	Urena capitata (L.) M.Gómez.
	Urena capitata var. *capitata*
	Urena moenchii M.Gómez.
***Malachra fasciata* Jacq.**	*Malachra alceifolia* var. *fasciata* (Jacq.) A.Robyns.
	Malachra fasciata var. *linearilo-ba* (Turcz.) Gürke.
	Malachra horrida (Span.) Miq.
	Malachra humilis Benth.
	Malachra kegeliana Garcke.
	Malachra lineariloba Turcz.
	Malva horrida Span.
***Malachra helodes* Mart.**	No synonyms
***Malachra radiata* L.**	*Malachra bracteata* Cav.
	Sida radiata L.
	Urena radiata (L.) M. Gómez.
***Malachra rudis* Benth.**	*Malachra poeppigii* Gürke.
***Malachra urens* Poit. ex Ledeb. y Alderstam.**	*Urena urens* (Poit. ex Ledeb. & Alderstam) M. Gómez.

4. Botanical Description of the Species of the Genus *Malachra* L.

The genus *Malachra* L. is represented by herbs or suffrutes, sometimes puberulent, generally hispid, or with stinging trichomes. Leaves are simple or palmately lobed; acute, acuminate, or obtuse at the apex; truncated or subcordate at the base; serrated or crenated; and generally pubescent. They also present: bracteate inflorescences; axillary or terminal heads; broadly cordate-ovate bracts at the base, with prominent nerves often alternating with whitish areas, although it can be in other parts green and sessile. Absent calliculus (except in *M. radiata*); small calyx, five-lobed; white, yellow, or lilac corolla; and five-lobed leaves can also be observed. Additionally, schizocarpal fruits have the shape of a wheel similar to a cheese that can be split into five ripe wing types; flowers are in heads, surrounded by bracts larger than them [17,41–44].

***Malachra alceifolia* Jacq.** is a herb or shrub, 1. 6 m tall. The aerial parts and petioles are hispid, simple or split, flavescent, tuberculate base, scattered hairs, short, star-shaped, and long forming knots, with stem pubescence and a green to reddish color. The leaves are simple, opposite, and lobed, with up to five lobes, with pubescence, and their margins are serrated or toothed. There are inflorescences in axillary heads with the presence of acuminate bracts and flowers with five petals, 2 to 3 cm in diameter, with a yellow coloration. The fruits have bracts and persistent calyx, with numerous seeds, up to 2 mm in diameter, dark colored, and flattened (Figure 1) [44].

Figure 1. *Malachra alceifolia* Jacq.

***Malachra capitata* Linn.** is a herb or subshrub, up to 2 m tall, with stem pubescence and green to orange coloration. The leaves are simple, opposite, palmate or lobed, with up to five lobes; the texture of the leaves is velvety and their margins are crenulate or serrated. Inflorescences are peduncular and axillary, with the presence of lanceolate bracts; flowers have five petals, 1 cm in diameter, with a white coloration. Schizocarpic fruits have single seeds up to 3 mm in diameter, and are dark colored (Figure 2) [45].

Figure 2. *Malachra capitata* Linn.

***Malachra fasciata* Jacq.** is a herb or subshrub, up to 2 m tall, with stem pubescence, simple or stellate trichomes up to 7 mm, and green to orange coloration. The leaves are simple, opposite, ovate, truncated at the base, acute at the apex, lobed or deeply parted, otherwise crenate-serrate, pubescent above with appressed trichomes. The heads are short-stalked bracts, 2–6 per head, lance/ovate, subcordate at the base, acute at the apex, often ciliate, prominently hispid. Calyx 4 to 5 mm, hispid; petals white 6–8 mm, mericarps light brown to grayish green, reticulate veined (Figure 3) [46].

Figure 3. *Malachra fasciata* Jacq.

***Malachra radiata* (L.) L.** is a herb or suffrutex, 1.5 m tall, with stem pubescence and green and purple coloration. The leaves are simple, opposite, palmate or lobed, with up to seven lobes; the texture of the leaves is velvety, and their margins are crenulate or serrated, and most apical leaves may have a triangular shape. Inflorescences are pedicular and terminal, with the presence of ovate or acute bracts; flowers have five petals, 2.5 cm in diameter, with a lilac coloration and purple at the base. Schizocarpic fruits have numerous seeds, up to 2 mm in diameter, and are dark colored (Figure 4) [47].

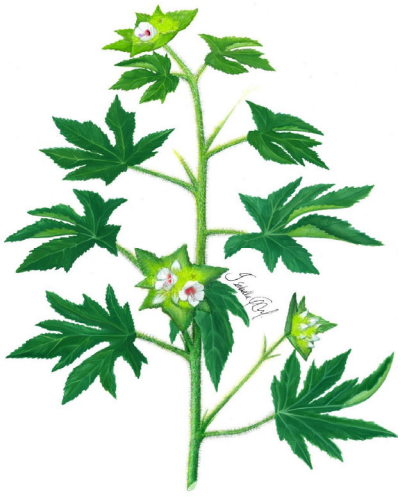


Figure 4. *Malachra radiata* (L.) L.

***Malachra ruderalis* Gürke.** is an annual herb, up to 3 m high, with stem pubescence and green coloration. The leaves are simple, opposite, palmate or lobed, with up to five lobes; the texture of the leaves is velvety, and their margins are crenulate; the most apical leaves have a triangular shape. It shows pedicular inflorescence with terminal or acute axillary bracts, five petals, 3 cm long, with yellow schizocarpic fruit with numerous dark-colored seeds up to 2 mm in diameter (Figure 5) [48–49].

Figure 5. *Malachra ruderalis* Gürke.

***Malachra rudis* Benth**. is a perennial herb, up to 0.7 m high, with a stem that has very short pubescence, and its coloration is light green. The leaves are simple, opposite, lobed, with up to three lobes; velvety texture; crenulated margins with pedicular, axillary, or terminal inflorescence; ovate bracts with five petals; 1.5 cm in long. Schizocarpic fruits are yellow to white with numerous seeds up to 1 mm in diameter, one per carpel (Figure 6) [48–49].

Figure 6. *Malachra rudis* Benth.

***Malachra urens* Poit. ex Ledeb. & Alderstam** is an annual herb, up to 1 m high, with pubescent stems of different sizes and green to orange coloration. The leaves are simple, opposite and lobed, with up to three lobes relatively marked, with pubescence; the margins of the leaves are toothed, about 3–12 cm long. Inflorescences are peduncular racemes with acuminate, boat-shaped, pubescent bracts. Flowers have five petals, 2 to 3 cm in long,

with a yellow color. Schizocarpic fruits have mericarps and pubescent bracts, with numerous seeds, up to 2 mm in long, dark colored, and flat (Figure 7) [48–49].

Figure 7. *Malachra urens* Poit.

***Malachra helodes* Mart.** is an annual herb, up to 1 m high. The stem is slightly pubescent with dark to light green coloration. The leaves are simple, opposite, and lobed, with up to five lobes that are well marked, with slightly marked pubescence on the underside; the margins of the leaves are serrated, about 3–10 cm long. Inflorescences are terminal and axillary racemes with the presence of acuminate bracts in the form of pubescent. The flowers have five petals, 2 to 3 cm in length, with a pink color. Schizocarpic fruits with mericarps and bracts with stem indumentum hispid; terminal inflorescence; pinkish flower; epicalyx absent; fruit, up to 4 mm in length; glabrous indumentum (Figure 8) [48–49].

Figure 8. *Malachra helodes* Mart. ex Ledeb. & Alderstam.

5. Geographical Distribution of the Genus *Malachra* L.

The genus *Malachra* L. is geographically distributed in tropical and subtropical America, west tropical Africa, and Southwest Asia [49].

