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The Need to Teach Natural Medicine in Educational Institutions to Prevent Health Risks in Children and Adolescents

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Abstract

The aim of this theoretical-practical study is to alert families to the excessive and improper use of medicinal plants. Our sociological analysis reveals a high consumption of plants with medicinal interest; however, society remains largely unaware of the potential consequences of their use, indicating a clear lack of knowledge regarding medicinal species. While this form of medicine is widely used, it is neither medically supervised nor adequately regulated by pharmaceutical authorities. The species being consumed, their potential adulterations, and possible falsifications are often unknown. The widespread use of these plants is largely driven by oral transmission within communities and by commercial advertising. From an educational perspective, the teaching of medicinal plant use is not included in student curricula, highlighting the need for its integration into formal education. To enhance knowledge of medicinal plants, we provide an overview of some widely used species with therapeutic applications in digestive disorders, liver conditions, cholesterol regulation, blood glucose levels, blood pressure control, weight management, and respiratory ailments. The inclusion of frequently used species aims to contribute a glossary of scientific terms, promoting scientific literacy and raising social awareness regarding the responsible use of natural medicine.

Keywords: *Medicinal Flora, Lack of Knowledge, Education, Teaching, Society, Health, Adulterations, Intoxications.*

Introduction

History of Natural Medicine

The use of medicinal plants by humans dates back to many centuries before Christ. Egyptians, Babylonians, Hebrews, Phoenicians, Chinese, Greeks, and Romans all utilized plants to combat human diseases. As a result, there is a pharmaco-historical tradition that should not be disregarded by modern medicine, as contemporary medical practices have evolved from these ancient foundations.

In ancient Egypt, around 1300 BCE, plants such as hemp and flax were cultivated along the banks of the Nile, while expeditions to foreign lands brought back valuable botanicals such as frankincense (*Boswellia sacra*), myrrh (*Commiphora myrrha*), sandalwood (*Santalum album* L.), and ebony (*Diospyros ebenum*). These contributed to the development of a pharmacopoeia, classifying plants according to their uses: purgatives, vermifuges, diuretics, cosmetics, and aromatic herbs for culinary purposes. Medicinal plants also played a role in the mummification process, as documented in the Egyptian Ebers Papyrus, a 20-meter-long manuscript discovered in 1872.

In ancient Babylon, located in the valley of the Tigris and Euphrates rivers, medicinal plants such as cereals, dates, grapevines, and sesame (*Sesamum indicum*), which remains widely used in contemporary nutrition, were extensively cultivated. Among the Hebrews, myrrh and frankincense held particular significance, with their use persisting in religious ceremonies to this day. Additionally, wheat, wine, and oil were integral to their religious rites. The Phoenicians, a civilization dedicated to commerce and maritime trade, frequently engaged in the trade of frankincense, myrrh, perfumes, spices, balsams, wine, and oil (Arribas, 1986).

However, it is the Chinese civilization that is credited with the earliest recorded cultivation of medicinal plants, dating back to approximately 3000 BCE. Their pharmacopoeia included around 600 plant species

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used in various therapies. By this time, *Panax ginseng*, a member of the *Araliaceae* family, was already known, a plant still widely used in natural medicine today (Font Quer, 2002).

In ancient Greece and Rome, medicinal plants were well known, with their therapeutic and toxic properties carefully studied. Many species were cultivated in gardens and orchards. During this period, medicine transitioned from being a mystical, priestly practice to a discipline pursued by alchemists and philosophers. Aristotle (384–322 BCE) conducted extensive studies in natural history and botany, while Hippocrates (460– 377 BCE), regarded as the father of medicine, compiled existing medical knowledge into the *Corpus Hippocraticum*, detailing plant-based remedies for specific diseases (Cabezón, 1997).

During the Roman era, the reliance on medicinal plants intensified, leading Roman society to import products such as pepper, cinnamon, and myrrh from Spain, Africa, and, primarily, the East. The study of medicinal botany reached its pinnacle with Galen (Claudius Galenus), considered the father of pharmacy. His works, along with those of Dioscorides and Pliny, remained essential references for many years thereafter.

It was the Arabs who first established a clear distinction between medicine and pharmacy. Avicenna, a highly renowned physician, made significant contributions to the study of medicinal plants, as evidenced in his seminal work, Canon Medicae. The Arab pharmacopoeia encompassed approximately 1,400 drugs, with 200 of them being introduced for the first time. Their knowledge and expertise in medicinal plants spread across France, Italy, and Spain (Cabezón, 1997; González Herrera, 1002).

From the early 11th century to the late 14th century, the Schola Medica Salernitana (Salerno Medical School), under the Benedictine Order, gained widespread recognition. The school documented over 100 medicinal plants, and thanks to the Benedictine monks, many botanical gardens dedicated to medicinal plants were established and preserved. Some of these cultivated species, such as aconite, digitalis, fennel, mint, sage, lemon balm, and rosemary, continue to be used today.

