IMPORTANT MEDICINAL PLANTS OF ARGENTINA

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Contents

Summary

A compendium of more than forty plant species that are in great demand in popular medicine in Argentina is presented in this chapter. Our intention is to provide knowledge on the different aspects of their distribution within the national territory, concerning their botanical description and the results of the phytochemical and pharmacological-toxicological studies carried out to date, as well as detailing their folkloric uses. This chapter is presented in two sections: the first corresponds to plants that have existing scientific studies about their phytochemistry and bioactivity, which often corroborate their folkloric use, with the second section corresponding to those plants that have folk medicinal use by the local and aboriginal population, but have few relevant phytochemical studies and no pharmacological or toxicity studies. With this present compilation of plant species used in folk medicine, it is hoped to emphasize the importance of these plants, and to promote the phytochemical and toxicological study of

Argentina's medicinal plants for the development of new active compounds while protecting the biodiversity.

1. Introduction

Argentina, the eighth largest country is the world, is located in the southernmost part of the American continent and is mainly distributed longitudinally along an axis of 3,694 km from the city of La Quiaca in the north to the city of Ushuaia in the south, with a surface area of 2,791,810 km^2. Its wide extension and its longitudinal disposition offer a great variety of macro-geographic areas with topographic variability and climatic gradients. There are mountain ranges in the west and the north reaching up to 6000 m above sea level, plateaus in the south, and plains in the east with tropical and subtropical climates. A variety of climates are found, with and without dry seasons in the north, temperate pampean, mountain and oceanic climates in the central area and towards the east, and cold, humid and polar climates accompanied by strong winds in the south. In this way, a great natural diversity is generated, which places Argentina in seventh place of the countries of America with the greatest biological diversity at a global level (https://news.mongabay.com/2016/05/top-10-biodiverse-countries/).

Before European colonization, the current Argentinean territory was occupied by different indigenous communities that used local natural resources to treat various health-related problems. As mentioned above, the large territorial extension of Argentina with its consequent geographical and climatic variability influenced the selection of medicinal flora, which varied among the different original communities. In addition, different preparations of the medicinal material existed, according to the rituals and customs of each of the communities. For example, the Chorotes, Diaguitas Calchaquí, Kolla, Chiriguanos, and other societies in north-western Argentina selected their medicinal plants based on the analogy between the disease to be treated and the anatomical characteristics of the plant, so that a red fruit would be used to treat bleeding wounds. On the other hand, in the south-west of Argentina, in the Patagonian region, for the Mapuche and Tehuelche cultures, taste and smell were the principal guide in the search for and selection of medicinal plants. In the Guaraní or Comechingones civilizations, there was a strong relationship between religious-cosmological factors and the plants selected for medicinal purposes.

The knowledge concerning medicinal plants among indigenous peoples was transmitted orally among healers; so much of this information was lost with the arrival of the Europeans and transculturation, which had a strong impact on the existing Amerindian societies. In the particular case of Argentina, it was the Spanish who arrived in a first migration, and with them came the first compilers of the native medicinal plants used by the original Americans: in 1710 Pedro de Montenegro published *Materia Médica Misionera* (Missionary Materia Medica); and Giuseppe Jolis, who explored the Argentine Chaco, published for the first time details about the native medicinal flora of northeastern Argentina in his work *Saggio Sulla Storia Naturale of Provincia del Gran Chaco* (1789). Migration then continued with the arrival of Europeans from other regions. Among these, was P. G. Lorentz, who made important contributions to the study of the native medicinal flora in *Plantae Lorentzianae* (1874) and *Symbolaead Floram Argentinam* (1879), based on his research carried out in the central and

northwestern regions of Argentina. Another academic who made important contributions to the area of national botany was Hieronymus G., a German botanist who published *Plantae Diaphoricae Florae Argentinae* (1882), a compilation of native medicinal and useful plants.