The species of the genus *Malachra* L. are native to: South America countries (northeast Argentina, Bolivia, north Brazil, northeast Brazil, southeast Brazil, Colombia, Ecuador,

French Guiana, Guyana, Paraguay, Peru, Suriname, and Venezuela); Central America countries (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama); southwest Caribbean and Bahamas (Aruba, Cuba, Dominican Republic, Haiti, Jamaica, and Trinidad-Tobago); North America countries (Mexico); American Caribbean (Puerto Rico); Africa countries (Benin, Burkina, Congo, Chad, Ivory Coast, Mali, Ghana, Sudan, Niger, Nigeria, Senegal, and Togo); Caribbean Sea Islands (Netherlands Antilles, Leeward Is., Windward Is., and Venezuelan Antilles) [49]. Moreover, the genus has been introduced in: Asian countries (India, Thailand, Bangladesh, Taiwan, Philippine, and Indonesian); United States (Hawaii, Louisiana Florida, and Texas); Caribbean Sea Islands (Guadalupe, Martinique, and Granada) [49] (Figure 9).

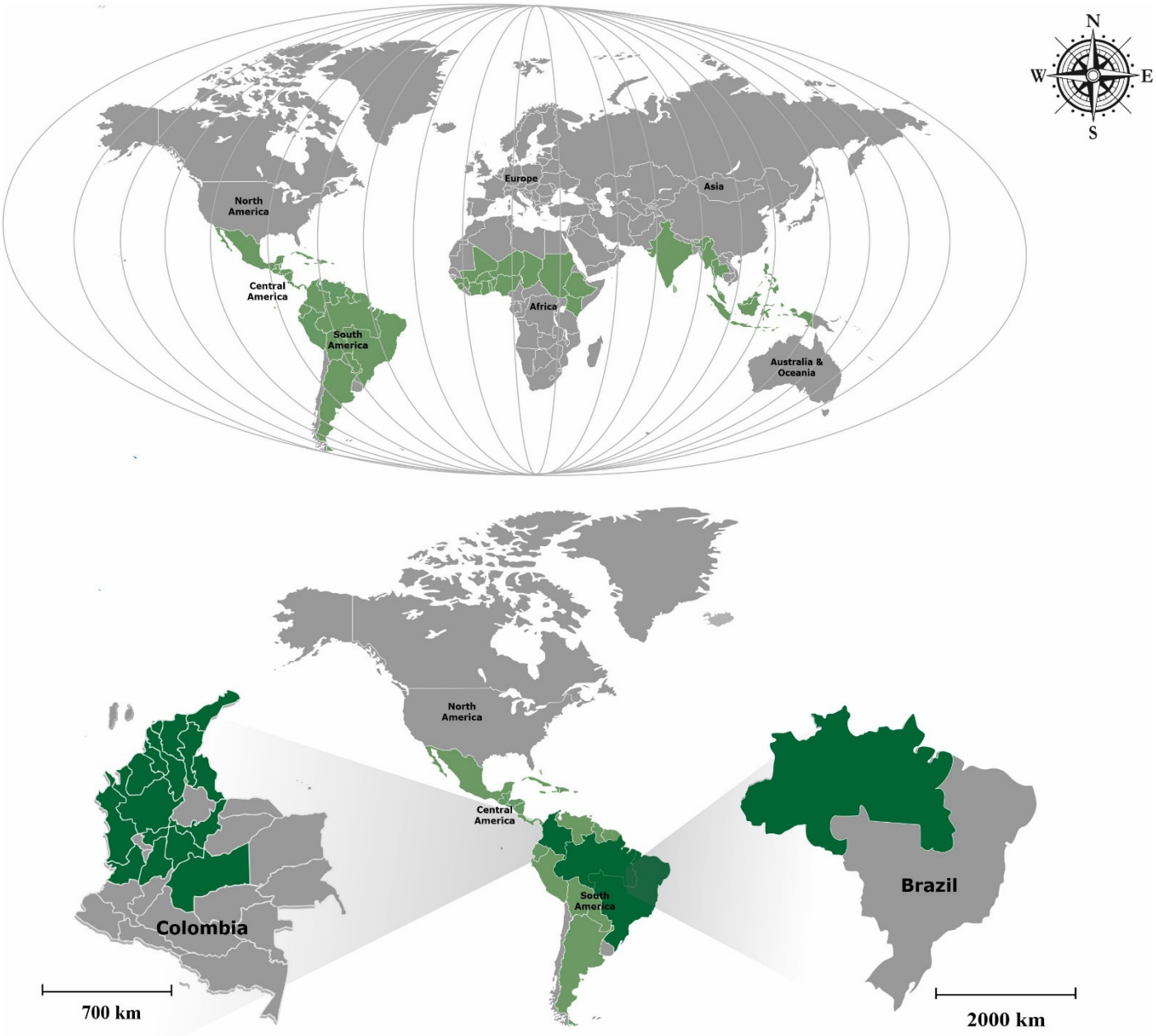


Figure 9. Geographical distribution of the genus *Malachra* L. Colombia and Brazil (green) countries with greater diversityThe countries of Colombia and Brazil have the largest number of species of the genus *Malachra* L., with six of the nine accepted names (*Malachra alceifolia* Jacq.; *Malachra capitata*

(L.) L.; *Malachra fasciata* Jacq.; *Malachra radiata* (L.) L.; *Malachra ruderalis* Gürke Benth., with the different species *Malachra rudis* Benth. present only in Colombia [50] and the species *Malachra helodes* Mart. present only in Brazil [43]), followed by Peru, Ecuador, and Puerto Rico with five of the nine accepted names, see Table 3 [49,50].

Table 3. Global geographical distribution of the species of the genus *Malachra* L.

Species	Countries
***Malachra alceifolia* Jacq.**	Belize, Brazil, Costa Rica, Colombia, Ecuador, Guyana, Guatemala, French Guiana, Ghana, Granada, India, Jamaica, Martinique, Mexico, Peru, Panama, Philippines, Puerto Rico, Suriname, Thailand and Venezuela,
***Malachra capitata* (L.) L.**	Belize, Bolivia, Brazil, Costa Rica, Colombia, Ecuador, Guatemala, Guadalupe, Honduras, Mexico, Nicaragua, Peru, Panama, Puerto Rico and Thailand.
***Malachra fasciata* Jacq.**	Belize, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Dominican Re-public, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Haiti, Honduras, Jamaica, Leeward Isle, Mexico, Nicaragua, Pana-ma, Puerto Rico, Suriname, Trinidad-Tobago, Venezuela, Wind-ward Isle
***Malachra radiata* (L.) L.**	Argentina, Benin, Bolivia, Brazil, Burkina, Chad, Colombia, Congo, Costa Rica, Cuba, Dominican Republic, El Salvador, Ghana, Guya-na, Haiti, Honduras, Ivory Coast, Jamaica, Mali, Mexico, Nicaragua, Niger, Nigeria, Panama, Paraguay, Peru, Puerto Rico, Senegal, Su-dan, Surinam, Togo, Venezuela
***Malachra ruderalis* Gürke.**	Bolivia, Brazil, Colombia, Ecuador, Peru
***Malachra rudis* Benth.**	Colombia, Ecuador, Peru.
***Malachra urens* Poit. ex Ledeb. & Alderstam.**	Bahamas, Cuba, Dominican Republic, Florida, Haiti, Jamaica, Puerto Rico
***Malachra helodes* Mart.**	Brazil

The distribution of the species in Brazil and Colombia covers most of the regions [43,50]. The species with the highest abundance are found in Colombian Caribbean, denoting their preference for warmer climates. In terms of their ecology, they prefer open habitats such as the savannah and scrublands; however, they can occur less frequently in dry and humid forests. There have been a few reports on the conservation status of the species in the genus *Malchara* L. In this study, in Table 4, only the conservation status of *Malachra alceifolia* Jacq., in Colombia, is included.

Table 4. Species of the genus *Malachra* L. occurring in Colombia.