During the Renaissance, botany, which had previously been considered part of Materia Medica, emerged as an independent scientific discipline. A notable figure in this development was Carl von Linné (Carl Linnaeus), whose creation of the binomial nomenclature significantly advanced the classification and understanding of plant species. Linnaeus' contributions, along with the exploratory voyages of Columbus, Vasco da Gama, and Magellan, played a decisive role in the expansion of medicinal botany. These expeditions led to the discovery of numerous plants from the New World, such as tea, coffee, tobacco, and coca.

The discovery of the Americas and the establishment of trade routes with Asia greatly enriched the European market with new medicinal substances. This necessitated a deeper understanding of the plants from which these substances were derived, leading to the emergence of pharmacognosy as a specialized field of study (Cano et al., 2007).

Active Compounds Present in Medicinal Plants

The development of the pharmaceutical industry over the past 30 years, alongside the gradual decline of natural medicine, skepticism among certain sectors of the population toward modern medicine, and the continuous pursuit of beauty, has led to a renewed increase in the use of medicinal and aromatic plants (Cano et al., 2009).

Currently, there is a high demand for medicinal plants, which are sold in herbal stores, para-pharmacies, commercial retail chains, and even through street vendors. However, despite this widespread consumption, society has increasingly distanced itself from botanical knowledge, relying on individuals who, in most cases, are not experts in plant identification. This has led to the prevalent use of vernacular (local) names instead of scientific names following the Botanical Nomenclature Code, causing confusion and potential health risks (Cano-Ortiz et al., 2024). The growing demand for medicinal and aromatic plants has spurred increased research in botany and phytochemistry, aiming to enhance the understanding of the active

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compounds involved in phytotherapy (Lad & Frawley, 1995).

In addition to producing primary metabolites such as carbohydrates, proteins, and lipids, plants generate active *compounds* as secondary metabolites, which are responsible for their therapeutic properties and medicinal applications.

The main bioactive compounds found in plants include glycosides, essential oils, tannins, resins, and mucilages. Mucilages, in particular, exert a mechanical laxative effect and contribute to a sensation of fullness, making them a common ingredient in weight-loss diets. This has led to their widespread use among adolescents pursuing slimming regimens. Mucilages are frequently found in botanical families such as *Malvaceae* (e.g., *Malva sylvestris, Althaea officinalis*).

Vitamins and mineral elements serve as essential biochemical catalysts for the human body and are abundantly found in plants. Certain plants also produce natural antibiotics, such as *Penicillium*, the fungal source of penicillin (Cano et al., 2007). Plants are a primary source of vitamins, with examples including vitamin E (*a- tocopherol*), which is particularly abundant in olive oil, especially in the Hojiblanca variety (Barranco et al., 2004). Other vitamins of high biological significance include vitamins A, C, and B-complex.

The objective of this study is to assess societal knowledge regarding medicinal plants, their applications for various ailments, and the level of awareness and understanding of the value of natural medicine.

Materials and Methods

A study was conducted on plant species commonly used by the population for health-related disorders. To this end, a randomly selected, irreversible, anonymized survey was administered to 100 individuals to determine which plants they use as natural medicine and for which ailments these plants are employed. In parallel, a set of survey items was applied to students training to become future teachers. The objective was to identify the most frequently used species within their families and the specific health conditions they address. This information was then used to select plant species to be incorporated into educational curricula, focusing on their application as natural remedies.

Given the challenges posed by scientific language, scientific literacy and environmental education are essential (Guerrero Fernández et al., 2022; Lara Calderón, 2014). For this reason, we established a glossary comprising 106 medical-pharmaceutical scientific terms deemed relevant to adolescent health.

To achieve this goal, students were instructed in herbarium techniques, plant identification, and the structural, morphological, and ecological characteristics of the selected species. This approach aimed to enable them to assess whether plants had been adulterated or falsified, determine their suitability for medicinal use, and recognize potentially toxic species. Additionally, a literature review was conducted to identify the active compounds present in these species and their phytotherapeutic applications. This review was based on various authoritative sources, including manuals on botany, phytotherapy, and pharmacopoeias (Losa et al., 1970; 1972; Mayor López & Álvarez Rodríguez, 1980; Izco et al., 1997; Guerra et al., 2001; Real Farmacopea Española, 1997; Farmacopea Caribeña, 2005; Real Decreto Ministerio de Salud y Consumo, 2004; Flores et al., 2003).

A set of 10 questions was administered to 80 students, anonymized in an irreversible manner, in compliance with Ley Orgánica 3/2018, of December 5, on the Protection of Personal Data and the Guarantee of Digital Rights. The questions were rated on a Likert scale from 1 to 5. The questions included were as follows:

On a scale from 1 to 5, how would you rate the use of medicinal plants?

Which do you consider more effective: official medicine or natural plant-based medicine?

Have you received any training regarding the use of medicinal plants in school or secondary education?

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On a scale from 1 to 5, do you believe the use of medicinal plants is more prevalent in rural or urban environments?

Who is more knowledgeable about plants and their uses: rural populations or those in large cities?

Is it easy to differentiate plants rich in alkaloids from those that do not contain alkaloids?

Do you know many, few, or no medicinal plants for health or beauty purposes?

Do you think it is beneficial to raise social awareness about the use of medicinal plants?

Are edible plants as important for health as medicinal plants?