Migrants were naturally distributed by the ethnic composition of their migratory origin. Thus, the large cities of the central area attracted Spanish and Italian migrants, the north-eastern area was colonized by Poles, Russians, and Germans, the north-western region was populated by migrants of Arab and Middle Eastern origin, while the Patagonian region of Argentina was populated by Welsh, German, and Swiss migrants. All these migratory currents brought their own medicinal plants with them, which over time incorporated local plant resources, because of their similarity to the material of their native origin. Many medicinal plants were collected by the migrants after receiving information about them from the nearest indigenous communities. This confluence in the use of medicinal plants between the original cultures of America and the European, African and Asian migrants substantially increased the number of plant species used to treat problems arising from different diseases, which later, with the advance of medicine, was relegated to folkloric or traditional medicine. In recent years, due to a change in many people's way of thinking, the idea of health care has become more closely associated with natural products, and has led to a growth in sales and consumption of medicinal and aromatic plants in the urban areas of Argentina, which now represent more than 60% of the population. This trend, however, is most notable in the north of the country and in the south-west region of Patagonia, where the indigenous component of the population is higher than in the big cities. In the province of Neuquén, there is now an intercultural hospital (Ranguiñ Kien), the first in America, where traditional and modern medicines coexist, located in Ruca Choroi in the territory belonging to the Huenguihuel community. Although the sale of medicinal plants or their parts principally takes place in pharmacies or herbalists, there is a significant percentage of this material sold on the street or in informal markets (Figure 1).

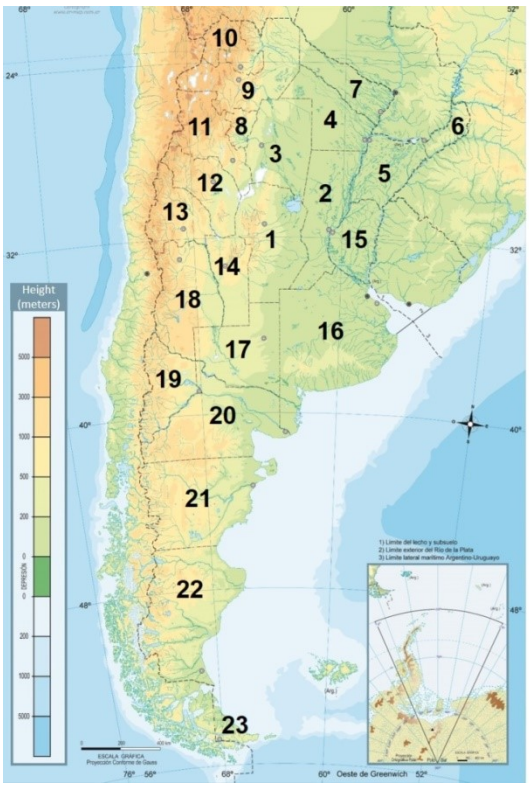
According to WHO (1978), a medicinal plant is defined as any plant species that contains substances that can be used for therapeutic purposes, or whose active principles can serve as precursors for the synthesis of new drugs. However, many of these have not been evaluated following modern scientific methodologies, and consequently their effectiveness in the treatment of the diseases they claim to cure is currently in doubt, with their medicinal use deriving from empirical knowledge. Therefore, in recent years, an increasing number of scientific studies have been carried out in order to evaluate the medicinal properties claimed by the population of many plants.

One danger facing plants in general and medicinal plants in particular, is the continuous encroachment of the agricultural frontier, which accelerated in the 1990s in Argentina with the cultivation of soya bean in the form of direct sowing. In addition to this problem, a large part of the informal market for medicinal plants is supplied directly from natural populations, without any control by national or provincial authorities.

Due to the large number of species used as medicinal plants in Argentina, this compendium does not intend to show the totality of these species, but rather highlights those that are most commonly found in popular markets, and those that are most widely

used due to their accessibility. The following is a list of these plant species, which are distributed in different areas and provinces of the country, as shown in Figure 2.

Figure 1. A Rural market in northwestern Argentina



Argentine provinces:
1. Córdoba
2. Santa Fe
3. Santiago del Estero
4. Chaco
5. Corrientes
6. Misiones
7. Formosa
8. Tucumán
9. Salta
10. Jujuy
11. Catamarca
12. La Rioja
13. San Juan
14. San Luis
15. Entre Ríos
16. Buenos Aires
17. La Pampa
18. Mendoza
19. Neuquén
20. Río Negro
21. Chubut
22. Santa Cruz
23. Tierra del Fuego

Figure 2. Physical-political map of Argentina. Province distribution

2. Medicinal Plants of Argentina

2.1. Medicinal Plants with Phytochemical, Pharmacological and/Or Toxicological Studies (Listed In Alphabetical Order by Generic Name)

2.1.1. *Acanthostyles buniifolius* (Hook. & Arn.) R.M. King & H. Rob. (syn. *Eupatorium buniifolium*) (Asteraceae)

Botanical Characteristics: This is a shrub that can reach up to two metres in height. Its leaves are linear and elongated, with its flowers arranged in cylindrical chapters of white-reddish colors.

