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Study of Chemical Characterization of Medicinal Plants Used for Traditional Medicine: A Review

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Medicinal plants have been widely used in traditional medicine for centuries to treat various diseases, including diabetes, hypertension, and others. This study aims to the chemical characterization of medicinal plants commonly used traditional medicine, particularly for treating conditions such as diabetes and hypertension. A comprehensive analysis was conducted on various species, including Aloe vera, Visnagadaucoides, Foeniculum vulgare, and others, identifying key active compounds such as polysaccharides (up to 60% of dry leaf matter in Aloe vera), phenolic compounds, and essential oils. Specific components include khelline (0.3-1.2%) and visnagine (0.05-0.3%) in Visnagadaucoides, and trans-anethole (31-36%) and alpha-pinene (14-20%) in Foeniculum vulgare. The chemical composition of these plants varies based on factors such as geographic origin and plant part used. While some components offer therapeutic benefits, others may pose toxic risks, highlighting the need for a detailed understanding of these compounds. Given the variability in traditional medicine practices, the study underscores the importance of assessing the safety and efficacy of these plants, aligning with the World Health Organization's recommendations for standardizing herbal medicines. The results aim to contribute to a safer integration of traditional practices into modern healthcare systems, promoting the responsible use of medicinal plants in Morocco.

Keywords: Active Compounds Analysis; Chemical characterization; Diabetes and Hypertension Treatment; Medicinal plants; Traditional Medicine Safety.

The use of medicinal plants has long been a cornerstone of traditional medicine practices across many cultures, including Morocco. This practice holds particular significance in rural areas where access to modern pharmaceuticals is often limited by economic and geographical barriers. In these regions, people have relied for centuries on the therapeutic properties of local plants to treat various ailments, including chronic conditions such as diabetes and hypertension. Morocco's rich biodiversity, with its vast array of aromatic and medicinal plants, forms an integral part of the country's cultural heritage and healthcare practices. However, the widespread use of these plants in traditional medicine raises concerns about their chemical composition and safety profiles, especially since the specific active ingredients and their effects are not always well understood.

Moroccan traditional medicine is both diverse and deeply rooted in cultural practices, providing a wide range of treatments for common health conditions. Previous studies, such as those conducted by Bellakhdar (1997)[1], Hmamouchi (2001)[2], and Salhi, (2010)[3], have meticulously documented the extensive knowledge about the medicinal uses of plants passed down through generations. While this traditional knowledge is invaluable, it often lacks the scientific validation and standardization that are common in modern medical practices. Consequently, the safety and effectiveness of many traditional remedies remain debatable, especially when compared to modern pharmaceuticals, which undergo rigorous testing and regulatory scrutiny before being approved for use. Moreover, the use of medicinal plants, though often seen as a cost-effective solution, can come with significant risks. In Morocco, the incidence of poisonings related to the use of medicinal plants is notably high, suggesting that the therapeutic use of these aromatic and medicinal plants is not without danger. This risk is exacerbated by the fact that traditional medicine practices do not always follow standardized dosages or preparations, leading to potential misuse. For example, certain plants might contain bioactive compounds that are therapeutic in small doses but toxic when consumed in higher quantities or over extended periods. The lack of consistent quality control and the variability in plant potency due to different growing conditions further complicate the safety of these natural remedies.[4]

The rich biodiversity of Morocco contributes to the widespread availability of medicinal plants, fostering their extensive use in traditional therapies. The country's diverse ecosystems, ranging from coastal plains to mountainous regions, provide ideal conditions for a wide variety of plant species, including several that are endemic. Commonly used species like Artemisia herba-alba, Foeniculum vulgare (fennel), and Lavandula (lavender) are valued for their antimicrobial, anti-inflammatory, and digestive properties.[5]Despite their potential benefits, these plants can also contain compounds that may be harmful if improperly prepared or used. For example, Artemisia herba-alba is known for its medicinal properties but contains thujone, a compound that can be toxic in high concentrations.