Would you be interested in receiving botanical training for later application in schools?

Once the students agreed to participate, they were first verbally and in writing informed that the collected data would remain confidential and be used exclusively for scientific purposes. Participants were required to complete an informed consent form anonymously before taking the survey, which was provided in digital format. To prevent any potential coercion, the survey administrators emphasized that participation was voluntary, and participants could withdraw at any time.

This information was outlined in the survey form. Before the survey began, participants were asked if they had any questions or doubts regarding the study. Both before and after completing the survey, researchers were available to clarify any concerns that might arise during the process.

This study does not require approval from an ethics committee due to the irreversible anonymization of the data used. The basic anonymization guide published by the Spanish Agency for the Protection of Data and Ley Orgánica 3/2018 was followed, ensuring compliance with data protection regulations and digital rights.

As a result of the sociological opinion survey, an analysis of certain species used for various health disorders is presented. Above all, we aim to highlight the potential dangers associated with the use of natural medicine without adequate botanical knowledge, the risks posed by adulterations and falsifications of preparations, and the confusion regarding the identification of species that are safe for medicinal use versus those that are toxic (Schaumber & Paris, 1972; Stubin & Peris, 1998; Mayor López, 1980).

The responses from the 80 students were recorded in an Excel table and subjected to statistical analysis using the *Past.exe* software. A linear correlation was calculated for each item, followed by the average correlation across all items to apply Cronbach's alpha coefficient in order to determine internal consistency and reliability (Oviedo & Campos Arias, 2005). The following formula was used:

$$\alpha = \frac{n \times p}{1 + p(n-1)}$$

Where:

- α = Cronbach's alpha coefficient
- n = number of items
- p = average of all correlations

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Results

The ANOVA statistical analysis (Figure 1) reveals that there are no outliers in the data treatment, as the normal probability plot of the residuals displays the expected values when the distribution is normal. While we cannot definitively confirm a normal distribution, the null hypothesis cannot be rejected, as the Shapiro-Wilk test yields a value of 0.4479 and a p-value (normal) > 0.05, which indicates that we cannot reject the null hypothesis, suggesting that the result is not statistically significant.

The average linear correlation value (rrr) is 0.2000, Spearman's rank correlation coefficient (rsr_srs) is 0.2034, and the variance is 0.5279 (Table 1). Furthermore, at a 99% confidence level, the correlations are predominantly positive, with values approaching +1, and a variance of 0.5279, which falls within the normal range.

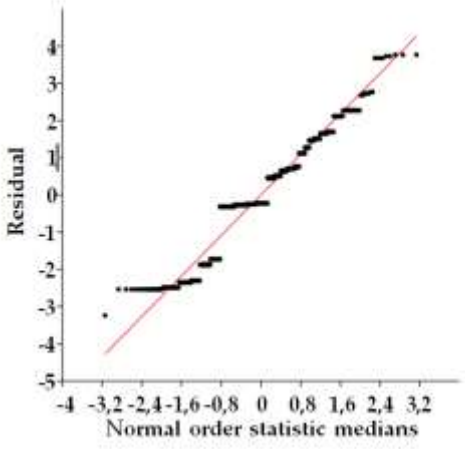

Figure 1. Analysis of the Data Treatment Via ANOVA Without Outliers.

Table 1. Analysis of Linear Correlation Rrr, Spearman's Rsr_Srs, Obtained Variance, And Shapiro-Wilk Normality Test

Correlation analysis and normality test	
Linear correlation r	0.2
Spearman´s corralation rs	0.2034
Variance	0.5279
Shaprio Wilk	0.4479
p(n)	> 0.05

Applying the Cronbach's alpha coefficient yields a reliability degree greater than 0.7, demonstrating the internal consistency of the data.

$$\alpha = \frac{n \times p}{1 + p(n-1)} = \frac{10 \times 0.2000}{1 + 0.2000(10-1)} = 0.7142$$

The results of the sociological survey show that among the 100 respondents, 75-80% have used medicinal plants at some point; however, they do not place excessive value on phytotherapy compared to conventional medicine, perhaps due to a lack of knowledge about the medicinal properties of plants (Acosta-Román, Frank Saldña-Chafoque, & Poma-Poma, 2023), although they do recognize that it is a useful complement. The respondents acknowledge that the most common use of phytotherapy is for digestive and respiratory disorders, with the most frequently used species being *Valeriana officinalis* for sleep aid (Vila, 1987) and chamomile for digestion, while Aloe vera is widely used for skin care. Women, with a percentage higher

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than 60%, are the predominant users of plant-based preparations.

The social interest in natural medicine is not supported in educational institutions, either due to a lack of teacher training or student demotivation towards science, likely due to a lack of future employment prospects, leading to poor education and an inability to address social issues (Martínez Aznar et al., 2002; Martínez Aznar & Ibañez Horcajo, 2006). The demotivation among students calls for a shift in the teaching paradigm to involve active learning (Figueiredo & Perticarrari, 2022). There is a need for strong scientific reasoning, directing the curriculum towards the concepts of health and disease, with particular attention to food safety (Revel Chion et al., 2021; Zochi et al., 2022).