Distribution and Habitat: This is an endemic species from South America, distributed throughout Latin America. Present in Bolivia, southern Brazil and Uruguay, and in Argentina extending from the north of Patagonia (the province of Rio Negro) to the north of the country. The area occupied in Argentina is also often called the peripampasic arc.

Phytochemical Studies: These studies present essential oils characterized by monoterpenic hydrocarbons, with the pinene isomers forming the majority. Phytochemical studies have isolated and identified phenolic acids and some flavones that are characterized by an unusual form that presents two ethers and a hydroxyl group in the C ring of the flavonoid. The flavonoids of *A. buniifolius* include salvigenin, acacetin and jaceidin.

Folk or Traditional Uses: The popular names used are “chilca”, “romerillo”, “chirca” or “mio-mio”. Although widespread throughout much of South America, reports of its medicinal uses are concentrated in Argentina, where its aerial part is used as for digestive, analgesic, sedative, antirheumatic purposes, and sometimes as a disinfectant for wounds or sores. The aerial parts are also used as insect repellants.

Toxicology and Pharmaceutical Studies: The essential oils show antimicrobial activity, as do some of its flavonoids. The digestive herb activity was found to be related to caffeic and chlorogenic acids, while the anti-inflammatory property is associated with the presence of centaureidin (Figure 3) and scopoletin. “*In vitro*” studies of organic extracts have shown an anti-epimastigote activity against *Trypanosoma cruzi.*

2.1.2. *Achyrocline satureioides* (Lam.) De Candolle. (Asteraceae)

Botanical Characteristics: The genus *Achyrocline* comprises approximately 42 species, including *A. satureioides*, which is a small perennial shrub that can reach up to 19 cm in height. The flowers bloom in clusters, and its leaves are thin and dark green (Figure 4).

Distribution and Habitat: *A. satureioides* is a herb native to the southeast region of South America. Its distribution extends from the north of Brazil to Argentina, where it occupies the central northeast region (from the province of La Pampa to the north of the country). It can grow up to 3000 meters above sea level.

