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Presented by:

GHALEM Zahia
KEROUM Zohra

Title

Ethnopharmacological study of natural products used to relieve the symptoms of menopause in Algeria: cellular and molecular aspect, virtue and toxicity.

Jury members:

President	Mrs. MAKHLOUFI C.	Professor
Examiner	Mrs. MOKHFI F.Z.	MCA
Supervisor	Mr. Khaled TAIBI	Professor
Co-supervisor	Mrs. Leila AIT ABDERRAHIM	Professor

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Présenté par :

GHALEM Zahia
KEROUM Zohra

Intitulé

Etude ethnopharmacologique des produits naturels utilisés pour soulager les symptômes de la ménopause en Algérie : aspect cellulaire et moléculaire, vertus et toxicité

Soutenu publiquement le :

Devant les membres de jury :

Président	Mme. MAKHLOUFI C.	Professeure
Examinatrice	Mme. MOKHFI F.Z.	MCA
Encadrant	M. TAIBI K.	Professeur
Co-encadrant	Mme. AIT ABDERRAHIM L.	Professeure

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الملخص

هذا البحث يقوم بدراسة إثنوفارماكولوجية شاملة للمنتجات الطبيعية المستعملة في الجزائر للتخفيف من أعراض سن اليأس، مع التركيز على جوانبها الخلوية والجزيئية، وفعاليتها، وسميتها. أُجريت الدراسة بين عامي 2024 و2025 بمشاركة 666 شخصًا من خلفيات متنوعة، وتم تحديد 71 علاجًا طبيعيًا؛ منها 68 نباتًا طبيًا و3 منتجات حيوانية (الحليب، العسل والزبادي). أظهرت النتائج أن عائلة الشفويات (Lamiaceae) كانت الأكثر تمثيلًا، فيما كانت أكثر النباتات استشهادًا بها : *Salvia officinalis* L.، *Mentha × piperita* L.، *Pimpinella anisum* L.، *Verbena officinalis* L.، *Cinnamomum verum* J.Presl، *Foeniculum vulgare* Mill.، *Origanum majorana* L.، *Zingiber officinale* Roscoe، و *Linum usitatissimum* L.. تم تحديد وتحليل جزيئات نشطة رئيسية مثل الفلافونويدات، والبوليفينولات، والمنثول، والسينمالدهيد، والسيترد، والأنيثول. رغم الاستخدام التقليدي الواسع والفعالية الملاحَظة لهذه العلاجات، تؤكد الدراسة على الحاجة الماسة إلى تحقيقات علمية صارمة لتقييم سلامتها وسميتها، بما في ذلك التفاعلات المحتملة مع الأدوية. تُسهم هذه النتائج في الحفاظ على المعرفة التقليدية المحلية وتأسيس قاعدة بيانات قيّمة للأبحاث المستقبلية الرامية إلى اكتشاف مركبات نشطة جديدة وتقييم إمكانياتها البيولوجية والكيميائية. وتشدد الدراسة على الضرورة الملحة لإجراء دراسات سُمّية شاملة، ودراسات الحرائك الدوائية والدراسات الديناميكية الدوائية، لضمان دمج هذه العلاجات التقليدية بأمان وفعالية في رعاية صحة المرأة خلال مرحلة انقطاع الطمث في الجزائر، مدعومًا بسياسات حكومية واضحة للتوحيد والمصادقة.

الكلمات الدالة

علم الادوية العرقية، اعراض انقطاع الطمث، الطب التقليدي، المنتجات الطبيعية، النباتات العطرية والطبية، الجزائر

Abstract

This research undertakes a comprehensive ethnopharmacological study of natural products used in Algeria to alleviate menopausal symptoms, focusing on their cellular and molecular aspects, efficacy, and toxicity. The study, conducted between 2024 and 2025, involved 666 participants from diverse backgrounds, and has identified 71 natural remedies; 68 medicinal plants and 3 by-products of animal origin (milk, honey, and yogurt). Results indicated that the Lamiaceae family was the most represented. However, *Salvia officinalis* L., *Mentha* × *piperita* L., *Pimpinella anisum* L., *Verbena officinalis* L., *Cinnamomum verum* J.Presl, *Foeniculum vulgare* Mill., *Origanum majorana* L., *Zingiber officinale* Roscoe, *Linum usitatissimum* L. were the most frequently cited. Key active molecules such as flavonoids, polyphenols, menthol, cinnamaldehyde, citral, and anethole were identified and analyzed. Despite the widespread traditional use and perceived efficacy of these remedies, the study highlights the critical need for rigorous scientific investigation to assess their safety and toxicity, including potential drug interactions. These findings contribute to the preservation of local traditional knowledge and establish a valuable database for future research aimed at identifying new active compounds and evaluating their biological and chemical potential. The study emphasizes the urgent necessity for comprehensive toxicological, pharmacokinetic, and pharmacodynamic studies to ensure the safe and effective integration of these traditional therapies into women's healthcare during the menopausal transition in Algeria, supported by clear governmental policies for standardization and approval.

Keyword

Ethnopharmacology, Menopause Symptoms, Traditional Medicine, Natural Products, Aromatic and Medicinal Plants, Algeria.

Résumé

Cette étude ethnopharmacologique exhaustive vise à documenter les produits naturels utilisés en Algérie pour soulager les symptômes de la ménopause, en se concentrant sur leurs aspects cellulaires et moléculaires, leur efficacité et leur toxicité. Menée entre 2024 et 2025 auprès de 666 participantes issues de milieux variés, elle a permis d'identifier 71 remèdes naturels : 68 plantes médicinales et 3 dérivés d'origine animale (lait, miel et yaourt). Les résultats montrent que la famille des Lamiacées est la mieux représentée. Toutefois, *Salvia officinalis* L., *Mentha* × *piperita* L., *Pimpinella anisum* L., *Verbena officinalis* L., *Cinnamomum verum* J.Presl, *Foeniculum vulgare* Mill., *Origanum majorana* L., *Zingiber officinale* Roscoe et *Linum usitatissimum* L. sont les plus fréquemment citées. Les molécules actives clés, telles que les flavonoïdes, les polyphénols, le menthol, la cinnamaldéhyde, le citral et l'anéthol, ont été identifiées et analysées. Malgré l'usage traditionnel répandu et l'efficacité perçue de ces remèdes, l'étude souligne l'impérieuse nécessité d'investigations scientifiques rigoureuses pour évaluer leur sécurité et leur toxicité, y compris leurs interactions médicamenteuses potentielles. Ces travaux contribuent à la préservation des savoirs locaux et constituent une base de données précieuse pour de futures recherches visant à identifier de nouveaux composés actifs et à évaluer leur potentiel biologique et chimique. L'étude insiste sur l'urgence de mener des études toxicologiques, pharmacocinétiques et pharmacodynamiques complètes afin d'assurer l'intégration sûre et efficace de ces thérapies traditionnelles dans la prise en charge de la ménopause des femmes en Algérie, appuyée par des politiques gouvernementales claires pour la normalisation et l'homologation.

Mots clés

Ethnopharmacologie, Symptômes de la ménopause, Médecine traditionnelle, Produits naturels, Plantes aromatiques et médicinales, Algérie.

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We were really grateful for his kind availability. We hope that these words serve as a testament to our sincere appreciation. Our promoter is the one we owe the most. We were able to do our ethnopharmacology investigation because of him.

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Dedication

First of all, we would like to express our gratitude to Allah

By the grace of Allah, I was able to accomplish this work. I am deeply grateful to Him for His guidance, His light, and the paths He has opened for me. All praise is due to Him, for He is the One who makes difficult things easy and illuminates the paths.

To my dear father,

The source of my determination and resilience. Thank you for always showing me the path, for your constant encouragement, and for the invaluable lessons that shaped who I am today.

To my beloved mother,

For being the foundation of my life, for your constant prayers, and for always being my safe harbor. Your unwavering faith in me, even when I doubted myself, gave me the courage to persevere. This is for you, with all my heart.

To my amazing sister Narimen,

Thank you for the endless laughter, the comforting presence, and for being a constant source of inspiration. My sincerest gratitude for your love and encouragement. You made this possible.