Currently, there is a growing interest in ethnobotanical studies that aim to recover traditional medicine by emphasizing its importance in health (Zambrano et al., 2015; Fernández-Hernández et al., 2021; Caruso, 2022; Gentile et al., 2022; Tavilla et al., 2022). A key issue in contemporary natural medicine is the origin of plants, which can be obtained either through field collection or cultivation. In the case of collection from plant populations, it must be carried out by experts who know how to harvest the medicinal parts. The enhancement of medicinal plant cultivation is of particular interest, as these plants represent valuable economic and social resources with ecosystemic significance (Milesi, 1991; Guerrero & Suarez, 2019; Cano Ortiz & Martínez Lombardo, 2009a,b; Muñoz López de Bustamante, 2002).

With these results, we analyze several species that are highly demanded by the population, though there is significant ignorance regarding medicinal plants, which poses a certain danger due to potential intoxications that may occur. Therefore, the teaching of Medicinal Botany is crucial, as the analysis of school curricula reveals that there are no contents related to natural medicine (Royal Decrees 1631/2006; 830/2010; 387/2021).

Discussion

Quality Control: Adulterations and Falsifications

The use of plants is so widespread that there is hardly a family that does not have some plant-based preparation, whether medicinal, such as carminatives, digestive aids, stimulants, relaxants, anti-inflammatory agents, and antibacterials, or plants with dermatological applications, used by the population in pursuit of healthy and beautiful skin; in other cases, plant preparations are used for weight loss diets. Students report a high use of plants such as chamomile in weight loss diets and for skin care, a trend that was also highlighted in previous studies by Cano et al. (2009).

The high consumption of plants by families, along with a lack of knowledge about them, jeopardizes the health of children, adolescents, young adults, and the elderly due to the absence of quality control, which may result in falsifications and contaminations. An example is dandelion, *Taraxacum officinale*, which may be adulterated with species like *Leontodon* (particularly L. *autumnalis)* and *Cichorium intybus* (Guerra et al., 2001). All this suggests that a better understanding of plants by the population is necessary to avoid health risks, something that is not happening, as evidenced in this study, due to the lack of such knowledge being taught in educational centers.

The high consumption calls for an increase in both collection and cultivation. Currently, a large portion is collected, and the first step is to ensure accurate identification (Rangel-Ospino, Díaz Santos, & Guerrero-Gutierrez, 2018). Once identified, it is essential to establish a "collection calendar" indicating the most favorable seasons and times for harvesting, as there are differences between young and adult individuals in terms of active ingredient content. This plant collection method poses a conservation risk, which has been highlighted by numerous studies. However, the use of medicinal plants holds great potential for sustainable development (Leé Garcés, Castillo Borges, Díaz Cintra, & González Benoit).

Environmental issues call for a greater commitment from the educational system through the use of botanical gardens and school gardens, which should act as learning laboratories (Martínez Machado & Rojas Ramirez, 2019; Cano-Ortiz et al., 2024; Bravo Mena et al., 2024).

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The amount of active ingredients depends not only on the developmental stage of the plant but also on the climate, which significantly affects the content of these compounds. In the case of aromatic plants, the content of secondary metabolites (López Gamboa, 2023), such as essential oils, is higher when plants grow in arid and semi-arid environments. The official parts of the plant, such as the root, stem, leaf, flower, fruit, and seed, must be harvested. These collections must be controlled; otherwise, populations can be over-harvested to the point of disappearance. Therefore, the cultivation areas should be expanded (Cano-Ortiz & Martínez Lombardo, 2009).

Quality control is of vital importance, as the high demand often leads to confusion due to misidentification, with the potential for contamination, adulteration, and falsification. Quality should be understood in a broad sense, encompassing all the links in the chain: cultivation, collection, drying, storage, and preparation of the plant drug. Quality control must first include a "raw material control guide," where as much information as possible should be gathered about the plant material (Guerra et al., 2001).

Latin and common names

Official part

Country or region of origin

Cultivation or collection data

Whether it is a wild or cultivated species

Date of collection

Vegetative stage at the time of collection

Phytosanitary treatments applied

Drying process

Characteristics of the location, temperature, and time used in the process

Storage conditions

Environmental conditions, such as temperature and humidity, as well as packaging, storage, and transportation conditions.

This information should be supplemented with all relevant data obtained from subsequent analyses, including macroscopic, organoleptic, microscopic, and appropriate chemical analyses, in order to detect foreign elements, contaminants, and to quantify the active ingredients present in the various official plant parts.

Preparation, Benefits, and Applications

Medicinal plants are prepared and administered only after being crushed, mashed, boiled, or reduced to powder. In general, we can establish two types of preparations: "home-made" and "galenic." The former has always been used to harness the healing properties of plants and remains useful today, considering how simple their application is. However, it is in homemade preparations where the greatest danger of poisoning exists, due to the lack of knowledge in rural populations, as the transmission of knowledge from parents to children has been lost. Traditional family medicine has been distorted in modern society, which calls for the need to implement its teaching in educational institutions. New expectations for the teaching of biological content need to be generated, adapted to societal needs (Páez-Rincón, Reyes-Roncancio, & Duvan, 2020). In this regard, we agree with Nguyen Thi Thanh Phuong (2025), as our sociological analysis

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shows a demand for natural medicine.