Given these complexities, there is a pressing need to better understand the chemical composition of Morocco's medicinal plants. Detailed scientific studies that focus on identifying the active compounds, understanding their therapeutic properties, and assessing their potential toxicity are essential for the safe use of these plants. This understanding would not only help ensure safer practices among those who use these plants as part of their traditional medicine but also facilitate their potential integration into modern healthcare systems. Aligning traditional practices with scientific research can enhance the credibility of these natural treatments and support their safe use.[6-8]

Therefore, the aim of this study is to investigate the basic chemical properties of the most commonly used medicinal plants, in order to bridge the gap between traditional knowledge and modern scientific understanding, and provide a valuable resource for the safe and effective use of medicinal plants in both traditional and contemporary healthcare settings. This approach is in line with the WHO guidelines on the standardization of herbal medicines, emphasizing the need for comprehensive assessment of their safety and efficacy. By highlighting the complex nature of these plants, this study seeks to promote informed use, mitigate risks, and preserve the valuable cultural heritage of traditional medicine.

MATERIALS AND METHODS

In this study involves a comprehensive review of 63 studies to investigate the basic chemical properties of the most commonly used medicinal plants. The objective is to bridge the gap between traditional knowledge and modern scientific understanding. Here's how the method is structured:

Data Collection

The study identifies and gathers data from 63 peer-reviewed articles and research studies focused on 55 medicinal plants. This ensures a wide and diverse base of information, encompassing different regions, plant species, and chemical analyses.

Analysis of Chemical Properties

The reviewed studies are analyzed to identify key chemical compounds found in the most commonly used medicinal plants. This includes active ingredients such as alkaloids, phenolics, flavonoids, and essential oils that contribute to their therapeutic effects.

The analysis integrates findings from these studies, categorizing the data by plant species, their chemical composition, and their documented therapeutic uses. This helps identify patterns, trends, and gaps in existing knowledge.By integrating traditional knowledge of medicinal plants with modern chemical and pharmacological research, this study aims to improve the understanding of their safe and effective use in both traditional and modern healthcare practices. The outcome of the analysis is to provide a valuable resource that informs healthcare providers, researchers, and policymakers about the safe and evidence-based use of medicinal plants.

This methodology ensures a systematic, evidence-based approach to understanding medicinal plants, offering a foundation for further research and practical applications in healthcare.

RESULTS

List and chemical characterization of the most used species.

***Aloe vera* (L.) Bum.f.**

Aloe vera leaves are composed of approximately 98% water and contain over 75 bioactive compounds, including polysaccharides, phenolic compounds, and organic acids. Additionally, they are rich in 20 minerals, 20 amino acids, and 12 vitamins. The primary secondary metabolites present are phenolic compounds, such as anthrone and chromone. Notably, the dry matter of the leaves, which accounts for only 1–2% of the fresh leaf weight, is predominantly composed of polysaccharides, making up about 60% of the dry content.[9,10]

***Visnagadaucoides* Gaertn.**

According to Bruneton (2009) ,[11] the main constituents of fruits are furanochromones (2-4%): visnagine (0.05-0.3%), Khel line (0.3-1.2%), etc, and angular pyranocoumarins (0.2 - 0.5%): Vis Nadine, sanidine, dihydrocodeine. The fruits also contain lipids (up to 18%), furan acetophenones, flavonoids (flavonols and flavonol sulfates) and 0.2 - 0.3 ml.kg-1 of oil.

***Foeniculum vulgare* Mill.**

Foeniculum vulgare Mill., commonly known as fennel, is a valuable source of essential oils with distinct chemical compositions depending on the plant part analyzed. According to Miguel (2010),[12]the essential oil extracted from the dried aerial parts primarily contains trans-anethole (31–36%), á-pinene (14–20%), and limonene (11–13%). In contrast, the fruit oil is dominated by methyl chavicol (also known as estragole), comprising 79–88% of its composition.