To my brothers Islem and Zakaria,

For your unconditional support, your camaraderie, and for always being there. This success is also yours, the fruit of our unbreakable bond and your constant encouragement.

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With much love and belief in all you will achieve.

To my colleague Zohra,

Thank you for your professionalism, your team spirit, and for the inspiration you have given me. This work would not have been the same without your commitment.

To my loved ones

Youcef, Asma, Khouloud

Dedication

To the one who taught me that giving is the secret to happiness, paved the paths of knowledge and learning for me, and illuminated my path in life with his penetrating insight, ***my dear father****, may God protect him.*

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To my support and my strength in this life, ***my brothers****, thank you for your continuous support and sincere love, which have been my greatest help.*

And to ***my companion and partner in my dreams****, you who have inhabited my heart and inspired my soul, I am grateful for your unwavering support and endless encouragement. Your presence has been the motivation behind every step toward success.*

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To every scientific soul eager for knowledge, and to every diligent student striving to achieve his dreams, I dedicate this humble effort, hoping to God that it will be beneficial and illuminate new paths.

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Introduction

Introduction

Menopause, a universal biological transition marking the end of a woman's reproductive life, is more than just the cessation of menstruation; it's a complex neuroendocrine shift typically occurring between the ages of 45 and 55 (Jeffrey et al. 2018). Defined clinically as 12 consecutive months without a period, this natural phase is driven by a decline in ovarian follicular activity and a significant drop in estrogen production (Genazzani et al. 2014).

For many, this hormonal shift ushers in a spectrum of physiological and psychological changes, including the often-disruptive hot flashes, night sweats, mood swings, vaginal dryness, and sleep disturbances (Santoro and Randolph 2011). These symptoms, as highlighted in contemporary research, can profoundly affect an individual's quality of life (Avis et al. 2020). Understanding the intricacies of this transition, influenced by genetics, lifestyle, and environmental factors, is key to navigating its challenges effectively (Heinrich et al. 2023).

The primary goal of menopausal treatment remains the alleviation of symptoms and improvement of quality-of-life (Davis et al. 2023). Hormone Replacement Therapy (HRT) continues to be the most effective and widely used treatment, significantly reducing vasomotor symptoms and preventing osteoporosis (Baber et al. 2016). Recent research and clinical guidelines have provided more nuanced insights into HRT's safety profile, emphasizing personalized risk-benefit assessments and shared decision-making (Jen-Hung et al. 2022). Studies continue to refine understanding of optimal dosages, delivery methods (e.g., transdermal vs. oral), and the timing of initiation, often highlighting that risks are lower when HRT is started earlier in the menopausal transition (Gartlehner et al. 2021). For women with contraindications to HRT, non-hormonal pharmacologic options such as selective serotonin reuptake inhibitors (SSRIs), gabapentin, and clonidine remain important alternatives (Ensrud et al. 2014).

Furthermore, newer non-hormonal agents are continually being investigated, such as fezolinetant, which has shown promise in recent trials for treating vasomotor symptoms by targeting neurokinin-3 receptors (Parsey et al. 2023).

Given concerns about the side effects of conventional hormonal treatments, many women continue to explore herbal medicine as a natural alternative for managing menopausal symptoms (Liang et al. 2021). Commonly used plants include black cohosh (*Cimicifuga racemosa*), red clover (*Trifolium pratense*), dong quai (*Angelica sinensis*), evening primrose (*Oenothera biennis*), and soy isoflavones (Nedrow et al. 2015). These are all believed to modulate hormonal balance

through phytoestrogens or other bioactive compounds (Chen et al. 2006). While some studies suggest potential benefits in reducing hot flashes, insomnia, and mood disturbances, results remain varied and often inconclusive, highlighting the need for more robust, standardized clinical trials (Franco et al. 2017).

Despite their popularity, the safety profiles of many herbal remedies remain under scrutiny (Verma 2017). Concerns persist regarding potential estrogenic effects that could interfere with hormone-sensitive conditions, as well as hepatotoxic (liver-toxic), nephrotoxic (kidney-toxic), or anticoagulant (blood-thinning) properties, especially with high doses or prolonged us (Al-Saeed et al. 2021).

For instance, recent reviews continue to caution about the association of black cohosh with rare cases of liver toxicity, and the potential for dong quai to increase bleeding risk is still noted (Teschke et al. 2020). The persistent challenges of lack of standardization in herbal preparations and the potential for herb-drug interactions underscore the critical need for rigorous safety evaluations and informed patient counseling (Angelo and Ernst 2009).

The objective of this study is to investigate scientifically the potential of particular herbal medicines used in the treatment of menopausal symptoms in Algeria, such as mood swings, sleep disturbances, and hot flashes. This research aims to explore, document, and describe the traditional uses along with the preparation techniques and perceived efficacy of these natural alternatives through an ethnopharmacological investigation using a questionnaire-based methodology. In addition to providing women looking for natural ways to manage menopausal symptoms with well-validated options, the ultimate goal is to validate the traditional knowledge surrounding these medicinal plants and advance our understanding of their therapeutic potential. It also emphasizes the significance of thorough safety evaluations and patient counseling based on actual usage.

Literature review

Literature review

The female genital system, from menarche to menopause, this dynamic system regulates hormonal cycles, supports fertilization and pregnancy, and adapts to physiological changes. (Berga and Naftolin 2023). Defined by the permanent cessation of menstrual periods, menopause signifies the natural end of a woman's reproductive years, typically occurring between the ages of 45 and 55 (World Health Organization 2024). The reproductive organs are located in a woman's pelvis, the area between the hips. Can feel hip bones below your waist, but your reproductive organs won't be affected if your thigh bones aren't evenly shaped (Netter 2018).

1. Female genital system

1.1. Definition

The female genital system, also known as the female reproductive system, encompasses a complex arrangement of internal and external structures essential for reproduction. It includes organs like the vagina, cervix, uterus, fallopian tubes, and ovaries. This system is dynamic, influenced by hormonal changes throughout a woman's life cycle, including the menstrual cycle and pregnancy (Hoare and Khan 2021).

1.2. Anatomy of the female genital system

The female reproductive organs can be subdivided into the internal and external genitalia (John et al. 2025). The vulva and vagina constitute the lower genital tract, while the upper genital tract consists of the uterus and cervix with the associated uterine (fallopian) tubes and ovaries (Rogers and Fischetti 2022).

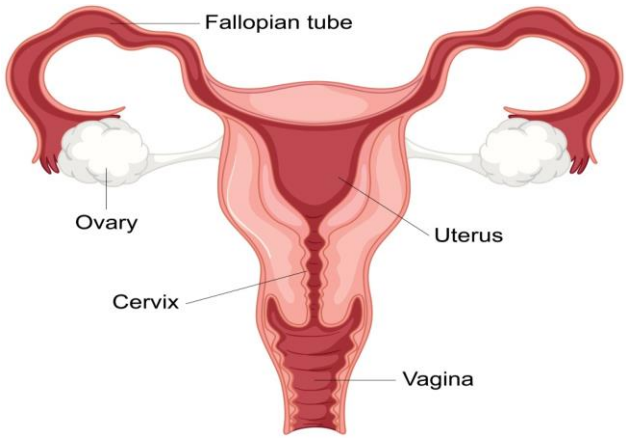

Figure 1. Female genital system (Hailes 2023).

1.2.1. Ovaries

The ovaries are essential for both hormone synthesis and reproduction. The ovary's granulosa and theca cells secrete a variety of hormones, such as progesterone and estrogen. During the proliferation phase, the follicles will mature here in the ovary **(**Richards and Pangas 2022). An abrupt increase in luteinizing hormone (LH) at around day 14 of the menstrual cycle triggers ovulation, the release of an egg from the ovary (Julie et al. 2023).

1.2.2. Fallopian tube

Fallopian tubes, also referred to as oviducts or uterine tubes, are tubular seromuscular structures that begin at the uterine horns, extend laterally along the upper edge of the mesosalpinx within the broad ligament, and end near the corresponding. They measure approximately 11 to 12 cm in length and possess a lumen diameter of less than 1 mm (Hoffman et al. 2020). The fallopian tube is divided into four distinct anatomical sections: uterine, isthmus, ampulla, and infundibulum (Edwards and Jones 2023).