Galenic preparations should be made by pharmacists and pharmaceutical industries (Flores et al., 2003). However, in official medicine, there is no teaching of Botany in medical schools, and even the botanical content in pharmacy schools is decreasing. The preparation of galenic products is left to pharmaceutical laboratories, which is why the incorporation of environmental knowledge on Medical Botany into medical studies is needed (Rodríguez Cabrera et al., 2020).

Currently, the use of plants has increased, bringing risks as the rural healer, who possessed empirical knowledge passed down through generations (Stübing & Peris, 1998), has disappeared. Identification, preparation, preservation, and sale are now carried out by individuals who are not experts, leading to potential errors that can harm health. Hence, the necessity to include Botany content in educational institutions. Students should be prepared not only to identify species but also to understand their autoecology in order to plan their cultivation and promote sustainable development (Jiménez Cabrera et al., 2015). In this sense, we agree with Carmona Hernández (2009), who advocates combining environmental education and health.

Medicinal, aromatic, culinary, biocidal, and dyeing plants offer two major benefits. On one hand, they provide environmental benefits by protecting the soil from erosion and allowing the use of marginal lands alongside beekeeping. Therefore, they serve as an alternative to traditional agriculture, providing socioeconomic benefits to depressed areas. This synergy promotes both development and conservation, fostering rural employment creation and primary transformation industries. Industrial applications include:

a) **Phytosanitary:** The production of herbicides, insecticides, fungicides, acaricides.

b) **Pharmaceutical:** A variety of medicinal principles are extracted to create diverse drugs.

c) **Dyeing:** The production of natural dyes in various colors.

d) **Cosmetics and Perfumery:** Many industries produce colognes, perfumes, cosmetics, lotions, soaps, bath salts, etc.

e) **Food Industries:** Plants are used to produce natural additives, colorants, flavorings, antioxidants, preservatives, liquors, and dietary products.

The preparations offered by specialized industries provide the necessary guarantees. Common preparations include: baths, infusions, liniments, lotions, poultices, compresses, decoctions or herbal teas, extracts, fumigation, gargles, injections, syrups, macerations, powders, ointments, balms, and wines. In general, we can categorize the administration methods into three main types: topical use, oral use, and parenteral use (Guerrero et al., 2001; Dalmau et al., 1998).

Therapeutic Applications Society Should Be Aware of

For digestive disorders, various plant species can be used. For euphoric actions, *Pimpinella anisum* (anise) and *Melissa officinalis* (lemon balm) are effective. Anise is carminative, intestinal antiseptic, and vermifuge due to its essential oil. It also acts as an intestinal antispasmodic due to the coumarins in its essential oil. Anise is used for flatulence, bloating, and difficult digestion caused by low gastric secretions. The recommended usage is in infusion. It is contraindicated in hemorrhages, hyperthyroidism, and hormonal disorders.

The officinal part used is the fruit. It should be stored in cool, well-sealed places, protected from light and humidity. Adulterations with *Conium maculatum* (poison hemlock), which is highly toxic due to its cicutine content, have been found. Adulteration with *Petroselinum sativum* (parsley) is easily detectable by experts. Almost all products sold in the market are adulterated with *Coriandrum sativum* (cilantro).

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Other species from the *Mentha* genus are carminative due to their essential oils, and also have analgesic, antispasmodic, gastrointestinal, choleretic, and cholagogue properties, meaning they stimulate bile production and expulsion. Due to the presence of essential oils and flavon

oids, they also have antiseptic and antifungal properties. *Mentha* species are used for bloating, hepatobiliary disorders, and hepatitis. They are consumed in a 5% infusion for 15 minutes, taking 1-3 cups after meals, or in dry extract, 1 gram per day divided into 2-3 doses. It is contraindicated during pregnancy, lactation, and for children under six years old.

In many Mediterranean countries, *Mentha pulegium* (pennyroyal) is used. Its infusion is free from terpene and sesquiterpene compounds; during preparation, a concentrate of pulegone, which can be toxic, is extracted. Therefore, precautions should be taken regarding dosage.

Traditionally, it has been attributed with antispasmodic, digestion-stimulating, antiseptic, choleretic, and carminative actions; however, these properties have not been confirmed by pharmacological studies. The essential oil of *Mentha pulegium* has been proven to have antimicrobial activity against various Gram-positive and Gram-negative bacterial strains, as well as antifungal activity and insecticidal properties. It is used in infusion and topically as a skin antiseptic (Boucha et al., 2003).

Equally important as *Matricaria chamomilla* (common chamomile) is *Chamaemelum nobile* (Roman chamomile), which also belongs to the Asteraceae family and shares similar characteristics with common chamomile. Both species can be adulterated in the same ways. The active principle is found in the flower heads, and the essential oil contains chamazulene. Traditional uses of Roman chamomile include its anti- inflammatory, antispasmodic, and antiseptic properties (Ladero, 1985; Frank Saldaña-Chafloque, Acosta- Roman, Yamil García González, & Mostacero-León, 2023). Chamazulene is also believed to have antioxidant properties by inhibiting lipid peroxidation in cell membranes.