***Coriandrum sativum* L.**

Coriandrum sativum L., commonly referred to as coriander, is a rich source of essential oil, with linalool (57.57%) and geranyl acetate (15.09%) identified as its major constituents. However, the chemical composition of the essential oil exhibits substantial variation depending on the fruit's ripening stage, reflecting the dynamic biosynthesis of its volatile compounds.[13]

***Carum carvi* L.**

Carum carvi L., commonly known as caraway, is characterized by essential oils rich in D-limonene (19.71%) and R-carvone (79.72%) as its primary constituents. However, studies by Garayasuggest that the chemical composition of the essential oil may exhibit slight variations depending on the geographic origin of the plant.[14]

***Cuminum cyminum* L.**

Cuminum cyminum L., commonly known as cumin, contains essential oil with limonene (21.7%), á-pinene (29.2%), linalool (10.5%), 1,8-cineole (18.1%), á-terpineol (3.17%) and linalyl acetate (4.8%), as its primary constituents. These components contribute to the aromatic and bioactive properties of cumin essential oil.[15]

***Apium graveolens* L.**

Apium graveolens L., commonly known as celery, has an essential oil composition comprising 28 identified components, accounting for 73.72% of the total oil content. The primary constituents include 1-dodecanol (16.55%),**4-**chloro-4,4-dimethyl-3-(1-imidazolyl) valerophenone (19.90%),4,4-D2-N-hexyl ethyl ether (4.11%) and methyl acid (4.93%).[16]

***Petroselinum crispum*(Mill.) Fuss**

Petroselinum crispum (Mill.) Fuss, commonly known as parsley, has been analyzed for its aqueous leaf extract, revealing the presence of several flavonoids and coumarins. Identified flavonoids include apigenin (1), apigenin-7-O-glucoside (cosmosiin) (2), and apigenin-7-O-apiosyl-(1'!2)-O-glucoside (apiine) (3). Additionally, the coumarin compound 2",3"-dihydroxyfuranocoumarin (hydrated oxypeucedanin) (4) was detected.[17]

***Artemisia absinthium* L.**

The analysis of absinthe oils cultivated in Estonia and air-dried allowed to identify sabinene (0.9 to 30.1%), myrcene (0.1 to 38.9%), 1 , 8-cineole (0.1 to 18.0%), artemisia ketone (0 to 14.9%), linalool and á-thujone (1.1–10.9%), â-thujone (0.1–64.6%), transepoxyocimene (0.1–59.7%), trans verbenol (0–11.7%), carvone (0–18.5%), (E) -abinyl acetate (0–70.5%), cur cumene (0 to 7.0%), neryl butyrate (0.1 to 13.9%), neryl 2-methylbutanoate (0.1 to 9.2%), 3- nerylmethyl butanoate (0.4 to 7.3%) and chamazulene (0 to 6.6%) [18].

***Artemisia herba-alba* Asso**

Forty-six components corresponding to 92.61% of the oil have been identified. The essential oils contained in majority are: cis-chrysanthenyl acetate (25.12%); (2E, 3Z) 3,5-heptadienal-2-ethylidene-6-methyl (8.39%); á-thujone (7.85%); myrtenol acetate (7.39%); verbenone (7.19%), chrysanthemum (4.98%).[19]

***Cynara cardunculus* L.**

The chemical composition of this species has shown that it contains variable levels depending on when it was collected; the polysaccharide content, for the two raw materials, reached 60%, including 30% hemicelluloses, the rest, or 70% cellulose [20]. Similarly, Falleh (2008)[21]indicated that the organs analyzed had different levels of total polyphenols. The phenolic content of the leaves and seeds was similar and twice as high as that of the flowers.