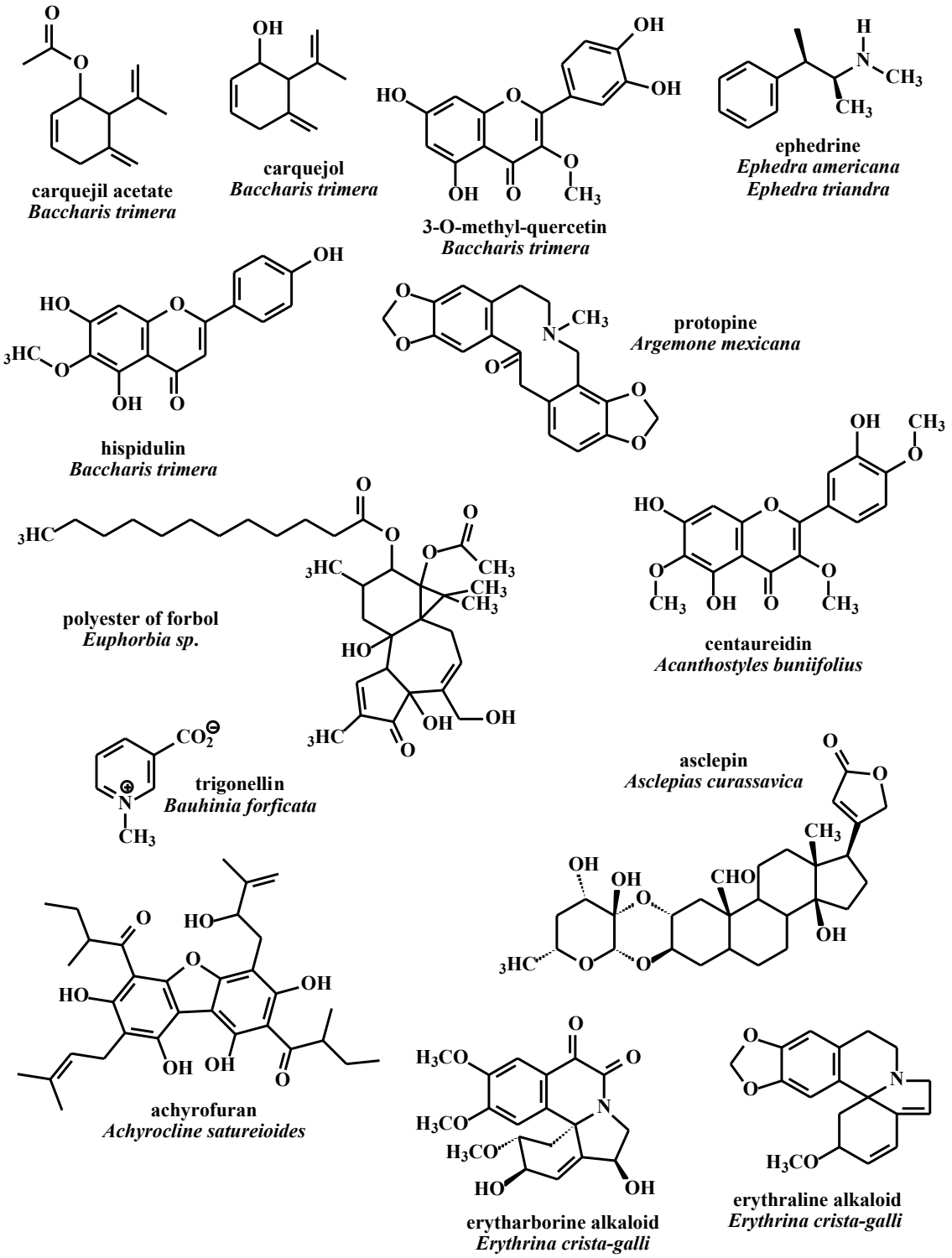


Figure 3. Structures of molecules of interest found in medicinal plants growing in Argentina (first part, genus A to E)

Figure 4. *Achyrocline satureioides* flowering plant (courtesy of Dr. Carolina Carrizo García)

Phytochemical Studies: The phytochemical studies carried out on different species of *Achyrocline* have reported the presence of mainly flavonols and flavones, and with flavonones at lower concentrations. This plant presents different chemotypes depending on the regions where it grows. The essential oil of this herb is characterized by a high concentration of sesquiterpene hydrocarbons, especially β-caryophyllene.

Folk or Traditional Uses: These plants are used to treat digestive and respiratory diseases. Some of its popular names are “marcela”, “marcela de campo” and “vira-vira”. In Argentina, its consumption as an infusion is to cure digestive problems and to act as an antidiabetic. The Qom, people of an ethnic group consume “marcela” infusions to lose weight. Possibly this effect of lose weight is related to the presence of the prenylated dibenzofuran, achyrofuran, which reduce the presence of sugar in the blood. It is also often used for asthma and in the regulation of menstruation.

Toxicology and Pharmacological Studies: The use of flavonols and flavones has been related to their digestive and respiratory properties, with quercetin, luteolin, and 3-O-methylquercetin being the flavonoids associated with the antioxidant, cytoprotective and anticancer activities of this plant. Extracts of *A. alata*, *A. flaccida,* and *A. satureioides* show re-epithelisation and the collagen remodeling properties of wounds due to their high concentratione of chlorogenic acid and quercetin, giving an anti-inflammatory effect. The hydroalcoholic extracts of the inflorescences of *A. satureioides* have a high concentration of luteolin and quercetin, with these two flavonoids producing an increase in mucus production and generating an anti-ulcer effect. The flavonols quercetin and 3-methylquercetin and the flavone luteolin have also shown skin protective properties against UV radiation. The prenylated dibenzofuran, known as achyrofuran (Figure 3), revealed a blood glucose-lowering activity.

2.1.3. *Adesmia boronioides* Hook (Fabaceae)

Botanical Characteristics: It is a perennial shrub, highly branched with very resinous glandular branches. It can reach a size of 40 cm. The leaves are approximately 4 cm, with very short petioles. The yellow flowers are 7-10 mm long and have a strong and pungent perfume.

Distribution and Habitat: Its distribution ranges from sea level to more than 2000 meters above sea level in the western region of Patagonia.