Scientific name	Vernacular Name	Habit	Geographical Distribution	Ecology (IUCN) *	Conserv. Status (IUCN) **
***Malachra alceifolia* Jacq.**	malauya, malva	Herb, subshrub	Native to Colombia, biogeographic region: Andean, Caribbean, Pacific 0–1800 m.a.s.l	Forest, woodland, savanna, shrubland,wetlands (inland), artificial–terrestrial.	LC (Least concern)
***Malachra capitata* (L.) L.**	malva, malvavisco	Herb, subshrub	Native to Colombia, biogeographic region: Andean, Caribbean, Pacific, Magdalena valley 200–1480 m.a.s.l	Forest, woodland, shrubland,artificial–terrestrial.	Not evaluated
***Malachra fasciata* Jacq.**	malva peluda, mano de muerto	Herb, subshrub	Native to Colombia, biogeographic region: Caribbean, Orinoquia, Magdalena valley 30–830 m.a.s.l	savanna, shrubland	Not evaluated
***Malachra radiata* (L.) L.**	malva pata de gallina	Shrub	Native to Colombia, biogeographic region: Caribbean, Amazonia 0–200 m.a.s.l	Savanna	Not evaluated
***Malachra ruderalis* Gürke.**	escoba, malva	Subshrub	Native to Colombia, biogeographic region: Andean, Pacific 5–1100 m.a.s.l	No report	Not evaluated
***Malachra rudis* Benth.**	malva cimarrona, malva peluda, malvón	Subshrub	Native to Colombia, biogeographic region: Andean, Caribbean, Pacific, Magdalena valley, Amazonia 0–2330 m.a.s.l	Forest, woodland, savanna, shrubland,wetlands (inland), artificial–terrestrial	Not evaluated

* Habitat according to IUCN Habitats Classification (International Union Conservation of Nature).
** Conservation status according to IUCN Categories and Criteria (International Union Conservation of Nature).

6. Species of the Genus *Malachra* L. with Ethnobotanical Use

Medicinal plants of traditional use have been included in the Traditional and Complementary Medicine (TCM) report by the World Health Organization (WHO). Many of them are used in developing countries such as Chile and Colombia, with usages of 71% and 40% of the population, respectively [51,52]. Table 5 lists and describes the species of the genus *Malachra* L. with reported medicinal use, including vernacular name, part of the plant used, condition treated, preparation and administration, and the country where its use has been reported. The species in the genus *Malachra* L. with the highest reported ethnobotanical use are *M. alceifolia* Jacq., (for treatment of inflammation, clogged nose, during malaria, childbirth, drunk headache, kidney disorder, fever, and headache), *M. capitata* (L.) L., (for pain, diarrhea, convulsion, hepatic cirrhosis, inflammation, pyrexia, ulcer, dementia, treatment of wounds, gastric disorders, jaundice, childbirth, malaria headache, and fever), *M. fasciata* Jacq., (for emollients, hemorrhoids, fever, impotence, gonorrhea, rheumatism, demulcent, and diuretic), *M. ruderalis* Gürke., (for pulmonary diseases, fever, cough, sore throat, flu, colds, whooping cough, pulmonary diseases, COVID-19, stomach problems, diarrhea, fever, skin spots, skin infections, gastritis, stress inflammation, and vaginal infection).

Table 5. Summary of the species of the genus *Malachra* L. with reported medicinal use.

Malachra Species	Vernacular Name	Part Used (Condition)	Principal Medicinal Indication/	Mode of Preparation	Way of Administration	Country	Reference
***Malachra alceifolia* Jacq.**	Malva	Leaf	Inflammation and clogged nose	Decoction	Orally	Colombia	[1]
		Leaf and shoots	Malaria	Decoction	Orally	Peru	[31–33]
		Leaf	Childbirth, kidney disorder	Leaves minced with an egg-white (and soap) in water: bath	Bath	Perú	[34]
			Drunk headache, kidney disorder	leaves minced with *Citrus aurantifolia* fruit juice and water	Bath	Perú	[34]
			Headache, malaria, and fever	Leaves minced in water: bath	Bath	Perú	[34]
			Headache	leaves infused and applied as a poultice	Application locally	Perú	[34]
***Malachra capitata* (L.) L.**	Malva of Horse, Malva-Xiu, Malachra, Yellow leaf bract, Brazil jute.	Roots, leaf	Pain, diarrhea, convulsion, hepatic cirrhosis, inflammation, pyrexia, ulcer, dementia, treatment of wounds, gastric disorders, jaundice embrocations for rheumatism lumbago, and febrifuge	Infusion, decoction	Orally	India, Perú	[53–55]
		Leaf	Childbirth, malaria, headache, and fever	Infusion, decoction	Orally	Perú	[34]
***Malachra fasciata* Jacq.**	dead hand, hairy grass, malva	Roots, leaf	Emollients, hemorrhoids, fever, and impotence	Infusion, decoction	Orally	Philippine's	[29]
	Brava, wild okra.	Leaf	Gonorrhea, rheumatism,	Decoction	No report	No report	[30]

			demulcent, and diuretic diseases of the respiratory tract: fever, cough, sore throat, flu, colds, pneumonia, whooping cough, pulmonary diseases, and COVID-19				
		Roots, fresh or dried		Infusion, decoction	Orally	Perú	[35]
***Malachra ruderalis* Gürke.**	Malva	Flowers	Stomach problems, diarrhea, fever, skin spots, skin infections, gastritis, and stress	No report	No report	Ecuador	[56]
		Whole plant	Inflammation and vaginal infection	Decoction	No report	Colombia	[57]

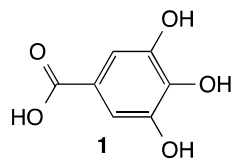
7. Phytochemistry Species of the Genus *Malachra* L.

Phytoconstituents are chemical compounds that plants synthesize as a defense mechanism against biotic and abiotic environmental conditions; they play key roles in biological processes [58,59]. Many phytoconstituents isolated from the genus *Malachra* L., such as flavonoids, coumarins, carbohydrates, glycosides, triterpenes, alkaloids, tannins, and saponins, exhibit pharmacologic activity. Table 6 lists the phytoconstituents reported only in *Malachra* species: *M. alceifolia* Jacq., *M. capitata* (L.) L., and *M. fasciata* Jacq, see Figure 10 molecular structure of some compounds isolated from species of the genus *Malachra* L.

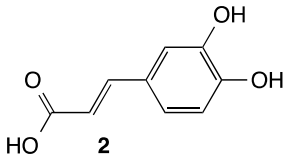
Table 6. Major phytoconstituents identified in species of the genus *Malachra* L.

***Malachra* species**	**Plant Part Used**	**Phytoconstituents**	**Reference**
***Malachra alceifolia* Jacq.**	Leaf	Flavonoids, steroids, triterpenes anthocyanins, leucoanthocyanins, saponins	[22]
	Flowers	Flavonoids, steroids, triterpenes anthocyanins, leucoanthocyanins	
	Root	Gallic acid **(1),** caffeic acid **(2),** rutin **(3),** quercetin **(4),** ferulic acid **(5)**	[23,24]
	Leaf	Rutin, ferulic acid	
	Stem	Gallic acid	
	Whole plant	*β*-Sitosterol **(6)**	[25]
***Malachra capitata* (L.) L.**	Root	Carbohydrates, phenols, flavonoids, glycosides, triterpenes, alkaloids, tannins, saponins	[23,24]
	Root	Tetradecanoic acid, ethyl ester **(7)**; linolenic acid, ethyl ester **(8)**; *(E)*-11-hexadecenoic acid, ethyl ester **(9)**; hexadecanoic acid, ethyl ester **(10)**;	[23,24]

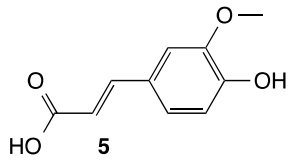
	Stem	octadecanoic acid, ethyl ester **(11)**; didecyl phthalate **(12)**; (*Z*,*Z*,*Z*)-1,4,6,9-nonadecatetraene **(13)**; squalene **(14)** Tetradecanoic acid, ethyl ester; pentadecanoic acid, 2,6,10,14-tetramethyl methyl ester **(15)**; linolenic acid, methyl ester; (*E*)-11-hexadecenoic acid, ethyl ester; octadecanoic acid, ethyl ester; (*Z*,*Z*,*Z*)-1,4,6,9-nonadecatetraene azobenzene, 4,4′-dibromo- **(16)**; squalene oleic acid **(17)** Cholestan-3-ol, 2-methylene-(3β,5α)- **(18)**; Tetradecanoic acid, ethyl ester 3,7,11,15-tetramethyl-2-hexadecen-1-ol **(19)**; Oxirane, tetradecyl- **(20)**; (*E*)-11-hexadecenoic acid, ethyl ester	[27,28]
	Leaf	Hexadecanoic acid, ethyl ester Phytol **(21);** (*Z*,*Z*) 6,9 pentadecadien-1-ol **(22)**; (*Z*,*Z*) 9,12-octadecadienoic acid **(23)**; octadecanoic acid, ethyl ester; squalene	[27,28]
	Leaf	Flavonoids, glycosides, triterpenes, alkaloids, tannins, saponins, phlobatannins	[27,28]
***Malachra fasciata* Jacq.**	Leaf	Aurantiamide acetate **(24)**	[29]
	Leaf	1,3-Diacylglycerol **(25)** 1,2-Diacylglycerol **(26)**	[30]