***Helianthus annuus* L.**

H. annuus has a chemical composition, the proportionality of the components of which can vary according to the geographical origin of the plant ,[22] and some have shown that the grains contain proteins (28.28%), carbohydrates (39.40%), and lipids (19.80%) are the main nutrients. Other substances are present with lower percentages: humidity (5.03%), crude fiber (3.50%), and ash (4.02%).[23]

***Brassica napus* L.**

Brassica napus L., commonly known as rapeseed, exhibits chemical composition variations based on seed color and growing conditions.[24]Yellow seeds contain higher oil (44%), protein (45%), and dietary fiber (16%) compared to black seeds. Conversely, black seeds have higher sucrose, oligosaccharides, starch, phosphorus, and glucosinolates. Environmental factors also significantly influence the species' composition.[25]

***Brassica oleracea* L.**

Brassica oleracea L. is nutritionally rich, containing vitamin C (62.27 mg/100 g), beta-carotene (6.40 mg/100 g), ash (2.11 g/100 g) and dietary fiber (8.39 g/100 g). It also provides 574.9 mg of polyphenolic compounds (chlorogenic acid) per 100 g, offering antioxidant and dietary benefits.[26]

***Eruca vesicaria* (L.) Cav.**

Eruca vesicaria (L.) Cav. primarily contains erucin in its fruit, stems, and roots (96.6%, 85.3%, 83.7%). Leaf essential oil includes â-elemene (35.7%) and hexahydrofarnesylacetone (23.9%).[27]

***Raphanus sativus* L.**

Raphanus sativus L. shows chemical variations between roots and leaves. Leaves contain higher protein, ash, and fiber, with calcium (752.64 mg/100 g) as the dominant mineral. They also have double the ascorbic acid (38.69 mg/100 g) and higher phenolic and flavonoid content than roots.[28]

***Juniperus phoenicea* L.**

Juniperus phoenicea L. shows chemical variation based on geographic origin. Moroccan oil contains 45 compounds (72%), while Tunisian oil has 31 compounds (99%). Major components include á-pinene (35.46–38.20%) and ä-3-carene (7.6–11.69%).[29]

***Citrullus colocynthis* (L.) Schrad.**

Citrullus colocynthis (L.) Schrad. is rich in bioactive compounds, including carbohydrates, proteins, amino acids, tannins, saponins, phenolics, flavonoids, flavone glucosides, terpenoids, alkaloids, anthranol, steroids, cucurbitacins, saponarin, and cardiac glycosides, highlighting its diverse phytochemical profile.[30]

***Cucumis sativus* L.**

Chemical analyzes have revealed that the leaf and fruit of C. sativus is a rich source of ashes, carbohydrates, fats, fibers, and proteins and significant amounts of vitamins C and E have also been observed.[31]

***Euphorbia resinifera* O. Berg & C.F. Schmidt**

The roots, stem, and flowers contain saponins, polyphenols, flavonoids, tannins, terpenoids, coumarins, and cardiac glycosides, and the stem is richest in flavonoids.[32]

***Glycine max* (L.) Merr.**

Glycine max (L.) Merr. oil contains 40 identified compounds, comprising 96.68% of total oil. Major components include 2,4-decadiene (9.15%), carvacrol (13.44%), p-cymene (4.87%), p-allylanisole (5.65%), and limonene (4.75%).[33,34]

***Ceratonia Siliqua* L.**

Ceratonia siliqua L., commonly known as carob, is rich in polyphenols and tannins. Carob beans contain 19 mg/g total polyphenols, 2.75 mg/g condensed tannins, and 0.95 mg/g hydrolyzable tannins.[35]The germ has higher concentrations of polyphenols (40.8 mg/g) and tannins. Carob flour is rich in carbohydrates (45%), moderate in protein (3%), and low in fat (0.6%).[36]

***Trigonella foenum-graecum* L.**

Trigonella foenum-graecum L., commonly known as fenugreek, is rich in bioactive compounds, including cyclic ethylene mercaptole compounds, N-methylhomopiperazine, vitamin E, cholestan-3-ol, and 5á-Androstan-16-one[37]. Its seeds contain 7.5% total lipids, composed of 84.1% neutral lipids, 5.4% glycolipids, and 10.5% phospholipids, highlighting its nutritional and medicinal importance, particularly for antioxidant, anti-inflammatory, and lipid-regulating properties.