Removal of the fallopian tubes may be necessary for malignancies involving the ovary, fallopian tube, or uterus, as well as benign conditions, including hydrosalpinx and tubo-ovarian abscess (Labidi-Galy et al. 2017).

One particular fimbria, called the fimbria ovarica, connects the infundibulum to the adjacent ovary. Beyond creating an environment for fertilization, the fallopian tubes also serve as a conduit for the ovum or gamete traveling from the ovary to the uterus (Eddy and Pauerstein 2020).

1.2.3. Uterus

The uterus is an unpaired, median organ located in the middle of the pelvis, between the bladder at the front, the rectum at the back, the vagina and perineum below, and the abdominal cavity above (Benleghib 2022). The uterus is divided structurally and functionally into two main regions: the muscular body forming the upper two thirds, and the fibrous cervix forming the lower third (Critchley and Babayev 2023).

1.2.4. Cervix

The cervix is a fibromuscular structure that connects the uterine cavity to the vagina. While typically described as cylindrical, the anterior and posterior walls are usually in close contact (Walter and Rengaswamy 2017). It’s cylindrical, slightly swollen in its middle part and will be divided into two parts by the insertion zone of the vagina: a supra vaginal part which extends the cervix and is visible in the pelvic cavity, an intra vaginal part visible with the speculum and

palpable by vaginal and rectal examination. This intra vaginal end is pierced by an orifice at its lower part; the external orifice of the cervix.it extends inside the uterus by a cavity; the cervical canal (Quasmieh 2012).

1.2.5. Vagina

The vagina is a reproductive organ in females that undergoes transformations throughout a woman's life. It functions in various ways influenced by hormonal shifts experienced during puberty, menstruation, pregnancy, and menopause (Meston et al. 2022).

It's an important part of both your internal and external reproductive anatomy. It's a powerful passage that plays a role in sex, menstruation, conception and childbirth (Stephanie et al. 2020).

2. Menopause

2.1. Definition

Menopause is one of the stages that make up the continuum of a woman's life and marks the end of her childbearing years. Most women experience menopause between the ages of 45 and 55 as a natural stage of biological aging (World Health Organization 2024). In the United States, the average age at physiological menopause is 51. Factors such as smoking, living at high altitudes, and malnutrition can lead to earlier menopause (Sun et al. 2012).

2.2. Symptoms of menopause

Menopausal symptoms can be very distressing and considerably affect a woman's personal and social life. It is becoming more and more evident that leaving bothersome symptoms untreated in midlife may lead to altered quality of life, reduced work productivity and, possibly, overall impaired health (Avis et al. 2015).

Menopause is often accompanied by a range of physiological and psychological symptoms, including hot flashes and night sweats sudden sensations of warmth in the face, neck, and chest, accompanied by flushing, sweating, palpitations, and physical discomfort lasting several minutes (WHO 2024). Additionally, women may experience changes in menstrual regularity and flow, eventually leading to the cessation of periods, along with vaginal dryness, dyspareunia (pain during intercourse), and urinary incontinence (Harlow et al. 2012). Sleep disturbances, such as insomnia, are also common, further exacerbated by nocturnal hot flashes (Joffe et al. 2010). Mood fluctuations, including depression and anxiety, frequently occur due to hormonal shifts and the psychosocial impact of menopausal transition (Gordon et al. 2018). These symptoms

collectively affect quality of life, highlighting the need for comprehensive management strategies.

2.3. Hormonal changes

When menopause is fully reached, the body's production of estrogen, progesterone, and testosterone is reduced greatly, while follicle stimulating hormone (FSH) and luteinizing hormone (LH) levels are increased. This can impact sex drive, cause changes to the skin, result in decreased bone mass which means bones become more brittle and can break more easily, and cause increased risk of cardiovascular disease and stroke (Santoro et al. 2021). Estrogen is an important hormone responsible for regulating the female reproductive system. It is produced primarily in the ovaries, with a small portion produced by the adrenal glands and fat cells. Estrogen affects sexual development, female characteristics, menstruation, pregnancy, and menopaus (El Khoudary 2022).

Similar to estrogen, progesterone production also decreases during menopause, especially after ovulation stops (Stephanie et al. 2023).

Follicular stimulating hormone (FSH) is made by the pituitary gland. It stimulates the growth of eggs in the ovaries and prepares them for fertilization. It also affects sexual development during the reproductive years. Without sufficient levels of FSH, the ovaries lose the ability to mature enough eggs, impacting the ability to reproduce and leading to infertility (Wilson 1998).

Follicle-stimulating hormone (FSH) levels typically rise during perimenopause and menopause as the ovaries become less responsive to FSH. This is because the pituitary gland produces more FSH to try and stimulate the ovaries to produce more estrogen (Orth and kovacs 2003).

3. Ethnopharmacology and drugs discovery

Ethnopharmacology is an amalgam of perspectives, primarily those of pharmacology pharmacognosy, anthropology, and botany. Since these are often flowering plants, it is typically seen as a subfield of ethnobotany, which is the study of how different ethnic groups use plants (Heinrich 2022). Recent advances increasingly integrate computational methods such as in silico docking, molecular dynamics, and network pharmacology to efficiently pinpoint active substances, often prior to experimental validation (Banerjee et al. 2024). This accelerates the translation of traditional remedies into modern therapeutics for diverse conditions, including neglected tropical diseases, antimicrobial resistance, cancer, and neurodegenerative disorders (Atanasov et al. 2021). Furthermore, the field leverages advanced analytics, omics technologies,

and biotechnological approaches to optimize lead compound, ensuring sustainable and ethical drug development that addresses intellectual property and benefit-sharing concerns (Wolfender et al. 2019).

4. Natural products

4.1. Definition

The word "natural product" refers to any natural substance, whether it comes from plants, animals, or minerals (Paterson and Anderson 2005). These products are frequently used by traditional physicians and as primary ingredients in the creation of contemporary medications (Newman and Cragg 2020). It constitutes a scientific pillar of therapeutic development. Activists rely on the traditional medicine of various ethnic groups. Ethnopharmacology allows the translation of shared knowledge and scientific expertise (Heinrich et al. 2020).

4.2. Medicinal plants

These are all plants that contain substances that can be used for therapeutic purposes or that are precorsorsin the synthesis of useful drugs (Khireddine 2013).

Plants contain secondary metabolites considered to be substances indirectly essential to plant life. Secondary metabolites contribute to the plant's adaptation to its environment and resistance to biotic and abiotic stresses. They generally give plants their therapeutic properties. These compounds are phenolic compounds, terpenes and steroids, and nitrogenous compounds including alkaloids, etc. (Khan et al. 2025).

4.3. Animals

The use of animals or animal products to treat human illnesses is known as animal-assisted therapy. Nowadays, the use of animals with medicinal properties is a common practice worldwide (Fine et al. 2024).

4.4. Minerals

All vitamins, minerals and trace elements play an important role in maintaining health and wellbeing among menopausal women. Due to their availability in nature, minerals have been a subject of interest, with a wide range of applications in various industries, and in particular their current and potential biomedical applications (Ghadiri et al. 2015).

Methodology

Methodology

1. Region of study

Algeria, by virtue of its expansive and diverse geography, stands as a veritable treasure trove of natural wealth, boasting a remarkable variety of flora, fauna, and mineral resources. This intrinsic richness, nurtured by a mosaic of edaphoclimatic conditions, from sun-drenched coastal plains to rugged mountain ranges and the vastness of the Sahara, lays the foundation for a unique ecological heritage. It is within this profound context of valuing and illuminating Algeria's traditional knowledge, particularly concerning its natural resources, that our ethnopharmacological study was undertaken. Our focus was specifically directed towards a pivotal physiological transition in women's lives i.e., menopause.