In the case of *Melissa officinalis* (lemon balm), the officinal organs are the stem with leaves and flowering tops. It has a pleasant lemon scent, more noticeable when rubbed. The flavor is bitter, aromatic, and ochre. A concern with this species is the possibility of adulteration with leaves of *Nepeta cataria var. citriodora*, which also has a lemon scent. Some of its most important chemical components include succinic acid, caffeic acid, tannins, triterpenes, essential oils, alcohols, aldehydes, phenolic acids (such as chlorogenic acid and caffeic acid), mucilages, and flavonoids. The essence extracted from the leaves has antibacterial and antifungal activity. Caffeic acid, isolated from the leaves, appears to inhibit protein biosynthesis.

Other species that contribute to digestive processes include *Ananas comosus* (pineapple), *Glycyrrhiza glabra* (licorice), *Foeniculum vulgare subsp. piperitum* (fennel), *Thymus mastichina* (marjoram), *Sideritis hirsuta* (hairy mountain tea), and *Sideritis romana* (Roman mountain tea).

Hepatobiliary disorders can be considered from several aspects (Guerra et al., 2001). Serious liver pathologies such as viral hepatitis and cirrhosis require medical control. However, hepatoprotective plants with active principles like silymarin, a potent hepatocyte regenerator, are commonly used for treatment. Some plants with choleretic and hepatoprotective actions include *Peumus boldus* (boldo), *Cynara scolymus* (globe artichoke), *Rosmarinus officinalis* (rosemary), *Thymus vulgaris* (thyme), and *Silybum marianum* (milk thistle). The species of *Cynara*, specifically *C. scolymus* and *C. cardunculus* (cardoon), are especially recommended in the diet, particularly for diabetics, as they contain inulin instead of starch, which helps reduce blood glucose levels. The recommended dosage is an infusion at 2-4%, 2-3 cups before meals.

With hypocholesterolemic and hypolipidemic properties, Cynara scolymus stands out; however, there are other species such as garlic, *Allium sativum*, and *psyllium*, *Plantago ovata*, that also contribute to lowering cholesterol levels. Adulterations with other *Plantago* species, such as *P. major* and *P. lanceolata*, which possess similar properties to the aforementioned, do not pose a risk of intoxication. In fact, *Plantago major*, or *Plantain*, is also used as an astringent, antihemorrhagic, and anti-inflammatory agent. It is additionally employed in the treatment of respiratory conditions (pharyngitis, tracheitis, and bronchitis). Externally, it is used in the treatment of acne, furunculosis, pruritus, and varicose ulcers.

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For the control of hypertension alongside hyperlipidemias, which are key risk factors for cardiovascular diseases, certain plants play a role. For instance, garlic (*Allium sativum*) acts as a hypotensive agent through peripheral vasodilation of arterioles and capillaries, attributable to its essential oil content, and is indicated for hypertension, arteriosclerosis, and hyperlipidemias.

The olive tree, *Olea europaea*, uses both the leaves and fruits. The leaves primarily contain oleuropein, along with flavonoids (rutin, mono- and diosides of flavones), a bitter principle (oleuropein), tannins, trace amounts of essential oil, and organic salts. The olives themselves contain monounsaturated fatty acids, predominantly oleic acid, as well as vitamin E (alpha-tocopherol), which varies in quantity depending on the variety. Deficiency in this vitamin leads to inhibition of sperm production and muscle and nerve damage, though the latter is rare.

The leaves possess hypotensive effects through a spasmolytic action on the walls of blood vessels via peripheral vasodilation. They are also diuretic due to the flavonoids and demonstrate mild hypoglycemic activity thanks to oleuropein, which promotes increased glucose uptake by tissues and enhanced insulin release by the islets of Langerhans (González Herrera, 1992).

They are used in the treatment of hypertension, diabetes, hyperuricemia, and arteriosclerosis due to their hypocholesterolemic properties from the flavonoids. Additionally, they exhibit bronchodilator activity. Olive oil, a fundamental component of the Mediterranean diet, is also laxative and serves as an effective choleretic. Due to its richness in unsaturated fatty acids, it is an excellent dietary product that should be used in the treatment of hypercholesterolemia and cardiovascular conditions resulting from diets high in animal and saturated vegetable fats. It has emollient properties, meaning it exerts a protective action on mucous membranes and the skin.

Respiratory conditions can arise from bronchial anomalies accompanied by coughing. There is a wide range of plants with anti-inflammatory, antipyretic, anti-pulmonary infection, expectorant, and antitussive (or demulcent) properties that can alleviate these anomalies. Notably, *Harpagophytum procumbens* (devil's claw) is anti-inflammatory, analgesic, and spasmolytic due to its bicyclic monoterpenes. Its flavonoid content also confers diuretic properties. It is used in cases of inflammation and edema, osteoarthritis, and musculoskeletal disorders. However, it is contraindicated during pregnancy and in certain digestive disorders, as it is laxative and may cause gastric intolerance.