***Centaurium erythraea* Rafin**

*Centaurium erythraea*Rafin., or centaury, contains 232 volatile compounds, making up 93.4% of its total oil. Key components include neophytadiene isomer III (10.1%), p-camphorene (5.6%), carvacrol (7.9%), thymol (4.2%), and hexadecanoic acid (4.9%).[38]

***Globularia alypum* L.**

Globularia alypum L. is rich in iridoids, heterosides, yellow dyes, , cinnamic acid, mineral salts protocatechic acid, , globularin, mucilages, mannitol, tannins, and globularic acid. Its leaves are abundant in flavonoids, polyphenols, and minerals, anti-inflammatory, offering antioxidant, and therapeutic properties.[40]

***Ajuga iva*(L.) Schreb.**

It is a plant very rich in flavonoids and tannins [41]. It also contains anthocyanins, phenolic acids, and other substances, in particular, ajugarin],2-deoxy-20-hydroxyecdysone, polypodine B and 14,15-dihydroajugapitine.[42-44]

***Marrubium vulgare* L.**

Marrubium vulgare L. essential oil contains 20–34 components, varying by plant part and analysis. Key constituents include â-bisabolene (20.4%), ä-cadinene (19.1%), and isokaryophyllene (14.1%).[45]Additional compounds identified include germacrene D (9.37%), citronellylformate (9.50%), citronellol (9.90%), and eudesmol (11.93%).[46]

***Origanum vulgare* L.**

Origanum vulgare L. is a widely used herb, with essential oils composed mainly of carvacrol, â-fenchyl alcohol, thymol, and ã-terpinene.[47]The oil's composition varies significantly based on species, varieties, and even within the same variety, reflecting its complex chemical profile and adaptability.[48]

***Rosmarinus officinalis* L.**

Rosmarinus officinalis L., commonly known as rosemary, contains essential oil rich in camphor, cineole, á-pinene, borneol, and camphene. It also includes tannins, flavonoids (e.g., apigenin, diosmin), terpenes, and polyphenols like rosmarinic acid and rosmaricin. Its composition varies with geographical origin.[49]

***Cinnamomum cassia* Presl**

Cinnamomum cassia Presl, or Chinese cinnamon, contains 41 volatile compounds in its bark oil, with variations based on growth stages and segments.[51]Its essential oils mainly include phenylpropanoids and monoterpenes, along with minor sesquiterpenes. Key components are cyclohexane derivatives (5.2%),benzebe styrene (5.5%), ä-cadinene (6.25%), á-copaene (11.42%), and cinnamic aldehyde (52.3%) .[52] The bark and stem also contain p-hydroxy cinnamic acid, ferulic acid, squalene, clovanediol, and á-bisabolene, offering aromatic and medicinal benefits.[53]

***Cinnamomum verum* Presl (Syn. *C. zeylanicum*)**

Cinnamomum verum Presl (Syn. C. zeylanicum), known as true cinnamon, contains 31 components in its essential oil. Key constituents include linalool (2.30%), (E)-caryophyllene (5.70%), and eugenol (86.02%), offering aromatic and medicinal benefits.[54]

***Allium cepa* L.**

Allium cepa L., or onion, is rich in carbohydrates, phenols, pigments, tear factor, and pyruvic acid. Phytochemical content varies by variety. Shallots have six times more polyphenols than Vidalia onions. Yellow onions are richest in flavonoids, while red onions contain anthocyanins (10% of flavonoids).[55]