This comprehensive research encompassed the entire Algeria, strategically designed to capture the full breadth of its lithological, structural, and floristic diversity. While nationwide in scope, the investigation specifically engaged a selection of prominent wilayas, including Tiaret, Oran, Algiers, Tissemsilt, Relizane, Chlef, Tlemcen, Mostaganem, Aïn Defla, Blida, and Tipaza, where the engagement and support for our questionnaire administration were most robust.

The diverse plant communities flourishing across these varied environments have, over generations, adapted to a myriad of biotic and abiotic stresses. This continuous interplay with their surroundings naturally stimulates the biosynthesis of a rich spectrum of secondary metabolites. These compounds are renowned for their wide-ranging pharmacological activities, holding significant potential for the effective management and alleviation of symptoms associated with menopause, thereby contributing to women's well-being.

2. Conduct of the study

The present ethnopharmacological study took place during the period 2024-2025, involving 666 participants residing in both rural and urban areas and representing various professions. These participants typically included herbalists, phytotherapists, doctors, pharmacists, elderly women, and university students, among others. Consequently, each participant was interviewed individually to ensure comprehensive data collection.

As this study aimed to identify and collect natural products used in traditional Algerian medicine for the treatment of menopausal symptoms, the plant and animal species, along with any relevant mineral resources employed for this purpose, have been meticulously documented.

This documentation specifically detailed the parts of the plants used, the methods of preparing the remedies, their routes of administration, and their dosages. This essential information was systematically gathered through direct interviews, based on a pre-established semi-structured questionnaire, thereby ensuring the depth and reliability of the obtained data.

3. Data collection

Data collection for this research was carried out using a pre-established questionnaire consisting of two distinct parts; the first part of the questionnaire concerned the participants' characteristics, aiming to gather crucial socio-demographic information. This included details on their gender, age, occupation, education level, and their location and living environment (whether rural or urban). However, the second part was devoted to information relating to the natural remedies used specifically to alleviate menopausal symptoms. This comprehensive section sought to identify the nature of the product used (plant, animal, or mineral origin), its traditional name, the recommended dosages, the method of its use (encompassing both preparation and administration), and any data pertaining to its potential toxicity. This information also aimed to assess the reasons for its use and its duration.

The participants were questioned using the local dialect, which facilitated deeper engagement and more authentic knowledge sharing. Following the survey, efforts were made to ascertain the origin of this traditional knowledge and to precisely describe the cited products, thereby facilitating their subsequent scientific identification.

4. Identification of the medicinal plant species

The taxonomic identification of the aromatic and medicinal plant species, and the subsequent determination of their scientific names, were carried out with methodological rigor. This procedure was based, on the one hand, on the vernacular names provided by the participants during the investigation. On the other hand, the confirmation of the collected specimens was achieved by systematically referring to the available specialized bibliography concerning the Algerian flora, notably the articles authored by our research supervisor, who is a specialist in this field. Furthermore, several other relevant books, dictionaries, and articles were consulted.

The verification of scientific names was performed in strict accordance with international taxonomy standards and was primarily based on the comprehensive database www.theplantlist.org. This approach ensured the accuracy of the botanical designations. For each identified species, its scientific name has been systematically supplemented by its common name(s) in the local language, thereby maintaining the vital link with popular knowledge and local usage. Moreover, a reference herbarium has been established from the collected specimens

and is now deposited in the laboratory of the molecular and cellular biology research team at Ibn Khaldoun University of Tiaret, Algeria, serving as a permanent record and future resource.

5. Data processing and analysis

Following the data collection phase, the information gathered was carefully organized and categorized in an Excel file.

This systematic approach enabled the computation of the frequency of use and citation for each of the natural products identified, providing a robust basis for further analysis.

Results

Results

The use of natural products in therapy has consistently shown positive results for the treatment of various pathologies. In the current context, ethnopharmacological studies are essential since they provide us with the opportunity to document in detail natural products and their uses by local communities, particularly their applications in traditional medicine.

In our research, we are paying particular attention to the use of these methods for the treatment of symptoms associated with menopause. Our goal is to highlight and scientifically confirm Algerian traditions that have endured, potentially offering options or additions to conventional care to enhance the well-being of women going through this physiological phase.

1. Characterization of the participants

The age range of [51–55 years old] has the highest participation rate and comprises the greatest number of informants, at 115 peoples. The age categories of [46–50 years old] and [56–60 years old] come in second and third, respectively, with a relatively high number of participants (about 105 and 100). These findings demonstrate the critical role that mature and seasoned people play in preserving and disseminating menopausal knowledge.

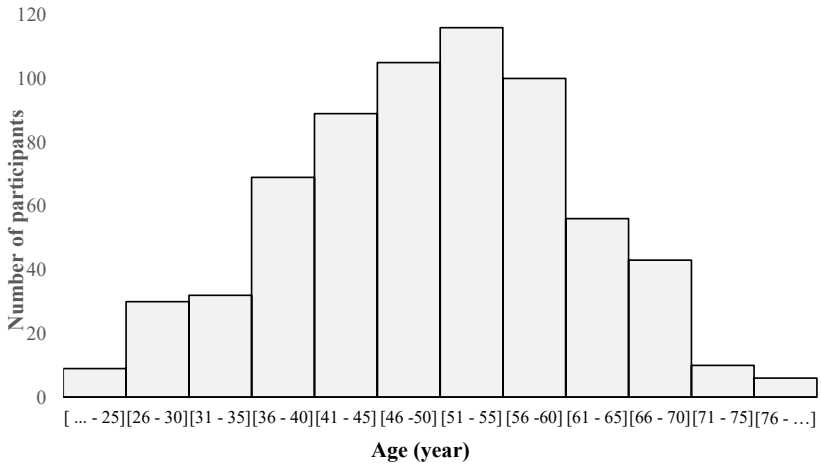

Figure 2. Distribution of the age groups of the participants.

The number of informants progressively declines as one moves away from these core groups. Notable participation is shown in the [41–45 years old] and [61–65 years old] age categories (around 90 and 55 people, respectively).

Younger age groups like [36–40 years old] (about 70 participants) and [31–35 years old] (about 35 participants) as well as senior age groups like [66–70 years old] (about 40 participants) also make contributions. There are fewer people in the youngest age groups [26–30 years old] (about 30 participants) and [... – 25 years old] (about 10 participants), as well as the oldest age groups [71–75 years old] (about 10 participants) and [76 –...] (about 5 participants).

In terms of the participants' sex distribution, female participants' rate (80%) was higher than that of male (20%).

Figure 3. Distribution of participants by sex.

The largest number of our participants is comprised of those categorized as illiterate, accounting for 242 individuals (36%). This highlights the significance of oral tradition and empirical learning in the transmission of ethnomedicinal practices. Following this, 156 participants (23%) possess a university-level education, indicating valuable insights from academically trained individuals who may bridge traditional and modern understanding.

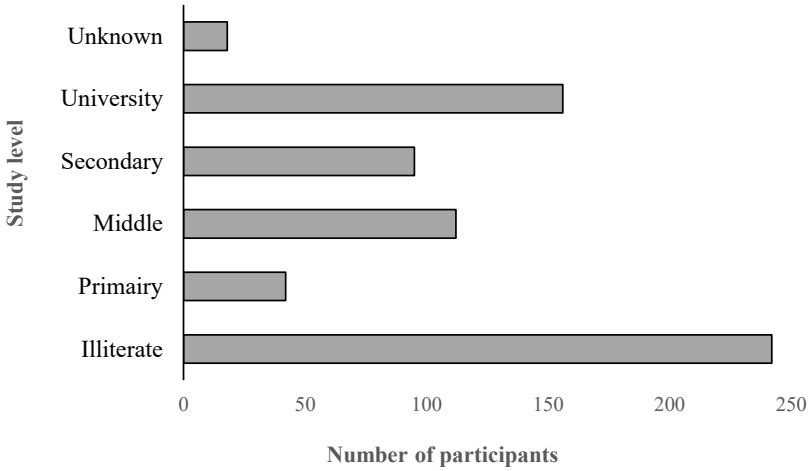

Figure 4. Level of study of participants.