Of significant importance in the treatment of colds, pharyngitis, bronchitis, irritating and spasmodic coughs, and influenza is *Glycyrrhiza glabra* (licorice), a plant cultivated for the utilization of its roots and rhizomes (Cano-Ortiz & Martínez Lombardo, 2009), where the active principles are localized. These include the triterpenoid saponoside glycyrrhizin, a powerful sweetener, flavonoids, and coumarins. It is glycyrrhizin that imparts demulcent, expectorant, and anti-inflammatory properties.

Eucalyptus, *Eucalyptus globulus* and *Eucalyptus camaldulensis*, both species use the leaves, which are harvested between April and September and dried in the sun. It is expectorant and a fluidifier of bronchial secretions, also exhibiting antiseptic and antipyretic properties due to the essential oil rich in terpenic oxides such as eucalyptol (80%), tannins, flavonoids, triterpenes, polyphenolic acids, 1-8 cineole, and resins. It is bronchodilator, antiasthmatic, and nasopharyngeal decongestant, acting as an expectorant and fluidifier of bronchial secretion. It is highly active as an antiseptic and astringent for the respiratory and urinary tracts, being indicated in conditions such as tracheitis, pharyngitis, bronchitis, asthma, cystitis, vaginitis, and blennorrhea, and also as a mild hypoglycemic and antipyretic.

Regarding the dosage of eucalyptol, it is commonly used via inhalation: vaporizations and inhalations at concentrations of 10-30%; externally: ointments for rhinitis at 1%, in liniments as a rubefacient at 25%, and in toothpastes as an antiseptic at 0.25%. Eucalyptol essence at excessively high doses can lead to respiratory difficulties, causing nausea, vomiting, and diarrhea. The undiluted oil is toxic, with doses exceeding 3.5% possibly requiring medical attention due to central nervous system depression. It is contraindicated in patients with severe liver disease, inflammatory bowel conditions, as well as in renal disorders and during lactation and pregnancy (Cano & Cano Ortiz, 2009).

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Currently, there is a high level of interest among adolescents in weight loss due to the sociological phenomenon of beauty standards, leading to the use of various plant species. In this context, a range of plants is used for their satiating, digestive, laxative, and diuretic properties, with the ability to enhance catabolism and remineralize. Plants such as *Plantago ovata* (psyllium), *Amorphophallus konjac* (glucomannan), and *Spirulina maxima* (spirulina) are commonly used for their satiating properties.

In general, all these plants act through their high mucilage content, which provides laxative and satiating effects, as seen with glucomannan and spirulina. The mucilage swells, forming a viscous gel that induces gastric satiety. Spirulina also acts as a dietary supplement in weight loss treatments, owing to its high content of vitamins and minerals.

Very digestible, mildly laxative, and satiating is pineapple, *Ananas comosus*, which, due to its bromelain content, promotes digestion. It is also diuretic and, with its vitamins A, B, and C, serves as a good vitamin supplement. It is commonly used in weight loss diets through the intake of powder capsules or dry extract.

As a diuretic, green tea, *Thea sinensis*, and horsetail, *Equisetum arvense*, both present diuretic activity due to their content of mineral salts and flavonoids. Caution should be exercised with horsetail during pregnancy and lactation. The primary risk associated with *E. arvense* is its potential adulteration with toxic species of horsetail.

Fucus, Fucus vesiculosus, has a high content of trace elements and mineral salts, making it remineralizing. Its iodine content stimulates the thyroid function, favoring catabolism. It is diuretic due to the presence of potassium salts and mildly laxative due to its mucilage content. It is contraindicated in cases of hyperthyroidism and should not be used continuously, as this seaweed may become contaminated with heavy metals, and its high iodine content requires the exclusive use of galenic forms.

Regarding purslane, *Portulaca oleracea*, the entire aerial plant is used, being rich in mucilage and mineral salts. Due to its abundance in mucilage, it is demulcent. It is also utilized for its anthelmintic and antibacterial properties in cases of dysentery and hemorrhoids. Due to its high mucilage content, it is of interest in weight loss diets, as its use in salads induces a sense of satiety, much like other mucilage-rich species. It also exhibits a mild laxative effect.

Conclusion

This study demonstrates that there is a high social demand for medicinal plants; however, we have also observed a significant lack of knowledge regarding Pharmaceutical and Medical Botany. This lack of knowledge is primarily due to the absence of formal education on these subjects in academic institutions, as the relevant content is not included in student curricula. On the other hand, the high social demand lacks sufficient health regulations, as controls are only present in pharmacies. The sale of these products in markets is not subject to regulation, partly due to the shortage of experts in the field. Therefore, we propose the inclusion of Medical Botany content in medical school curricula.

In this study, we aimed to express the social and educational situation concerning the teaching of Pharmaceutical and Medical Botany. Given the difficulty that scientific language presents for students and the general public with limited knowledge, we sought to introduce some species that are frequently used by the population. The goal is to raise awareness and educate people on the meaning of botanical terminology. For this reason, we have provided a glossary of scientific terms that will help foster scientific literacy.

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Appendix

Glossary of scientific terms for students

Antitussive: Inhibits coughing.

Anti-gastralgic: Prevents stomach pain.

Antiseptic: Prevents the development of germs.