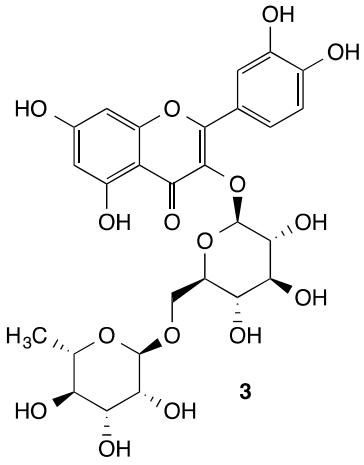
1



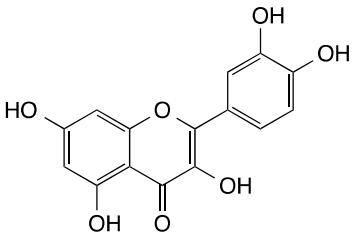
2



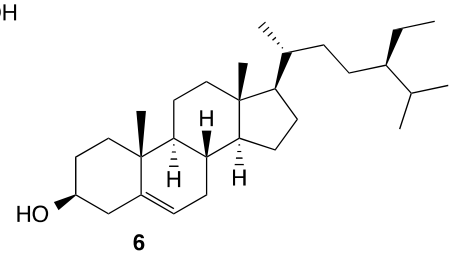
5



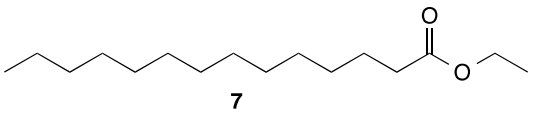
3



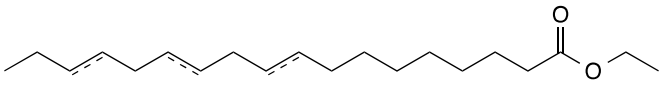
4



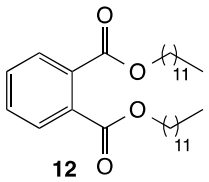
6



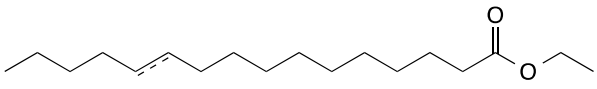
7



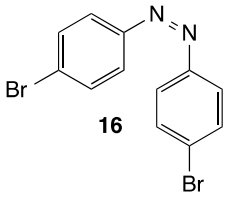
8 = linolenic acid, ethyl ester
11 = octadecanoic acid, ethyl ester



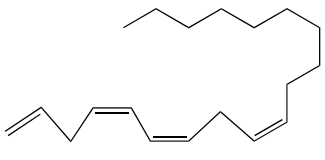
12



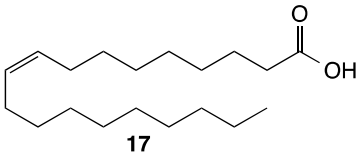
9 = (*E*)-11-hexadecanoic acid, ethyl ester
10 = hexadecanoic acid, ethyl ester



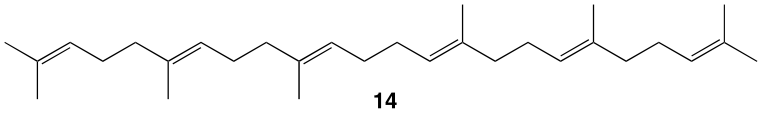
16



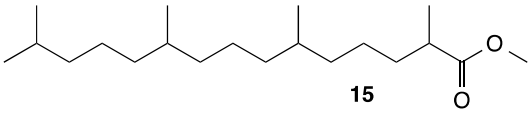
13



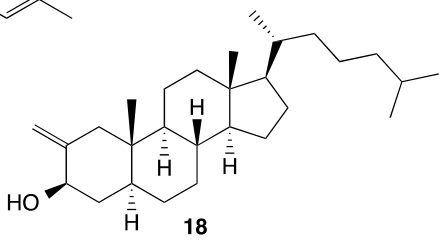
17



14



15



18

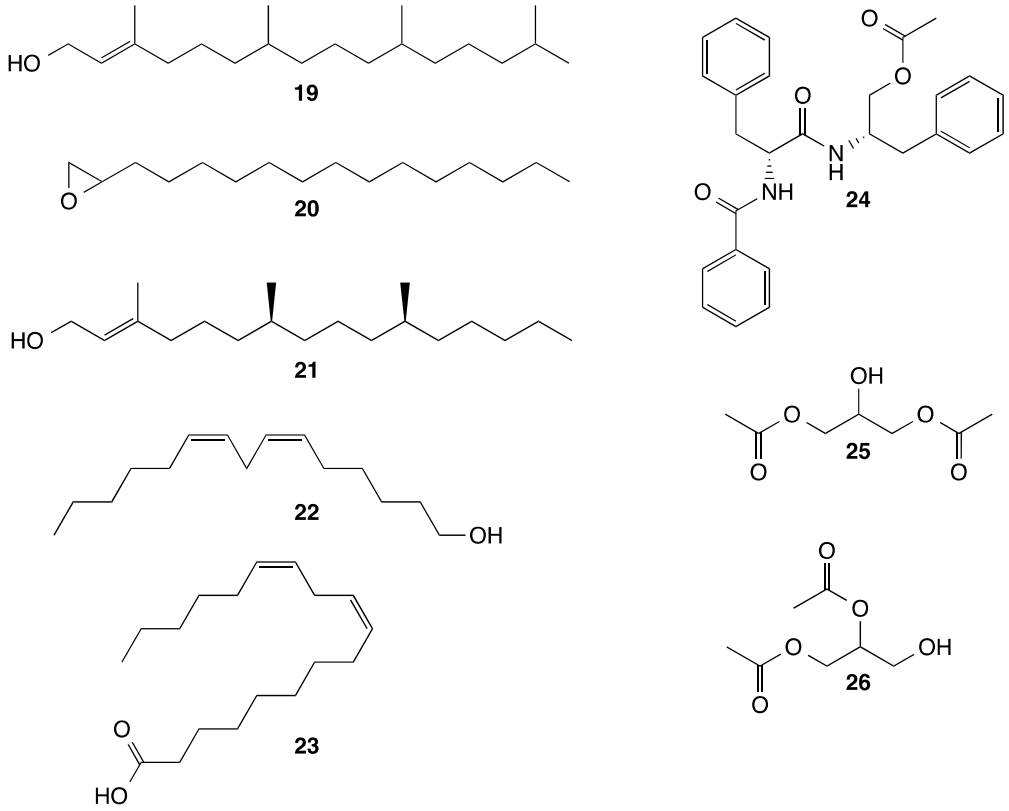


Figure 10. Molecular structure of some compounds isolated from species of the genus *Malachra* L.

Generally, organic compounds obtained from extracts, fractions, and isolated compounds of plant species possess unique structural characteristics among which the geometrical and energetic interactions of the atoms stand out; chirality and stereoisomers of molecular structures, intermolecular interactions, hydrogen bond acceptors and donors, molecular mass, diversity of ring systems, among others, become tools of interest for medicinal chemistry in drug development, to improve the potency, for pharmacokinetic properties, and to reduce the toxicity of new drugs [60]. However, the secondary metabolites isolated from plant species constitute a group of chemical molecules with a great diversity of biological activities applied to the pharmaceutical, cosmetic, and food sectors [61].