Informants with an average (middle school) education constitute 112 participants (17%), while those with a secondary (high school) education comprise 95 individuals (14%). Lastly, 42 participants (6%) have a primary school education. Additionally, 18 participants (3%) did not disclose their educational level. This comprehensive distribution underscores that knowledge pertaining to menopause is not confined to a single educational stratum but rather permeates various levels of formal schooling and informal learning within the local communities.

An analysis of the living conditions of the participants reveals a significant discrepancy between the representation of urban and rural areas. 92% of our informants live in urban areas, whereas only 8% come from rural areas. This distribution highlights the high percentage of urban people in our sample, which could be a reflection of knowledge access patterns or the general demographics pertinent to the menopausal ethnopharmacological study procedures described.

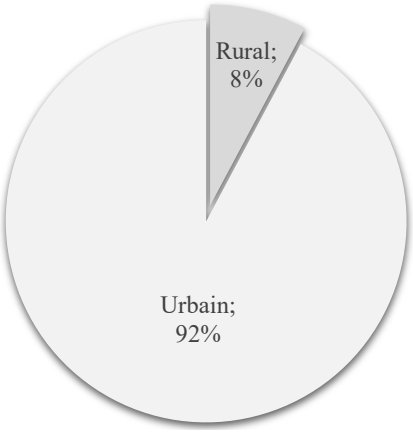

Figure 5. Distribution of participants according to their living environment.

Among our informants, 125 people, a sizable percentage were herbalists. Because of their in-depth understanding of medicinal plants and their direct interaction with patients seeking traditional therapies, these practitioners are extremely significant information sources. However, with 364 participants, homewives made up the biggest single group, underscoring their vital role in the transmission and domestic application of traditional knowledge connected to health.

Additionally, well-represented was the medical and paramedical sector, which provides an important link between conventional methods and contemporary viewpoints on healthcare. There were 6 gynecologists, 24 family doctors, 28 midwives, and 44 additional medical professionals in this group. 6 pharmacists also shared their perspectives.

We also added 6 phytotherapists. Lastly, the survey also included 46 jobless people, which expanded the variety of experiences and traditional knowledge that were recorded. This wide range of professional profiles significantly improved our comprehension of menopausal ethno-pharmacological practices in Algeria.

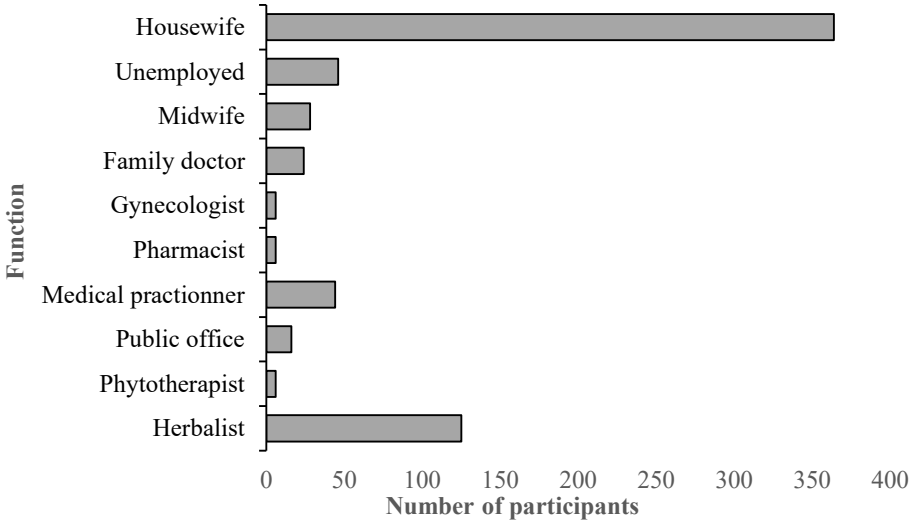

Figure 6. Nature of the function of the participants

2. Description of natural products used in traditional treatment of menopausal symptoms

According to the participants in this survey, Algerians have traditionally used 71 natural remedies of different origins to treat symptoms of menopause; 63 plant species, 5 plant products, and 3 animal products. The diversity of natural resources and the wealth of local abilities used to sustain this specific stage of women's lives are highlighted by this variability.

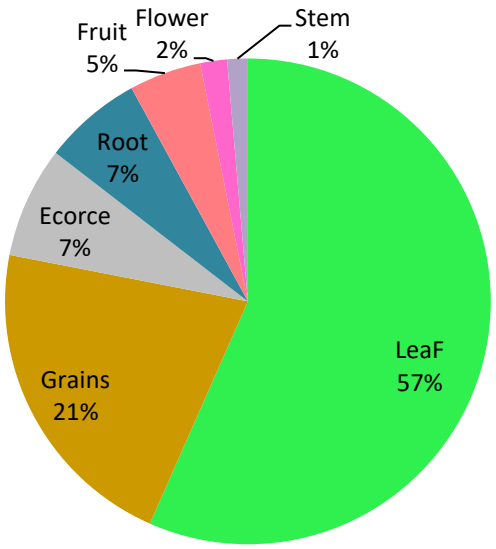

Figure 10. Principal plant parts used by the participants.

By far the most commonly used portion, leaves make for a substantial 57% of all documented uses. This significant dominance implies that in these traditional techniques, leaves are regarded as a major source of advantageous active chemicals.

After leaves, seeds account for a large 21% of all uses, demonstrating their importance in a variety of preparations. Additionally, roots and bark are employed extensively, accounting for 7% of all applications that have been reported.

Five percent of the uses are for fruits, while two percent are for flowers. Lastly, with only 1% of all usage, stems (tige) are the plant part that is least frequently mentioned in this study. This distribution demonstrates the customs and body of knowledge surrounding the plant parts thought to be most useful in treating menopausal symptoms.

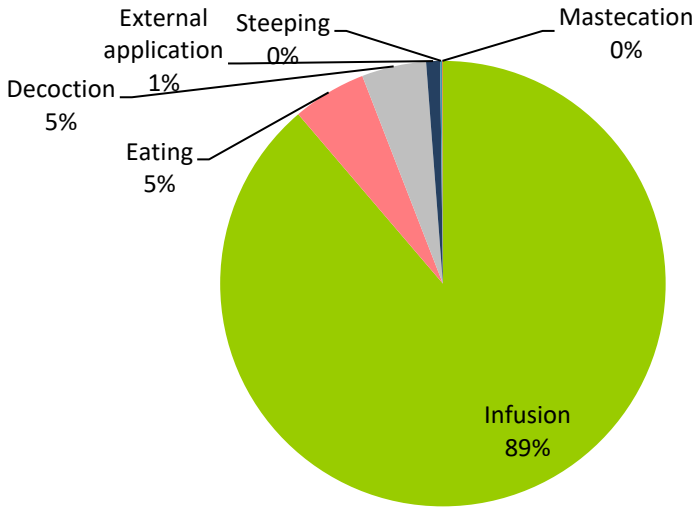

Figure 11. Methods of preparation and use of medicinal plants.

Infusion is the most common method for menopause, accounting for 89% of all reported uses. Decoction and direct ingestion are less frequent but have specific applications for certain plants or therapeutic effects. External application is only 1%, and maceration and mastication are rare or not used. Infusion is the cornerstone of traditional preparation methods.

4. Other natural products

In addition to the diverse array of aromatic and medicinal plants, our investigation revealed that participants commonly integrate other natural products into their traditional remedies for menopause.

These include products of animal origin such as honey, milk, and yogurt, highlighting a broader scope of traditional resources. Furthermore, five distinct by-products sourced from plants were identified: olive oil, sage oil, lavender oil, almond oil, and rose oil. The inclusion of these various natural derivatives underscores a comprehensive approach to addressing women's health through traditional practices.

Discussion

Discussion

From prehistoric and ancient times to the present, natural products have been essential in the prevention and treatment of a wide range of human illnesses. Natural products have drawn a lot of interest as novel therapeutic options throughout the last 20 years because of their bioactive natural components, which have a wide range of pharmacological and biological actions.

The goal of this ethnopharmacological study was to create a thorough inventory of natural remedies for menopausal symptoms in Algeria. According to our findings, 71 natural items are used in alternative treatments for menopause.