Antipyretic: Reduces fever.

Anti-ulcerous: Heals or alleviates ulcers.

Anti-atheromatous: Prevents degeneration of the arterial walls.

Antineoplastic: Prevents or inhibits the formation of tumors.

Anti-edematous: Inhibits excessive fluid accumulation in tissues.

Antispasmodic: Relieves or eliminates spasms by relaxing smooth muscles.

Aperitif: Stimulates appetite.

Astringent: Reduces secretion, facilitating wound healing.

Arteriosclerosis: Damage and loss of elasticity of the arterial walls.

Atheroma: Degeneration of the arterial walls.

Bacteriostatic: Inhibits bacterial proliferation.

Bactericidal: Acts as an antibiotic, killing bacteria.

Balsamic: Soothes the mucous membranes of the respiratory tract.

Bēquic: Calms coughing.

Bronchitis: Inflammation of the bronchial mucosa.

Cardiotonic: Tones the heart, normalizing heart rate.

Carminative: Reduces and eliminates gas formation in the digestive tract.

Cicatrizant: Facilitates wound healing.

Cirrhosis: Degenerative liver disease.

Cystitis: Inflammation of the urinary bladder.

Cytotoxic: Toxic to cells.

Cholagogue: Stimulates and increases the expulsion of bile from the gallbladder to the duodenum.

Choleretic: Stimulates bile formation in the liver.

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Demulcent: Non-fat substance that soothes and protects the skin and mucous membranes.

Dermatitis: Inflammation of the skin.

Diaforic: Promotes sweating.

Dysentery: Intense diarrhea accompanied by the evacuation of mucus and blood.

Dysmenorrhea: Dysfunctional menstruation.

Dyspepsia: Difficult and laborious digestion of a chronic nature.

Diuretic: Increases urine secretion.

Emetic: Induces vomiting.

Emollient: Fatty substance that acts as a protective agent on mucous membranes and skin.

Emmenagogue: Induces menstruation or increases menstrual flow.

Spasmolytic: See antispasmodic.

Estrogenic: Induces the production of estrogen hormones.

Stomachic: Facilitates digestion.

Narcotic: Substance that induces stupor and addiction.

Eupéctic: Stimulates gastric secretion, favoring digestion.

Expectorant: Promotes the expulsion of bronchial secretions.

Pharyngitis: Inflammation of the pharynx.

Febrifuge: See antipyretic.

Phlebitis: Inflammation of veins.

Galactagogue: Stimulates milk secretion.

Galénic: Relating to pharmacy.

Gastritis: Inflammation of the gastric mucosa.

Hemorrhoids: Varicose dilation of a vein in the hemorrhoidal plexus, resulting from persistent increased venous pressure.

Hepatobiliary: Related to the liver and gallbladder.

Hepatitis: Inflammation of the liver.

Hepatoprotective: Agent that protects the liver.

Hepatotoxic: Toxic to liver cells.

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Hepatostimulant: Stimulates liver function.

Hypercholesterolemia: High cholesterol in the blood.

Hyperlipidemia: Excess of triglycerides in the blood.

Hypertension: High blood pressure.

Hyperthyroidism: Condition caused by excess thyroid hormone production.

Hyperuricemia: Excess uric acid in the blood.

Hypnotic: Agent that induces sleep.

Hypocholesterolemic: Reduces cholesterol levels in the blood.

Hypoglycemic: Reduces blood glucose levels.

Hypolipidemic: Reduces levels of fatty acids in the blood.

Hypotensive: Lowers blood pressure.

Hypothyroidism: Condition caused by low thyroid hormone production.

Jaundice: Yellowing of tissues due to excess bilirubin in the blood.

Laryngitis: Inflammation of the larynx.

Laxative: Induces bowel movement.

Lipogenesis: Formation of lipids.

Lithiasis: Formation of calculi or stones, typically in the biliary or urinary tract.

Menorrhagia: Abnormally heavy menstrual flow.

Mydriasis: Dilation of the pupil.

Nephritis: Inflammation of the kidneys.

Parasympatholytic: Inhibits the parasympathetic nervous system.

Pectoral: Acts beneficially on the respiratory tract.

Pyelonephritis: Inflammation of both the kidney and renal pelvis.

Psoriasis: Chronic, recurrent skin disorder.

Prostatitis: Inflammation of the prostate.

Purgative: Compound that causes rapid bowel evacuation when taken orally.

Reconstituting: Improves the overall tone of the body.

Remineralizing: Supplies the body with minerals and trace elements.

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Rubefacient: Irritates the skin, causing redness.

Sedative: Calms nervous excitation.

Sudorific: Promotes sweating.

Tracheitis: Inflammation of the trachea.

Thromboembolism: Formation of blood clots in blood vessels.

Urethritis: Inflammation of the urethra.

Uricosuric: Facilitates the elimination of uric acid through urine.

Vasoconstrictor: Causes the contraction of blood vessel walls.

Vasodilator: Relaxes blood vessel walls, increasing their lumen.

Vermifuge: See antihelmintic.

Vesicant: Irritates the skin, causing blisters.

Vulnerary: Promotes wound healing.