Phytochemical Studies: This plant can produce up to 8% resin in relation to the total fresh weight of the plant. Among the most important components in essential oils or in resins we can find skele-6-en-9-one and skele-7-in-9-one. Other components that can be found are veratric acid, δ-cadinene, 1-epi-cubenol and α-copaen-11-ol. Flavonoids, triterpenoids and diterpenoids were also found. The southern populations were the only ones that gave a positive staining for cyanogenic glycosides. Cyanogenic plant populations would be associated with low altitude locations according to the bibliography consulted. The localities at altitudes close to sea level had a higher total content of phenols in autumn and a lower total content of flavonoids.

Folk or Traditional Uses: *Adesmia boronioides* known as paramela, is a native plant with a wide distribution in Argentine Patagonia, recognized for its medicinal use and its essential oils used by the cosmetic industry. Among the original communities of Patagonia Argentina we have Mapuches, Tehuelches or Günina küne, Pampas millcayac, Pampas allentiac among others. According to the archaeobotanical records, they used this plant as a fuel resource, taking advantage of the high concentration of resins. It is a plant used as medicine in a large part of the rural populations of Patagonia, forming part of the family medicine cabinets that helps them cope with health problems autonomously, a situation that occurs frequently due to forced isolation caused by strong winds and / or snowfall. Its medicinal use has been recorded in ethnobotanical works in Mapuche, Tehuelches or Günina küne, Pampas millcayac, Pampas allentiac communities. The herb has been mentioned for its digestive, antirheumatic, diaphoretic, and antiemetic properties. It is harvested in autumn-winter, and it is distinguished by its fragrant character and is classified within the group of plants with a *magic soul* and *sweet aroma* and *bitter taste*. It has been used since ancient times by the Mapuches, Tehuelches or Günina küne, Pampas millcayac, Pampas allentiac of the region mainly to relieve joint or muscle pain, bumps, sprains and cramps. It is also used in sprays to avoid coughs, asthma or cases of bronchitis.

Toxicology and Pharmacological Studies: Both resins and essential oils show antimicrobial, antifungal, anti-inflammatory and antioxidative activities. They also show anti-insect activity, control of *Triatoma infestans*, popularly known as *vinchuca*.

2.1.4. *Aloysia* sp. (Verbenaceae)

Botanical Characteristics: This is a class of flowering plants of the Verbenaceae family. These are generally aromatic plants and their inflorescence is usually a raceme with white and small tubular flowers. *Aloysia citrodora* Paláu (syn. *A. triphylla* (L´Her.)

Britton and *Aloysia polystachya* (Gris.) Moldenke are aromatic shrubs that can reach one to three m. in height. *A. citrodora* has lanceolate leaves with oil glands and small white flowers, and *A. polystachya* has ***v***ery small white flowers and the leaves are whole and oval (Figure 5).

Figure 5. Branches and leaves of *Aloysia polystachya*

Distribution and Habitat: Native to the Americas and grows in temperate, subtropical and desert climates. The *A. citrodora* species is native to South America. In Argentina, it is found in the northwest of the country (Jujuy, Salta, Tucumán, Catamarca, La Rioja and San Juan provinces), and *A. polystachya* grows in the northern region of the country (Catamarca, Córdoba, Corrientes, Entre Ríos, Formosa, La Rioja, Salta, Santiago del Estero, and San Juan), with populations of the plant being found up to an altitude of 1200 m.a.s.l.

Phytochemical Studies: *Aloysia citrodora* is listed in the Argentine National Pharmacopoeia and the Argentine Food Code as a vegetable condiment. The composition of its essential oil is the main reason for its domestication and commercialization, which contains more than 40% aldehydes. Three chemotypes of *A. citrodora* can be distinguished: i) pinene / curcumene, ii) sabinene / thujone / citronellal and iii) geranial / neral / limonene, with the latter chemotype being the most representative of the species. Vitexin, which is an apigenin flavone 8-C-glucoside, and isovitexin, an apigenin flavone 6-C-glucoside, can be isolated from aqueous infusions of *A. citriodora*.

Aloysia polystachya has two chemotypes separated by major monoterpenes in essential oil, one of which is carvone, with the other being α-thujone. Oxygenated monoterpenes

can represent more than 80% of the essential oil components. The following flavonoids have been isolated and identified from the organic extracts of *A. polystachya*: kaemferol, quercetin, and naringenin. Catechin and ferulic and gallic acids were also isolated and identified.