Gallic acid (GA) is a phenolic compound with anti-inflammatory, antimicrobial, hepatoprotective, neuroprotective, and carcinogenic properties that prevent gastrointestinal, cardiovascular, metabolic, and neuropsychological diseases [62]. The livers of Wistar rats exposed to carbon tetrachloride in doses of 50 mg/kg and 100 mg/kg GA, were evaluated by decreasing serum liver enzymes, regulating the expression of proinflammatory genes, and regulating the expression of antioxidant genes [63]; mercuric chloride induced at 200 mg/kg, increased glutathione peroxidase, superoxide dismutase, and catalase activity, and decreased the level of glutathione in liver tissue [64]. Caffeic acid has antimicrobial potential against *Staphylococcus aureus* strains with MICs from 256 μg/mL to 1024 μg/mL [65]. The compound quercetin isolated from extracts and organic fractions of *Allium cepa* L., *Morus alba*, *Camellia sinensis*, *Moringa oleifera*, and *Centella asiatica,* at doses between 50 and 100 mg/kg, and evaluated in in vivo models, showed antiulcer activity [66]. Beta-sitosterol isolated chloroform extract of *Corchorus capsularis L.* leaves has been shown to exhibit a significant effect against trypanothione reductase *Leishmania donovani* promastigotes at IC_{50} = 17.7 ± 0.43 μg/mL [67], and the dipeptide aurantiamide acetate patent has an effect of resisting influenza virus and an inhibition effect on a cytopathic effect mediated by the influenza A virus CN106431960B , filing date: 11 November 2018, legal status: active [68].

8. Species of the Genus *Malachra* L. with Pharmacological Activity

Applications of plant remedies in traditional medicine are still central in the health systems in some countries of world [69]. The biogenesis and biosynthesis of phytoconstituents in plant species provide an opportunity for medicinal chemistry to advance pharmacological studies for treating pathologies that have been little studied [70]. Table 7 summarizes the most important pharmacological activities reported for the genus *Malachra* L., such as antidiarrheal, anti-epileptic, antiulcerogenic, antioxidant, anticonvulsant, hepatoprotective, antiviral, anticancer, antibacterial, and anthelmintic properties. The bibliographic search describes only the pharmacological activities of *M. alceifolia* Jacq., *M. capitata* (L.) L., and *M. fasciata* Jacq.

Table 7. Summary of the species of the genus *Malachra* L. with reported pharmacological activity.

Malachra species	Plant Part Used	Extract/ Compounds	Pharmacological Activity	Concentration	Method	Major Findings	Reference
***M. alceifolia* Jacq.**	Leaf	Ethanolic	Antiplasmodial	10 µg/mL	In vitro *Plasmodium falciparum* 152.2 ± 28.6 nM Chloroquine control	Inhibitory activity on *P. falciparum* ferriprotoporphyrin biomineralization inhibition	[31, 32]
	Shoot	Ethanolic	Antiplasmodial	77 µg/mL	In vitro *Plasmodium falciparum* (3D7) chloroquine (concentration no report)	Inhibitory activity on *P. falciparum*	[33]
	Leaf	Ethanolic	Antibacterial	62.5 ppm	In vitro MIC	Inhibition of the growth of *Propionibacterium acnes* (ATCC 6919)	[71]
***M. capitata* (L.) L.**	Shoot	Aqueous	Antidiarrhoeal	200 and 400 mg/kg	In vivo oral administration to Wistar rats; castor oil-induced diarrhoea, enteropooling, and small intestinal transit; 5 mL/kg, p.o diphenoxlate control	Decreases intestinal transit	[72]
		Aqueous	Anti-epileptic	250 and 500 mg/kg	In vivo maximal electroshock (MES) and pentylenetetrazole	Anticonvulsant activity against MES and PTZ animal models	[72]

					(PTZ)-induced seizuresmodels in albino Wistar rats, pentylenetetrazol control		
		Aqueous	Anti-ulcerogenic	200 mg/kg and 400 mg/kg	In vivo oral administration to Wistar rats pylorus ligated model, 50mg/kg, p.o ranitidine control	Reduce the gastric acid secretion of pylorus	[72]
		Aqueous	Antioxidant	200 and 400 mg/kg	In vivo oral administration to Wistar rats	Inhibit the accumulation of lipid peroxidation product, superoxide dismutase, and catalase activities	[73]
		Aqueous	Hepatoprotective	100, 200 and 400 mg/kg	In vivo oral administration to Wistar rats, carbon tetrachloride CCl_4 induced hepatotoxicity	Reduced levels of the hepatic enzymes SGOT, SGPT, alkaline phosphatase (ALP), and acid phosphatase (ACP)	[74]
	Leaf silver nanoparticles (AgNPs)	n-hexane	Antibacterial	1 mM	In vitro MIC	Nanoparticles bactericidal *Bacillus subtillis, Micrococcus Luteus, Staphylococcus aureus and Pseudomonas aeruginosa*	[75]
	Leaf	Methanolic, Chloroform Benzene	Antibacterial	50 mg/ml	In vitro MIC	Inhibition of the growth of *Escherichia coli Listeria monocytogenes*	[76]

***Malachra fasciata* Jacq.**	Leaf	Chloroform/ Aurantiamide acetate	Antimicrobial	80 µg	In vitro MIC	Inhibition of the growth of *P. aeruginosa, B. subtilis, C. albicans*,	[29]
	Leaf	Unknown	Phototoxic (photosensitization)	Unknown	In vivo sheep females and male	Cause of primary photodermatitis in sheep ingestion leaf	[77]
	Leaf	Chloroform	Antifungal	30 µg	In vitro MIC	Inhibition of the growth of *Aspergillus niger*	[29]
	Leaf	-(-)loliolide	Antimutagenic	8 mg/kg	In vitro micronucleus test induced using mitomycin C, 32%	Reduce the number of micronucleated polychromatic erythrocytes (MPCE)	[30]

9. Conclusions

This review provides information and analysis of published scientific data on eight species of the genus *Malachra* L. of the family Malvaceae: *Malachra alceifolia* Jacq., *Malachra capitata* (L.) L., *Malachra fasciata* Jacq., *Malachra radiata* (L.) L., *Malachra ruderalis* Gürke., *Malachra rudis* Benth., *Malachra helodes* Mart., *Malachra urens* Poit., and *Malachra urens* Poit. ex Ledeb. & Alderstam. The plants are widely distributed in America, Africa, and Asia, with a greater distribution of species in the tropical and subtropical regions of Colombia and Brazil. These plant species have shown important applications in traditional medicine since their aqueous extracts are used for treating infectious, inflammatory, respiratory, digestive, and neurological problems. The active phytoconstituents isolated from the genus may be useful for the evaluation and identification of molecular targets against infectious pathogens or inflammatory processes. The presence of groups of metabolites such as flavonoids, sterol-terpenoids, and phenolics, including gallic acid, caffeic acid, quercetin, and β-sitosterol compounds may be associated with biological processes with activities such as antidiarrheal, antiepileptic, antiulcerogenic, antioxidant, anticonvulsant, hepatoprotective, antiviral, anticancer, antibacterial, and anthelmintic, with inflammatory activity being the most widespread. In turn, the presence of peptides with pharmacological potential, contribute to the search for drugs against oncological, metabolic, cardiovascular, and neglected tropical diseases. Therefore, this review contributes to the baseline knowledge for the search of information on the validation of the therapeutic use and conservation of traditional and ancestral knowledge of plant biodiversity in America, Africa, and Asia countries, as well as contributes to basic concepts for future research aimed at the discovery of new drugs.

Author Contributions: All authors have written, read, and approved the final version of the manuscript. L.C.-C., H.G.-E., and F.S.-H., were responsible for the first draft of the manuscript; J.S.-H., E.T.-N., J.M.-C., A.E.-G., K.J.A., and E.d.O.-F. participated in the coordination and guidance. All authors have read and agreed to the published version of the manuscript.