***Alium sativum* L.**

Allium sativum L., or garlic, is rich in essential oils, diallyl disulfides, allicin, alliin, alliinase, inulin, carbohydrates, selenium, vitamins (C, E A, B), and sulfur compounds. Tunisian garlic showed phenols (43.63 mg GA/g), flavonoids (13.18 mg quercetin/g), and proanthocyanidins (24.24 mg catechin/g) with strong antioxidant activity (DPPH test).[56]

***Hibiscus sabdariffa* L.**

Hibiscus sabdariffa L. contains organic, mineral, and amino acids in its calyxes, leaves, and seeds, varying by variety and region. It is valued for fiber and calyxes, especially red types, which are rich in anthocyanins (up to 1.5 g/kg), mainly delphinidin (71%) and cyanidin (29%).[57]

***Ficus carica* L.**

It is a plant rich in phenolic compounds, organic acids and volatile compounds [58].In addition, fifty-nine compounds were identified from the volatile fraction by GC / MS.Animal experiments have shown that bergapten and psoralen have strong anti-tumor activity.[59]

Eucalyptus globulus Labill.

Phytochemical analysis of this species, revealed that the composition of leaf essential oils varied depending on the maturity stage and the geographic origin of the plant. The primary component identified was 1,8-cineole, with concentrations ranging from 4.10% to 50.30%. Other significant constituents included spathulenol (0.12–17.00%),*p*-cymene (trace–27.22%), cryptone (0.00–17.80%), and á-pinene (0.05–17.85%). [60]

Syzygium aromaticum

*Syzygium aromaticum (L.)*Merr. & L.M. Perry, commonly known as cloves, is rich in bioactive compounds. Its essential oil primarily contains eugenol (72–90%), along with acetyl eugenol, â-caryophyllene, and vanillin. It also includes crategolic acid, tannins (e.g., bicornin, gallotannic acid), and methyl salicylate for analgesic effects. Flavonoids like eugenin, kaempferol, rhamnetin, and eugenitine, as well as triterpenoids such as oleanolic acid, stigmasterol, and campesterol, contribute to its complex composition, along with various.[61]

***Olea europaea* L.**

This plant's fruit is rich in fatty acids, including oleic acid (68.07%), palmitic acid (12.12%), arachidic acid (9.78%), DHA (2.65%), and EPA (0.53%). A total of 32 compounds (99.44% of the oil) were identified, with á-pinene (52.70%) as the major component.[62]

***Avena sativa* L.**

Species considered a healthy food containing significant quantities of soluble dietary fiber, â-glucans, fat-soluble vitamin E and polyunsaturated fatty acids worldwide.[63]

***Ruta montana* (L.) L.**

Spectrophotometric analysis of *Ruta montana* essential oil, utilizing the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, demonstrated significant antioxidant activity. Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS) identified a total of 20 compounds in the oil. The predominant constituents were undecan-2-one (32.8%), nonan-2-one (29.5%), nonanol-2-acetate (18.2%), and psoralen (3.5%), indicating the oil's potential bioactive properties.[64]

***Urtica dioica* L.**

Urtica dioica L., commonly known as the great nettle, is highly valued for its rich nutritional and phytochemical composition. The leaves are abundant in proteins and contain bioactive compounds such as flavonoids, mineral salts (calcium, potassium, and silica), and essential vitamins A and C. Additionally, they are a source of phenolic acids, including caffeic acid, caffeyl-malic acid, and chlorogenic acid. Other identified compounds include scopoletol, sitosterol, glycoproteins, lipids, sugars, and free amino acids.[64]

The roots of *Urtica dioica* contain polysaccharides, a lectin, and a variety of phenolic compounds such as acid-phenols, scopoletol, aldehydes, phenylpropanic, and homovanillic alcohols. They are also rich in lignans and sterols, including sitosterol, which contribute to their medicinal properties.[65]

***Zingiber officinale* Roscoe**

The rhizome of Zingiber officinale contains starch, proteins, fats of essential oils, but the composition varies according to the geographical origin of the rhizome, odorous compounds such as zingiberene, curcumene, camphene, bisabolene,citral and linalool.[66, 67]