This collection incorporates various elements including 63 aromatic and therapeutic herbs, honey, milk, yogurt, and plant oils (oil of sage, almond, lavender, olive, and rose). The most prevalent plant families were Lamiaceae, Apiaceae, Verbenaceae, and Lauraceae families.

The Lamiaceae family is notably prominent in this study, including species such as *Salvia officinalis* L. (الميرمية), *Lavandula stoechas* L. (الخزامة), *Mentha* × *piperita* L. (النعناع), *Origanum majorana* L. (البردقوش), *Thymus vulgaris* L. (الزعتر), *Rosmarinus officinalis* L. (اكليل الجبل), *Ocimum basilicum* L. (الحبق), *Marrubium vulgare* L. (المريوت), *Melissa officinalis* L. (الميليسا), and *Mentha pulegium* L. (الفليو).

Plants belonging to the Lamiaceae family are well-known for their rich and diverse phytochemical composition. These species are particularly abundant in various classes of active molecules that contribute to their therapeutic properties. Prominent among these are alkaloids, flavonoids, tannins, saponins, quinones, sterols, and triterpenes (Saeed et al. 2017). Numerous phytochemical investigations focusing on this family have also led to the identification of a wide array of volatile constituents, including mono- and sesquiterpenes, such as α- and β-pinene, menthol, thymol, eucalyptol, and limonene (Bentahar et Lamri 2018).

In addition, the Apiaceae family *Foeniculum vulgare* Mill. (زريعة البسباس), *Pimpinella anisum* L. (حبة الحلاوة), *Cuminum cyminum* L. (الكمون), *Petroselinum crispum* (Mill.) Fuss (المعدنوس), *Apium graveolens* L. (الكرافس), *Anethum graveolens* L. (الشبيط).

The Apiaceae family is notably rich in essential oils, secondary metabolites, and various phytochemicals, which contribute to its diverse pharmacological and nutritional properties. This family, comprising numerous genera and species, is widely distributed and utilized in both traditional and modern medicinal practices (Kooti et al. 2023). The richness in these compounds makes the Apiaceae family significant for various applications in health and industry. Apiaceae species are particularly abundant in essential oils, which are found in different plant parts such as

leaves, flowers, fruits, stems, roots, and rhizomes. These oils are commercially important and are used in spices and flavorings, with examples including anise, cumin, fennel, coriander, and caraway (Baser 2014). The essential oil content and composition can be influenced by environmental factors such as light, which can enhance the nutritional value of these plants (Raffo et al. 202). The family is a rich source of secondary metabolites, including coumarins, saponins, flavonoid glycosides, fatty acids, and terpenoids. These compounds are associated with various pharmacological activities such as analgesic, anti-inflammatory, anticancer, and antioxidant properties (Mohammed 2014).

Apiaceae plants also possess antidiabetic properties, attributed to their ability to inhibit carbohydrate hydrolyzing enzymes and stimulate insulin secretion (Bag et al. 2024), However, the family Verbenaceae consists of *Verbena officinalis* L. (اللويزة) this species contains iridoid glycosides, secoiridoid glycosides, phenylethanoid glycosides, flavones, and pentacyclic triterpenoids. It is noted for its antibacterial, antiviral, antifungal, and various other pharmacological activities, particularly in female reproductive health (Kubica et al. 2020).

The Lauraceae family is represented by *Cinnamomum verum* J.Presl (القرفة). *Laurus nobilis* L. (الرند). The Lauraceae family encompasses a diverse range of species known for their rich phytochemical profiles and active biological compounds. This family includes notable genera such as Licaria, Ocotea, and Nectandra, each contributing unique phytochemicals with significant pharmacological potential. The following sections detail the active molecules and phytochemical profiles of these genera. The Lauraceae family includes Licaria, Ocotea, and Nectandra, all of which are distinguished by their varied phytochemical compositions and related therapeutic qualities. Licaria's many traditional uses are attributed to its abundance of lignans, neolignans, lactones, triterpenes, alkaloids, and arylpropanoids (Akbar et al.2020). Neolignans, alkaloids, sesquiterpenes, flavonoids, and essential oils are abundant in ocotea and are associated with antibacterial and anti-inflammatory properties (Salleh and Ahmad 2019). With notable seasonal fluctuations in its chemical composition, nectandra is characterized by its essential oils, especially sesquiterpene hydrocarbons and oxygenated sesquiterpenoids (Ferraz and al. 2018).

The strong antibacterial and antioxidant properties of essential oils produced from Lauraceae species demonstrate their potential for use in medicinal applications (Goudjil and al. 2015). Additionally, a number of species in the family have long been used for their anti-inflammatory properties, a practice that is corroborated by several bioassays that demonstrate their effectiveness (Zeković et al. 2016). While the Lauraceae family shows promising potential in pharmacology, it is essential to consider the challenges in standardizing these natural products for clinical use, as variability in chemical composition can affect therapeutic outcomes. However, the most popular aromatic and therapeutic plants were *Salvia officinalis* L. (الميرمية),

Mentha × *piperita* L. (النعناع), *Pimpinella anisum* L. (حبة الحلاوة), *Verbena officinalis* L. (اللويزة), *Cinnamomum verum* J.Presl. (القرفة), *Foeniculum vulgare* Mill. (ريعة البسباس), *Origanum majorana* L.(البردقوش) and *Zingiber officinale* Roscoe (الزنجبيل).

Salvia officinalis L. (Sage or المرمية) is a highly valued medicinal plant in traditional medicine, known for its diverse therapeutic properties due to its rich phytochemical composition. It is traditionally used to treat mild digestive disorders, mouth/throat inflammation, minor skin irritations, and excessive sweating (due to its antiperspirant effects). Some studies suggest it may also enhance memory and cognitive function. Its high polyphenol and flavonoid content contributes to antioxidant and anti-inflammatory effects, while its antimicrobial activity is effective against various bacteria, yeasts, and fungi (Boufadi et al. 2023).

S. officinalis exhibits estrogenic activity *in vitro*, primarily due to luteolin-7-O-glucuronide (EC_{50}: 129 µg/mL) (Rahte and al. 2013). *In vivo* studies in rats show that sage tea boosts reproductive hormones (FSH, LH, estrogen, progesterone), suggesting potential benefits for fertility and hormonal balance (Al-Bediry et al. 2013). Clinically, a fresh sage preparation reduced menopausal hot flashes by 64% over eight weeks (Bommer et al. 2011). Toxicity studies indicate low acute oral toxicity (LD_{50} >5000 mg/kg in mice) (El-Sayed et al. 2017), but sage contains thujone, a neurotoxic compound (oral LD_{50} in mice: 192 mg/kg for pure thujone) (Jäger and al. 2009). The LC_{50} metric is irrelevant for oral consumption, as it applies to environmental (not dietary) exposure.

S. officinalis L. has demonstrated significant potential in alleviating menopausal symptoms, particularly hot flashes and night sweats. Clinical evidence includes a multicenter trial showing that a fresh sage preparation substantially reduced daily hot flash frequency (Li et al. 2022), as well as a systematic review and meta-analysis confirming its effectiveness in decreasing both the frequency and severity of hot flashes while also improving night sweats, fatigue, and concentration (Walbroel et al. 2011). These findings support its traditional use as a natural remedy for menopausal discomfort.

The mechanism is not fully understood but is thought to involve sage's mild phytoestrogenic properties, mimicking estrogen effects, or modulating neurotransmitters involved in thermoregulation (Taleb et al. 2021).

Mentha × *piperita* L. (Mint or النعناع), is a well-known aromatic and medicinal herb that is used extensively across the world for its many therapeutic uses and distinctive scent. Its distinct phytochemical makeup is primarily responsible for its both conventional and contemporary uses.

Mentha × *piperita* L. (peppermint) is a traditional medicinal herb valued for its essential oils (menthol, menthone, 1,8-cineole), flavonoids, and phenolic acids like rosmarinic acid, which contribute to its therapeutic effects (Taleb et al. 2021). While primarily known for digestive,

respiratory (expectorant), and analgesic benefits (da Costa et al. 2021), it also offers supportive relief for menopause symptoms such as nausea, tension headaches, and anxiety, with its cooling effect potentially aiding hot flashes (da Costa et al. 2021).