Funding: The Program to Support Research Groups, Vice-Rectory for Research at the University of Cartagena (N° 031–2021). This work was supported by the National Program for Doctoral Formation Minciencias (L.C.C: 727- 2015, F.S.H: 8852- 2020).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgement: All authors acknowledge the collaboration of Isabella Gonzalez Meza. (isacienciag22@gmail.com) who was responsible for preparing the illustrations of the *Malachra* species.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Gómez-Estrada, H.; Díaz-Castillo, F.; Franco-Ospina, L.; Mercado-Camargo, J.; Guzmán-Ledezma, J.; Medina, J.D.; Gaitán-Ibarra, R. Folk medicine in the northern coast of Colombia: An overview. *J. Ethnobiol. Ethnomed.* **2011**, *7*, 27. https://doi.org/10.1186/1746-4269-7-27.
2. World Health Organization. WHO global report on traditional and complementary medicine 2019. Available online: https://books.google.com.co/books?hl=es&lr=&id=WHOyDwAAQBAJ&oi=fnd&pg=PP1&dq=World+Health+Organization+(WHO)+medical+traditional&ots=h2ipw5cQpI&sig=2pW6jgNRbJp0W1Agx9UJG6aEf7k#v=onepage&q=World%20Health%20Organization%20(WHO)%20medical%20traditional&f=false. (Accessed on 10 February 2022).
3. Anand, U.; Jacobo-Herrera, N.; Altemimi, A.; Lakhssassi, N. A Comprehensive Review on Medicinal Plants as Antimicrobial Therapeutics: Potential Avenues of Biocompatible Drug Discovery. *Metabolites* **2019**, *9*, 258. https://doi.org/10.3390/metabo9110258.
4. Yuan, H.; Ma, Q.; Ye, L.; Piao, G. The Traditional Medicine and Modern Medicine from Natural Products. *Molecules* **2016**, *21*, 559. https://doi.org/10.3390/molecules21050559.

5. Muñoz, D.; Cuca, L. Cytotoxic compounds from plant sources and their relationship with inhibitor of apoptosis proteins. *Rev. Colom. Cancerol*. **2016**, *20*, 124–134. https://doi.org/10.1016/j.rccan.2015.10.002.
6. Coello-Cedeño, D. Alcaloides de la Chavelita (*Catharanthus roseus*) Agentes quimioterapéuticos en la lucha contra el Cáncer. *Researchgate* **2019**, *12*, 317–330. https://doi.org/10.13140/RG.2.2.18585.57449.
7. Ershad, M.; Meredith, A.; Shah, N.; Khalid, M.M. *Cardioactive Steroid Toxicity*; StatPearls Publishing: Treasure Island, FL, USA, 2022.
8. Hyuga, M.; Oshima, N.; Amakura, Y.; Hakamatsuka, T.; Goda, Y.; Hanawa, T.; Kobayashi, Y. Ephedrine Alkaloids-Free Ephedra Herb Extract, EFE, Has No Adverse Effects Such as Excitation, Insomnia, and Arrhythmias. *Biol. Pharm. Bull.* **2018**, *41*, 247–253. https://doi.org/10.1248/bpb.b17-00803.
9. Cheong, D.H.J.; Tan, D.W.S.; Wong, F.W.S.; Tran, T. Anti-malarial drug, artemisinin and its derivatives for the treatment of respiratory diseases. *Pharmacol. Res*. **2020**, *158*, 104901. https://doi.org/10.1016/j.phrs.2020.104901.
10. Montinari, M.R.; Minelli, S.; De Caterina, R. The first 3500 years of aspirin history from its roots—A concise summary. *Vascul. Pharmacol*. **2019**, *113*, 1–8. https://doi.org/10.1016/j.vph.2018.10.008.
11. Devereaux, A.L.; Mercer, S.L.; Cunningham, C.W. DARK Classics in Chemical Neuroscience: Morphine. *ACS Chem. Neurosci.* **2018**, *9*, 2395–2407. https://doi.org/10.1021/acschemneuro.8b00150.
12. Cervantes-Ceballos, L.; Sánchez-Hoyos, F.; Gómez-Estrada, H. Antibacterial activity of *Cordia dentata* Poir, *Heliotropium indicum* Linn and *Momordica charantia* Linn from the Northern Colombian Coast. *Revista Colombiana de Ciencias Químico-Farmacéuticas* **2017**, *42*, 143–159. https://doi.org/10.15446/rcciquifa.v46n2.67933.
13. Tran, N.; Pham, B.; Le, L. Bioactive Compounds in Anti-Diabetic Plants: From Herbal Medicine to Modern Drug Discovery. *Biology* **2020**, *9*, 252. https://doi.org/10.3390/biology9090252.
14. Germosén Robineau, L.; García González, M.; Morón, F.; Costaguta, M.; Delens, M.; Olmedo, D.; Gómez-Estrada, H.A. Farmacopea Vegetal Caribeña. University of Cartagena, Editorial University of Cartagena, ISBN: 978-958-5439-06-1; 2017.
15. Germosén-Robineau, L.. *Farmacopea Vegetal Caribeña* Segunda edición; TRAMIL (Pharmacopée traditionnelle Caraïbe). Editorial Universitaria UNAN-León ,ISBN: 99924-56-25-6. República Dominicana. **2005.** Available online: https://www.tramil.net/es/publicaciones_tramil.html. (accessed on 12 February 2022).
16. Hassler, Michael (2004–2022): World Plants. Synonymic Checklist and Distribution of the World Flora. Version 14.1. Available online: www.worldplants.de (accessed on 21 September 2022).
17. World Flora Online (WFO). *Malachra* L. 2022. Available online: http://www.worldfloraonline.org/taxon/wfo-4000022923 (accessed on 21 September 2022).
18. Govaerts, R.; Nic Lughadha, E.; Black, N.; Turner, R.; Paton, A. The World Checklist of Vascular Plants (WCVP), a continuously updated resource for exploring global plant diversity. *Sci. Data* **2021**, *8*, 215. https://doi.org/10.1038/s41597-021-00997-6.
19. Christenhusz, J.M.; Byng, J.W. The number of known plants species in the world and its annual increase. *J. Phytotaxa*. **2016**, *261*, 201–217. https://doi.org/10.11646/phytotaxa.261.3.1.
20. Christenhusz, M.J.M., Fay, M.F. & Chase, M.W. Plants of the World. An illustrated encyclopedia of vascular plants: 1-792. Kew Publishing, The university of Chicago Press. **2017.** Available online: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:28016-1.
21. The IUCN Red List of Threatened Species. Version 2022-1. Available online: https://www.iucnredlist.org/. (accessed on 30 September 2022).
22. Guerreo, T.; Vejarano, P.; Ochoa, R. Tamizaje fitoquímico y cuantificación de flavonoides totales de las hojas y flores de *Malachra alceifolia* Jacq. *Ethnobot. Res. Appl.* **2018**, *4*, 70–75. Available online: https://revistas.unas.edu.pe/index.php/revia/article/view/73 (accessed on 21 August 2022).
23. Sindhu, L.; Neelamegam, R. HPLC determination of flavonoids in the methanol extracts of *Malachra capitata* (L). *WJPPS* **2015**, *4*, 1495–1503. Available online: https://storage.googleapis.com/journaluploads/wjpps/article_issue/1438403289.pdf (accessed on on 21 August 2022).
24. Sindhu, L.; Neelamegam, R. Evaluation of phytochemical profile in ethanol extracts of *Malachra capitata* (L.) by GC-MS analysis. *W.J.P.R*. **2015**, *4*, 1342–1353. Available online: https://wjpr.net/abstract_file/3364.
25. Jadhav, R.; Parihar, S. Isolation and Study of β-sitosterol the Unsaponifiable Matter from the Plant *Malachra capitata* (Linn). *Biomed. Pharmacol. J.* **2014**, *7*, 285–287. https://doi.org/10.13005/bpj/489.
26. Saleem, H., Sarfraz, M., Ahsan, H. M., Khurshid, U., Kazmi, S. A. J., Zengin, G., ... & Ahemad, N. Secondary metabolites profiling, biological activities and computational studies of *Abutilon figarianum* Webb (Malvaceae). *Processes.* **2020.** 8(3), 336. https://doi.org/10.3390/pr8030336.
27. Dipak, K.; Rupali, S.; Syed, I.; Bhadange, D.G. Phytochemical screening of eight traditionally used ethnomedicinal plants from Akola District (M.S.) India. *I.J.P.B.S.* **2010**, *1*, 253–256. Available online: https://www.ijpbs.net/abstract.php?article=NDE= (accessed on 30 August 2022).
28. Pratyusha, S.; Jayasri, P.; Elumalai, A. Study on phytochemical profile and antiulcerogenic effect of *Malachra capitata* (L.) in albino Wistar rats. Intern. *I.J.P.P.R.* **2012**, *3*, 97–103. Available online: http://www.preclinicaljournal.com/download.php?id=116&f=116_97-103.pdf (accessed on 30 August 2022).
29. Ragasa, C.; Hofileña, J.; Co, A.; Rideout, J. Antifungal diacetylglycerols from *Malachra fasciata* and Pithecolobium dulce. *Chem. Res.* **2005**, *19*, 1–5. Available online: https://acquire.cqu.edu.au/articles/journal_contribution/Antifungal_diacetyglycerols_from_Malachra_fasciata_and_Pithecolobium_dulce/13398602 (accessed on 30 March 2022).