Folk or Traditional Uses: *A. citrodora* is also known as "*hierba luisa*" or "*cedrón*". The infusions of the leaves are used for their antispasmodic, eupeptic, antiflatulent, expectorant, and anti-asthmatic properties. It is also consumed as an aromatic tea. *A. polystachya* is popularly named "té de burro" or "poleo de Castilla", and its leaves are used to make infusions or to mix with *I. paraguariensis* in the drink called "mate". This infusion is used as a digestive and carminative tonic. It is also used to treat "empacho".

Toxicology and Pharmacological Studies: The anti-spasmodic properties of the aqueous extracts of *A. citrodora* are related to the presence of vitexin, while the analgesic property could be associated with the presence of the flavonol artemitin and the flavonone hesperidin. Other properties found from "in vitro" studies of the different extracts of *A. citrodora* are anti-dental caries, and antifungal (dermatophyte), antibacterial, antioxidant and anti-radical effects.

The sedative property of the "té de burro" infusion is related to the presence of the oxygenated monoterpene thujone, and with the presence of the α−β unsaturated ketone carvone being the active principle that gives the infusions antispasmodic, eupeptic, and carminative properties. The aqueous extracts have shown anti-colorectal cancer and anxiolytic-like properties in "in vitro" studies. The anxiolytic effect of extracts of leaves of *A. polystachya* could be related to the presence of carvone, limonene, and acteoside. Acteoside is a verbascoside, which is a phenylpropanoid sugar ester.

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Biographical Sketches

Zygadlo Julio Alberto. Doctor in Biological Sciences from the National University of Córdoba. He currently works as a Professor of Organic Chemistry and Natural Products, where he develops undergraduate and graduate teaching activities. He is a researcher at the National Council for Scientific and Technical Research (CONICET) and a member of the Phytochemistry area of the Multidisciplinary Institute of Plant Biology (IMBIV). His research activities encompass fundamental studies in essential oils and phytochemical studies on medicinal plants. His research group is currently developing new uses of essential oils for the control of pests of veterinary or agricultural importance and his recent research project involves new devices for the controlled release of bioactive substances. He has been invited to collaborate with research groups of private and/or public institutions in the Dominican Republic, Costa Rica, Uruguay, Spain, Portugal, Germany, and Finland. From his line of work he has directed several doctoral theses and published numerous scientific papers. He is a member of several academic societies like the Cordoba Biology Society.

Zunino María Paula. Dr. in Biology. Assistant Professor of the Chair of Organic Chemistry and Natural Products, undergraduate and postgraduate professor at the Faculty of Exact Physical and Natural Sciences, National University of Córdoba. Argentina. Researcher at the National Council for Scientific and Technical Research (CONICET) and member of the Phytochemistry area of the Multidisciplinary Institute of Plant Biology. Her line of research is related to the biological activity of natural compounds, especially volatile compounds such as monoterpenes. In this field of research, she directs several doctoral theses and has published numerous scientific papers.

Ponce Andres. MD, Ph.D. An experienced headteacher with over 25 years of experience in providing the vision and leadership required to ensure a high quality of education for students. Having a proven track record of successfully managing resources and staff to improve educational services, thereby providing students and teachers with the best environment to achieve their full potential.https://scholar.google.com.ar/citations?user=ckH4624AAAAJ&hl=es&oi=ao

Usseglio Virginia Lara. Dr. in Biology. She has been a CONICET Doctoral Fellow from 2016 to 2021 and a Ph.D. student in Biological Sciences (FCEFyN-UNC). Member of the Multidisciplinary Institute of Plant Biology (IMBiV-CONICET-UNC) and of the Institute of Food Science and Technology-Faculties of Exact Physical and Natural Sciences-National University of Córdoba (ICTA-FCEFyN-UNC). She is assigned to the subject "Natural Products" belonging to the Chair of Organic Chemistry and Natural Products (FCEFyN-UNC). She is the author and co-author of 7 publications in peer-reviewed scientific journals and she has presented 17 papers at conferences and/or scientific and educational meetings. In 2019, she directed a bachelor's thesis to obtain the title of biologist (FCEFyN-UNC). In 2018 she received a special mention in the VI National Photography Contest, "Science in Focus - Technology in Focus" of the Ministry of Education, Culture, Science and Technology (Argentina). She is an active part of the university extension program "Ciencia para Armar" (science to put together) (SECyT-UNC). She is a member of the International Society for Chemical Ecology (ISCE).