Research highlights peppermint's antioxidant and anti-inflammatory properties, which may mitigate menopause-related oxidative stress. *In vitro* studies demonstrate strong radical scavenging activity (IC_{50}: 126.695 µg/mL) (da Costa et al. 2021), with hydro-ethanol extracts showing notable nitric oxide scavenging (Kumar et al. 2011). *In vivo* studies on rats reveal reduced oxidative markers (e.g., malondialdehyde) at 5 mg/200 g body weight (Amini et al. 2018) and anti-inflammatory effects in paw edema models (Zgórka et al. 2017). Toxicity studies suggest safety (LD_{50} > 5000 mg/kg) (Ali et al. 2018). However, variability in phytochemical content due to extraction methods necessitates further research to standardize dosages for clinical menopause management. While promising for symptom relief via antioxidative pathways, direct hormonal modulation remains unconfirmed.

Pimpinella anisum L. (Anise or حبة الحلاوة), a member of the Apiaceae family, is renowned for its aromatic seeds primarily due to its essential oil's main component, trans-anethole, alongside other volatiles like estragole, and non-volatile compounds such as flavonoids and coumarins (Mosavat et al. 2015). Traditionally, it is widely utilized as a digestive aid for flatulence and cramps, an expectorant for coughs, and a lactagogue to promote milk production, also exhibiting antimicrobial properties. Critically, anise has garnered attention for its application in menopause management, particularly for hot flashes, as its primary constituent, anethole, acts as a phytoestrogen, weakly mimicking estrogen's effects; clinical trials have shown its efficacy in reducing the frequency and severity of hot flashes in postmenopausal women (Pourgholami and Khadem 2012).

Clinical trials demonstrate the efficacy of *P. anisum* (anise) in alleviating menopausal symptoms, particularly hot flashes. A randomized study involving 72 menopausal women showed that daily intake of three capsules significantly reduced both the frequency (from 7.89 to 1.04) and severity (from 11.50 to 1.90) of hot flashes after eight weeks of treatment (Pourgholami and Khadem 2012). These findings were supported by other similar studies (Ghotbi et al. 2017). While the exact mechanisms remain under investigation, the phytoestrogenic (anethole) and antispasmodic properties of anise are believed to contribute to its therapeutic benefits (Mosavat et al. 2015).

P. anisum (anise) exhibits low acute toxicity in rodent studies, with whole-extract LD_{50} values suggesting safety (e.g., 4.1 g/kg for methanolic extract, (Shah et al. 2013) >5 g/kg for aqueous extract) (Hajhashemi et al. 2012). However, a specific active fraction showed moderate toxicity (LD_{50}: 95 mg/kg) (Pourgholami and Nahidi 2014). Clinically, anise is well tolerated at

therapeutic doses (330 mg, 3x/day), significantly reducing menopausal hot flashes without severe side effects (Pourgholami and Khadem 2012).

Verbena officinalis L. (Vervain or اللويزة), a member of the Verbenaceae family, is valued for its rich phytochemical profile, predominantly featuring iridoid glycosides like verbenalin, along with various flavonoids and phenolic acids such as verbascoside, all contributing to its diverse therapeutic effects (Owolabi et al. 2010). Traditionally, it is widely recognized as a nervine and mild sedative, used to alleviate anxiety, stress, and improve sleep, and also finds application in digestive support and as an anti-inflammatory agent (Gruenwald and Brendler 2007). While not directly targeting hormonal hot flashes, *Verbena officinalis* plays a significant supportive role in menopause management by addressing common associated symptoms such as anxiety, mood swings, and sleep disturbances, thereby contributing to overall emotional balance and well-being during this physiological transition (Ghazghazi and al., 2017).

V. officinalis L. (vervain) shows promise for managing menopausal symptoms, supported by clinical trials demonstrating reductions in hot flashes and mood swings (Owolabi et al. 2010). Animal and in vitro studies reveal hormonal modulation, estrogen-like activity (Kołodziejczyk et al. 2012), and antioxidant effects (Kubica et al. 2020). Safety is well established, with low acute toxicity (LD_{50} >2000–5000 mg/kg) and a high safety margin for its active compounds (Aliyu et al. 2015; Sisay et al. 2019).

Cinnamomum verum J.Presl. (Ceylon Cinnamon or القرفة), a prized spice, derives its therapeutic properties primarily from its essential oil, rich in cinnamaldehyde, along with other volatile compounds and significant levels of polyphenolic compounds like proanthocyanidins and phenolic acids (Kumar and Kumari 2017). Generally, it is widely utilized for its benefits in digestive health, potent antimicrobial and antifungal activities, and its traditional role in blood sugar regulation and improving cardiovascular parameters (NCCIH 2025). While not a primary phytoestrogen for menopausal symptoms like hot flashes, cinnamon offers valuable supportive benefits during the menopausal transition by potentially aiding metabolic health (e.g., blood sugar stability), subtly influencing mood and energy levels, and providing anti-inflammatory and antioxidant support to address associated systemic changes, contributing to overall well-being.

C. verum (cinnamon) shows potential for managing menopausal symptoms through estrogen-like effects. *In vivo* studies in ovariectomized mice demonstrate reduced anxiety and improved cognitive function (Zhou et al. 2020), while *in vitro* research confirms estrogen receptor modulation (Hajirahimkha et al. 2013). A clinical trial in postmenopausal women (1 g/day for 2 months) reported improved psychological symptoms without severe side effects (Esmaeilzadeh et al. 2024). While promising, further clinical validation is needed for standardized use.

Studies on *C. verum* extracts in rodents consistently demonstrate low acute oral toxicity. For instance, the oral LD_{50} for cinnamon oil is reported as 2800 mg/kg in rats and 2670 mg/kg in mice (Lewis 1996). An aqueous bark extract of *C. verum* in rats was found to have an oral LD_{50} greater than 5000 mg/kg, indicating it is "practically non-toxic" at this dose (Jayaprakasha and Negi 2007). Furthermore, a polyphenol-based standardized extract of *C. verum* bark administered as a single oral dose did not cause death or treatment-related toxic effects in rats, showing an LD_{50} >2000 mg/kg (Anderson et al. 2004). These findings collectively suggest a high safety profile for various cinnamon extracts in acute oral exposure.

Foeniculum vulgare Mill. (Fennel or زريعة البسباس), an aromatic Apiaceae herb, is valued for its culinary and medicinal uses. Its therapeutic effects stem from essential oils (rich in trans-anethole, fenchone, estragole) and phenolic compounds (flavonoids, coumarins) (Rather et al. 2016). Traditionally used as a carminative, antispasmodic, expectorant, and galactagogue, it also exhibits antimicrobial, antioxidant, and anti-inflammatory properties.

For menopause, fennel's phytoestrogenic trans-anethole helps alleviate hot flashes, night sweats, and vaginal atrophy, with clinical trials confirming efficacy (Zamani et al. 2018). It may also improve sleep disturbances, offering a natural alternative for menopausal symptom relief.

Fennel has shown promise in addressing menopausal symptoms, supported by both *in vivo* and *in vitro* evidence. A randomized, triple-blind clinical trial demonstrated that 100 mg of fennel capsules significantly reduced menopausal symptoms, as assessed by the Menopause Rating Scale (MRS), over an 8-week period (Rahimikian et al. 2017). Biochemically, research indicates that fennel extracts possess phytoestrogenic properties, suggesting their potential to modulate hormonal changes during menopause (Malini et al. 2018). Although specific *in vitro* studies directly examining fennel's effects on menopausal symptoms are limited, its components are known to exhibit anti-inflammatory and antioxidant activities, which could contribute to overall symptom relief (Badgujar et al. 2014).