30. Ragasa, C.; Peñalosa, B.; Rideout, J.A. bioactive dipeptide derivate from *Malachra fasciata. J.P.S.* **1998**, *127*, 267–276. Available online: https://inis.iaea.org/search/search.aspx?orig_q=RN:30051341.
31. Kvist, L.; Christensen, S.; Rasmussen, H.; Mejia, K.; Gonzalez, A. Identification and evaluation of Peruvian plants used to treat malaria and leishmaniasis. *J. Ethnopharmacol.* **2006**, *106*, 390–402. https://doi.org/10.1016/j.jep.2006.01.020.
32. López-Cuesta, B. Studio Ethnobotanics of Plants Against Malaria. 2017. Available online: http://147.96.70.122/web/TFG/TFG/Memoria/Beatriz%20Cuesta%20Lopez.pdf (accessed on 22 March 2022).
33. Ruiz, L.; Ruiz, L.; Maco, M.; Cobos, M.; Gutierrez-Choquevilca, A.-L.; Roumy, V. Plants used by native Amazonian groups from the Nanay River (Peru) for the treatment of malaria. *J. Ethnopharmacol.* **2011**, *133*, 917–921. https://doi.org/10.1016/j.jep.2010.10.039.
34. Odonne, G.; Valadeau, C.; Alban-Castillo, J.; Stien, D.; Sauvain, M.; Bourdy, G. Medical ethnobotany of the Chayahuita of the Paranapura basin (Peruvian Amazon). *J. Ethnopharmacol.* **2013**, *146*, 127–153. https://doi.org/10.1016/j.jep.2012.12.014.
35. Delgado-Paredes, G.; Delgado-Rojas, P.; Rojas-Idrogo, C. Peruvian Medicinal Plants and Cosmopolitan Plants with Potential use in the Treatment of Respiratory Diseases and COVID-19. *I.J.P.A.E.S.* **2021**, *11*, 295–321. https://doi.org/10.26502/IJPAES.202107.
36. Bojórquez. G.; Esqueda-Esquivel, V.; Balbuena-Melgarejo, A.; Rosales-Robles, E.; Sánchez-Nava, S.; Santillanes-Navidad, R.; Zita-Padilla, G. Maleza asociada a potreros de colima y costa de Jalisco, México. *Manejo Y Control. De Malezas En Latinoamérica* **2011**, Available online: https://somecima.com/wp-content/uploads/2018/07/2013.pdf (accessed on 25 January 2022).
37. Fernández-Hernández, D.M. Butterflies of the agricultural experiment station of tropical roots and tubers, and Santa Ana, Camagüey, Cuba: An annotated list. *Acta Zool. Mex.* **2007**, *23*, 43–75. Available online: http://www.acuedi.org/ddata/F3057.pdf (accessed on 25 January 2022).
38. Cabrera, E. Caracterización De La Vegetación Natural De Sucesión Primaria En El Parque Nacional Volcán Pacaya Y Laguna De Calderas, Guatemala. 2006. Available online: https://repositorio.catie.ac.cr/bitstream/handle/11554/4580/Caracterizacion_de_la_vegetacion_natural.pdf?sequence=1&isAllowed=y (accessed 25 January 2022).
39. Lima, L.F.; Oliveira, J.O.; Carneiro, J.N.P.; Lima, C.N.F.; Coutinho, H.D.M.; Morais-Braga, M.F.B. Ethnobotanical and antimicrobial activities of the *Gossypium* (Cotton) genus: A review. *J. Ethnopharmacol.* **2021**, *279*, 114363. https://doi.org/10.1016/j.jep.2021.114363.
40. Stevens, P.F. Angiosperm Phylogeny Website. Version 14, July 2017 and Continuously Updated Since. Will Do. Available online: http://www.mobot.org/MOBOT/research/APweb/ (accessed on 10 June 2022).
41. Medicinal Plant Names Services (M.P.N.S.). *Malachra.* 2022. Available online: http://mpns.kew.org/mpns- portal/ (accessed on 11 January 2022).
42. Plants of the World Online (P.O.W.O.). *Malachra*. 2022. Available online: www.plantsoftheworldonline.org (accessed on 11 February 2022).
43. Tropicos.org. Missouri Botanical Garden. Available online: http://www.tropicos.org/Name/19601021 (accessed on 1 July 2022).
44. World Flora Online. *Malachra alceifolia* Jacq. 2022. Available online: http://www.worldfloraonline.org/taxon/wfo-0000449783 (accessed on 30 June 2022).
45. World Flora Online. *Malachra capitata* (L.) L. 2022. Available online: http://www.worldfloraonline.org/taxon/wfo-0000449780 (accessed on 1 July 2022).
46. World Flora Online. *Malachra fasciata* Jacq. 2022. Available online: http://www.worldfloraonline.org/taxon/wfo-0000449806 (accessed on 1 July 2022).
47. World Flora Online. *Malachra radiata* (L.) L. 2022. Available online: http://www.worldfloraonline.org/taxon/wfo-0000449849 (accessed on 1 July 2022).
48. The Global Biodiversity Information Facility (G.B.I.G.). *Malachra.* 2022. Available online: www.gbif.org (accessed on 11 February 2022).
49. The International Plant Names Index and World Checklist of Vascular Plants 2022. Available online: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:25960-1 (accessed on 22 August 2022).
50. Bernal, R.; Gradstein, S.R.; Celis, M. (Eds.) Catálogo de Plantas y Líquenes de Colombia. In *Instituto de Ciencias Naturales*; Universidad Nacional de Colombia: Bogotá, Colombia, 2015. Available online: http://catalogoplantasdecolombia.unal.edu.co (accessed on 1 July 2022).
51. Organización Mundial de la Salud. Estrategia De La OMS Sobre Medicina Tradicional 2002–2005. Available online: http://apps.who.int/iris/bitstream/handle/10665/67314/WHO_EDM_TRM_2002.1_spa.pdf;jsessionid=007D5B498F9F504213736D6236E9E05E?sequence=1 (accessed on 22 August 2022).
52. Organización Mundial De La Salud. Medicina tradicional. 56ª Asamblea Mundial De La Salud. A56/18 Punto 14.10 Del Orden Del Día Provisional 31 De Marzo De 2003. Available online: https://apps.who.int/gb/ebwha/pdf_files/WHA56/sa5618.pdf (accessed on 22 August 2022).
53. Avinash-Deodhar, K. A systematic review of *Malachra capitata*: Medicinal properties and constituents. *J.A.S.J.T.* **2016**, *7*, 3310–3313. Available online: https://www.journalajst.com/systematic-review-malachra-capitata-medicinal-properties-and-constituents (accessed on 25 August 2022).
54. Sanyal, S. Morpho-Taxonomic Studies of Some Members of Malvales (Cronquist, 1981) Occurring in Saltlake City, North 24 Parganas, West Bengal. *I.J.I.R.S.E.T.* **2016**, *5*, 8564–8572. Available online: http://www.ijirset.com/upload/2016/may/245_MORPHO_TAXONOMIC_new.pdf (accessed on 25 August 2022).