DISCUSSION

As is the case with plants in general, the chemical components of LDCs mentioned are numerous and highly diverse. Some of these components are of therapeutic interest and, due to their chemical nature, pose no major risks of contraindications or intoxication. Other components fall into the category of toxic substances or poisons. But, more often than not, given the great wealth of chemical components of plants (or species), it is very rare to find a plant of which all the components can be used in traditional medicine without risk. In addition, in the case of traditional medicine practices, the use of this or that plant is neither quantitatively nor quantitatively standardized.[67]Traditional medicine practices vary significantly across countries and regions, influenced by cultural traditions, historical contexts, and personal beliefs.[68]Since 2000, the WHO has advocated evaluating the safety and effectiveness of herbal medicines to standardize their use and incorporate them into modern healthcare systems.[69]

Vigilance with regard to the toxicity of plants is therefore necessary. In fact, in Morocco, plants are the source of 5.1% of poisonings which were reported during the period 1980 to 2008 at the Center Antipoison du Maroc (CAPM), all causes combined, apart from stings and scorpion poisonings, taking into account the under-notification of cases of poisoning by plants .[70]

For the plants, which we cited in our study, to our knowledge, very few of them have benefited from an assessment of this risk. For each plant used, it is, therefore, time to determine the most complete inventory of chemical components possible and determine the environmental factors that influence this composition. Thus, as indicated the active principles or components responsible for pharmacological activity will be identified and isolated and the cellular and molecular mechanisms involved in phytotherapy could be within the reach of the user.[71]Research on the medicinal plants *Garcinia mangostana, Garcinia atroviridis, Moringa oleifera, , Allium spp., Apium graveolens, and Curcuma longa* highlights their diverse therapeutic properties: *Garcinia mangostana* exhibits antiviral effects against HIV-1 and HPV, hepatoprotective activity, and improves lipid profiles and oxidative stress in diabetic models.[72-75]*Garcinia atroviridis* shows antiviral properties against DENV and antimalarial potential by targeting Plasmodium falciparum proteins.[76,77]*Moringa oleifera* demonstrates antiviral activity against SARS-CoV-2 via dual inhibitors when combined with Curcuma longa, promoting its role in COVID-19 treatment.[78,79]*Allium spp.* displays antimicrobial activity against drug-resistant pathogens and antiviral effects against dengue virus type-2.[80,81]*Apium graveolens* improves reproductive health by enhancing progesterone-induced blocking factors (PIBF) during pregnancy and reduces stress, protecting folliculogenesis markers.[82]*Curcuma longa* possesses antiviral activity against SARS-CoV-2 and demonstrates antimicrobial properties against bacteria, viruses, and fungi.[83]

CONCLUSION

The chemical components of LDCs are very numerous, diverse and vary from one species to another or even from one part of the plant to another. But even if a plant has this virtue, considering the greatest number of chemical components it contains (hundreds), it could contain chemical compounds which by their nature or by their misuse are toxic or even fatal. Thus, it is very rare to find a plant of which all the components are medicinally usable without risk. Thus, the danger of phytotherapy without knowing its basis can come from the chemical nature of a toxic chemical compound absorbed even in small doses than by overdosing the absorption of a product which is not toxic in small quantities or low frequency. Invigilance is therefore essential. It should also be noted that, in the case of traditional medicine practices, the use of this or that plant is neither quantitatively nor quantitatively standardized.

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Informed Consent Statement

This study did not involve human participants, and therefore, informed consent was not required

Clinical Trial Registration

This research does not involve any clinical trials**.**

Authors' Contribution

Chebabe Mlouda: Conceptualization, Methodology, Writing – Original Draft; Elkhoudry Noureddine, Chahboune Mohamed, Laamiri Fatima Zahra, Marc Ikram, Mochhoury Latifa — Analysis, Review & Editing.

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