F. vulgare Mill. demonstrates low acute oral toxicity in preclinical studies, with an oral LD_{50} of 5.52 mL/kg for seed fixed oil in mice, indicating high safety margins for therapeutic use (Zargari et al. 2014). While intraperitoneal administration shows lower LD_{50} values (1.038 mL/kg for essential oil; 9.772 mg/kg for juice) due to direct systemic absorption (Tognolini et al. 2007, Al-Hizab et al. 2018), these routes are pharmacologically irrelevant for oral herbal preparations. Importantly, CL_{50} measures (assessing airborne/waterborne toxicity) are inapplicable to orally consumed fennel products. These toxicological data support fennel's safety profile when used at appropriate therapeutic doses for menopausal symptom relief.

Origanum majorana L. (Marjoram or البردقوش), a fragrant herb belonging to the Lamiaceae family, is widely used in culinary arts and traditional medicine for its distinct aroma and

therapeutic benefits. Its medicinal properties are largely attributed to its rich essential oil content and various phenolic compounds. The essential oil primarily consists of sabinene, terpinen-4-ol, γ-terpinene, and cis-sabinene hydrate, while non-volatile components include flavonoids (e.g., diosmetin, luteolin, apigenin), phenolic acids (e.g., rosmarinic acid, caffeic acid), and tannins (Touati et al. 2024). Traditionally, marjoram is valued for its digestive aid properties (e.g., relieving flatulence and indigestion), its antispasmodic effects, and its use as a mild sedative for anxiety and insomnia. It also exhibits significant antioxidant, anti-inflammatory, and antimicrobial activities. While direct clinical evidence specifically linking *O. majorana* to the alleviation of hormonal hot flashes in menopause is limited, its traditional uses suggest supportive roles in managing mood swings, anxiety, and sleep disturbances commonly associated with the menopausal transition. Its potential to modulate hormonal balance (e.g., affecting prolactin levels) has been explored in other contexts, hinting at a broader potential in women's health that might indirectly benefit perimenopausal symptoms, but more targeted research on menopause is needed (Ghorbanzadeh et al. 2020).

Current research demonstrates that *Origanum majorana* exhibits significant potential for managing menopausal symptoms through multiple mechanisms. *In vivo* studies using female rats administered marjoram leaf extract (540 mg/kg) showed notable hormonal regulation, including reduced prolactin levels, balanced LH, FSH, and estrogen levels, and decreased body and reproductive organ weights, suggesting therapeutic effects on menopausal hormonal changes. Complementary in vitro studies reveal that marjoram possesses phytoestrogenic properties, capable of binding to estrogen receptors to mimic estrogenic activity, thereby potentially alleviating menopausal symptoms without the risks associated with conventional hormone therapy (Kołodziejczyk et al. 2012). Safety assessments indicate low acute oral toxicity, with essential oil showing an LD_{50} of 2.24 g/kg in rats (Heikal 2015) and aqueous extracts demonstrating no toxicity at doses up to 10 g/kg in mice (Seoudi et al. 2011). Importantly, while CL_{50} measures are irrelevant for oral administration, the established LD_{50} values confirm marjoram's safety profile at therapeutic doses, supporting its potential as a natural alternative for menopause management. These findings collectively suggest that *Origanum majorana* may offer a safe and effective phytoestrogenic option for alleviating various menopausal symptoms.

Zingiber officinale Roscoe. (Ginger or الزنجبيل), a widely recognized rhizome, is highly prized globally for its pungent flavor and extensive historical use in traditional medicine across diverse cultures. Its therapeutic efficacy is primarily attributed to its complex array of non-volatile pungent compounds and volatile essential oils. The most significant active molecules include gingerols (e.g., 6-gingerol, 8-gingerol, 10-gingerol), shogaols (dehydrated gingerols, especially 6-shogaol, formed during drying or heating), and zingerone, which are responsible for

its pungency and many pharmacological activities. Its essential oil contains sesquiterpenes like zingiberene, ar-curcumene, and bisabolene (Kumar et al. 2021). Traditionally, ginger is widely employed as a potent anti-emetic for nausea and vomiting (including motion sickness and pregnancy-related nausea), a powerful anti-inflammatory and analgesic agent (for conditions like osteoarthritis and muscle pain), and a digestive aid (Mashhadi et al. 2013).

Zingiber officinale provides valuable supportive therapy for menopausal symptoms through multiple mechanisms. Contemporary research confirms its anti-inflammatory properties help alleviate menopausal arthralgia and myalgia, while its anti-emetic action addresses gastrointestinal disturbances common during this transition (Hosseini et al. 2020). Additionally, ginger's vasoactive and thermogenic properties may improve circulation and metabolic function, potentially mitigating fatigue and enhancing quality of life (Anh and al. 2020). These pleiotropic benefits position ginger as an important adjunct in comprehensive menopause management strategies.

Ginger shows promise in alleviating menopausal symptoms through multiple mechanisms. Clinical studies in postmenopausal women demonstrate that daily supplementation (400–800 mg) improves cognitive function, as evidenced by enhanced N100 and P300 amplitudes (Saenghong et al. 2018). *In vivo* research in rats suggests ginger may support hormonal balance by increasing testosterone and reducing oxidative stress (Khaki et al. 2018), while *in vitro* studies confirm its antioxidant capacity in mitigating oxidative damage (Bilto and Alabdallat, 2015). Although these findings highlight ginger’s potential as a natural therapy, further research is needed to clarify its mechanisms and compare its efficacy to conventional hormone treatments (Hosseini et al. 2020). For orally consumed ginger, acute toxicity is exceptionally low, as demonstrated by high LD_{50} values in rodent studies. Research shows no mortality or toxicity signs at 5000 mg/kg (Alabi and al. 2023), with another study establishing an oral LD_{50} of 3800 mg/kg (Ugwu et al. 2022). Even prolonged administration (2000 mg/kg daily for 35 days) caused no adverse effects in rats (Smith and Jones 2022). These findings confirm that ginger is practically non-toxic at typical therapeutic doses, supporting its safe use in menopause management.

Conclusion & perspectives

Conclusion

This extensive ethnopharmacological investigation in Algeria has revealed an astounding amount of traditional wisdom on natural treatments for menopausal symptoms. The study, which had 666 participants from a variety of geographic locations and included homemakers, traditional healers, and adult women, emphasizes the critical role that oral communication plays in this situation.

The main conclusions of the study revealed the usage of 71 distinct natural items, including 3 animal products (milk, honey, and yogurt), 5 plant-derived oils, and 63 aromatic and medicinal plants. The Lamiaceae, Apiaceae, Verbenaceae, and Lauraceae families, all renowned for their diverse active chemical profiles, were the most often mentioned plant groups. *Salvia officinalis*, *Mentha × piperita*, *Pimpinella anisum*, *Verbena officinalis*, *Cinnamomum verum*, *Foeniculum vulgare*, *Origanum majorana*, and *Zingiber officinale* were among the most often used herbs.

Deeply ingrained customs were highlighted by the fact that leaves were the most often employed plant portion (57%), and infusion was the most popular preparation technique (89%).

Many of these natural medicines work through different channels in terms of how they work. To reduce hot flashes and night sweats, plants that imitate estrogen, such as *Salvia officinalis*, *Pimpinella anisum*, and *Foeniculum vulgare*, have phytoestrogenic benefits. Others, like lavender oil and *Verbena officinalis*, have sedative and nervine qualities that help with stress, anxiety, and sleep issues. Additionally, olive and rose oils, as well as ginger, cinnamon, and peppermint, offer comprehensive anti-inflammatory, antioxidant, digestive, and metabolic support, all of which enhance general wellbeing. Milk and yogurt are examples of animal products that provide essential nutritional support for gut and bone health, two important areas of postmenopausal wellness.

However, the study highlights serious safety issues in spite of the conventional use and apparent efficacy. The urgent need for thorough scientific validation is highlighted by documented occurrences of adverse effects, such as poisoning episodes, digestive problems, renal and liver affects, and possible drug interactions. Additional toxicological, pharmacokinetic, and pharmacodynamic studies are thus required. The safe and successful integration of these traditional therapies into women's healthcare throughout the menopausal transition in Algeria ultimately depends on their careful and evidence-based use, backed by explicit government policies for standardization and approval.

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