55. Vibrant, H. *Malachra capitata*. 2010. Available online: http://www.conabio.gob.mx/malezasdemexico/malvaceae/Malachracapitata/fichas/ficha.htm (accessed on 11 February 2022).
56. Caballero-Serrano, V.; McLaren, B.; Carrasco, J.C.; Alday, J.G.; Fiallos, L.; Amigo, J.; Onaindia, M. Traditional ecological knowledge and medicinal plant diversity in Ecuadorian Amazon home gardens. *Glob. Ecol. Conserv.* **2019**, *17*, e00524. https://doi.org/10.1016/j.gecco.2019.e00524.
57. Lagos-Castillo, C. Plantas Medicinales utilizadas en el tratamiento ginecológico en Leticia y Puerto Nariño (Amazonas, Colombia). Universidad del Bosque. *Etnobiología* **2015**, *13*, 53–72. Available online: https://dialnet.unirioja.es/servlet/articulo?codigo=5294496 (accessed on 25 August 2022).
58. Abat, J.K.; Kumar, S.; Mohanty, A. Ethnomedicinal, phytochemical and ethnopharmacological aspects of four medicinal plants of Malvaceae used in Indian traditional medicines: A Review. *Medicines* **2017**, *4*, 75. https://doi.org/10.3390/medicines4040075.
59. Varma, N. Phytoconstituents and their mode of extractions: An overview. *Res. J. Chem. Environ. Sci.* **2016**, *4*, 8–15. Available online: http://www.aelsindia.com/rjcesapril2016/2.pdf (accessed on 25 August 2022).
60. Najmi, A.; Javed, S.A.; Al Bratty, M.; Alhazmi, H.A. Modern Approaches in the Discovery and Development of Plant-Based Natural Products and Their Analogues as Potential Therapeutic Agents. *Molecules* **2022**, *27*, 349. https://doi.org/10.3390/molecules27020349.
61. Batiha, G.E.S.; Beshbishy, A.A.; Tayebwa, D.S.; Shaheen, M.H.; Yokoyama, N.; Igarashi, I. Inhibitory effects of Uncaria tomentosa bark, Myrtus communis roots, *Origanum vulgare* leaves and *Cuminum cyminum* seeds extracts against the growth of Babesia and Theileria in vitro. Jap. *J. Vet. Parasitol*. **2018**, *17*, 1–13.
62. Kahkeshani, N.; Farzaei, F.; Fotouhi, M.; Alavi, S.S.; Bahramsoltani, R.; Naseri, R.; Momtaz, S.; Abbasabadi, Z.; Rahimi, R.; Farzaei, M.H.; et al. Pharmacological effects of gallic acid in health and diseases: A mechanistic review. *Iran. J. Basic Med. Sci*. **2019**, *22*, 225–237. https://doi.org/10.22038/ijbms.2019.32806.7897.
63. Ojeaburu, S.I.; Oriakhi, K. Hepatoprotective, antioxidant and, anti-inflammatory potentials of gallic acid in carbon tetrachloride-induced hepatic damage in Wistar rats. *Toxicol. Rep*. **2021**, *8*, 177–185. https://doi.org/10.1016/j.toxrep.2021.01.001.
64. Goudarzi, M.; Kalantar, M.; Kalantar, H. The Hepatoprotective Effect of Gallic Acid on Mercuric Chloride-Induced Liver Damage in Rats. Jundishapur *J. Nat. Pharm. Prod*. **2017**, *12*, e12345. https://doi.org/10.5812/jjnpp.12345.
65. Kępa, M.; Miklasińska-Majdanik, M.; Wojtyczka, R.D.; Idzik, D.; Korzeniowski, K.; Smoleń-Dzirba, J.; Wąsik, T.J. Antimicrobial Potential of Caffeic Acid against*Staphylococcus aureus*Clinical Strains. *BioMed Res. Int.* **2018**, *2018*, 7413504. https://doi.org/10.1155/2018/7413504.
66. Anand David, A.V.; Arulmoli, R.; Parasuraman, S. Overviews of biological importance of quercetin: A bioactive flavonoid. *Pharmacogn. Rev.* **2016**, *10*, 84–89. https://doi.org/10.4103/0973-7847.194044.
67. Pramanik, P.K.; Chakraborti, S.; Bagchi, A.; Chakraborti, T. Bioassay-based *Corchorus capsularis* L. leaf-derived β-sitosterol exerts antileishmanial effects against *Leishmania donovani* by targeting trypanothione reductase. *Sci. Rep*. **2020**, *10*, 20440. https://doi.org/10.1038/s41598-020-77066-2.
68. Application and its preparation of the Aurantiamide acetate in anti-influenza virus medicament. Patent CN106431960B. China. Guangzhou Institute Of Respiratory Health, Macau Univ of Science and Technology, First Affiliated Hospital of Guangzhou Medical University. **2018.** Available online: https://patents.google.com/patent/CN106431960B/en. (accessed on 25 August 2022).
69. Batiha, G.E.; Alkazmi, L.M.; Wasef, L.G.; Beshbishy, A.M.; Nadwa, E.H.; Rashwan, E.K. *Syzygium aromaticum* L. (Myrtaceae): Traditional Uses, Bioactive Chemical Constituents, Pharmacological and Toxicological Activities. *Biomolecules* **2020**, *10*, 202. https://doi.org/10.3390/biom10020202.
70. Beshbishy, A.M.; Batiha, G.E.S.; Adeyemi, O.S.; Yokoyama, N.; Igarashi, I. Inhibitory effects of methanolic Olea europaea and acetonic Acacia laeta on the growth of *Babesia* and *Theileria*. *Asian Pac. J. Trop. Med*. **2019**, *12*, 425–434.
71. Salazar-Gómez, L.; Pérez-Coronado, J. Evaluación in vitro Del Efecto Antibacteriano De Los Extractos Etanólicos De *Maclura tinctoria* Linn, *Cassia fistula* Linn. Y *Malachra alceifolia* Jacq, Y Su Contribución a La Formulación De Un Fitoterapéutico Para El Tratamiento Del Acné. 2018. Available online: http://hdl.handle.net/11227/7008 (accessed on 9 September 2021).
72. Gopi, G.; Jayasri, P.; Elumalai, A. Anti-epileptic activity of *Malachra capitata* (L) on maximal electroshock (MES) and Pentylenetetrazole (PTZ) induce seizures models. *Int. J. Pharmacol. Toxicol.* **2012**, *2*, 104–108. Available online: http://www.ijidd.com/File_Folder/76-80.pdf (accessed on 22 September 2022).
73. Anil-Kumar, V.; Prunachander, K.; Vasudevamurthy, V.; Kannappan, N.; Spandana, V. Anti-oxidante activity of *Malachra capitata* (L) against Carbon Tetrachloride (CCL4) induce erythrocyte damage in rats. *Int. J. Pharmacol. Res.* **2012**, *2*, 74–78.
74. Sriam, N.; Vinoth-Kumar, K.; Mantry, S.; Sakthivel, S.; Shiva-Prasad, P. Hepatoprotective effect of *Malachra capitata* (L) against Carbon Tetrachloride induced hepatotoxicity in wistar albino rats. *Int. J. Pharm. Rev. Res.* **2012**, *2*, 106–110. Available online: https://file:///D:/Documents/Downloads/HEPATOPROTECTIVE_EFFECT_OF_MALACHRA_CAPI.pdf (accessed on 22 September 2022).
75. Srirangam, G.M.; Rao, P. Synthesis and characterization of silver nanoparticles from the leaf extract of against *Malachra capitata*. RJC **2017**, *10*, 46–53. https://doi.org/10.7324/RJC.2017.1011548.
76. Naik, R.M.; Ahmed, S.; Venkatalakshmi, K. Preliminary Phytochemistry and Anti-Microbial Activity of *Malachra capitata* Plant. *Am. J. PharmTech Res.* **2018**, *8*, 258–263. Available online: http://ajptr.com/assets/upload/publish_article/AJPTR-83022_443.pdf (accessed on 22 September 2022).

77. De Araújo, V.O.; Neto, T.S.O.; Simões, S.V.D.; da Silva, T.K.F.; Riet-Correa, F.; Lucena, R.B. Primary photosensitization and contact dermatitis caused by *Malachra fasciata* Jacq. N.V. (Malvaceae) in sheep. *Toxicon* **2017**, *138*, 184–187. https://doi.org/10.1016/j.toxicon.2017.09.009.