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THEME

Survey on the Traditional Use of Medicinal Plants for Gastrointestinal, Hepatic, Renal, and Neurological Disorders in Local Communities

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بسم الله الرحمن الرحيم

DEDICACES

I dedicate this success, first and foremost, to my ambitious self, who began this dream with determination and completed it with pride and achievement. I also dedicate it to everyone who supported me throughout my university journey, step by step.

With all my love and gratitude, I dedicate the fruits of my success and graduation:

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To my beloved **father**, my role model, and the dearest person to my heart.

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To my beloved **mother**.

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who brought indescribable happiness into my life. I pray that Allah protects their innocent smiles and blesses them with a future full of success and happiness.

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I dedicate this graduation, the fruit of years of hard work and sleepless nights, to the soul of my beloved grandmother, who passed away while her prayers still live within my heart. May Allah shower her with His vast mercy and make her grave one of the gardens of Paradise.

I also dedicate it to my mother and father, who were the light in the darkness of my path, the support that never wavered, and the prayers that never ceased. No matter how much I write, I will never be able to repay your kindness and sacrifices.

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DEDICACES

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To my dear father, who worked hard and sacrificed so that I could reach this day, and who has always been a symbol of patience and perseverance.

To my beloved grandmother, the warmth of my heart and the one whose sincere prayers always accompanied me, may Allah protect you and preserve your beautiful presence in my life.

To my dear husband, my life partner and my support through every moment of hardship, thank you for always being my comfort, strength, and support.

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Finally, we pray to Allah to make this work purely for His noble sake and beneficial to everyone who reads it.

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ملخص

تهدف هذه الدراسة إلى توثيق استعمال النباتات الطبية والعطرية في علاج اضطرابات الجهاز الهضمي وبعض الاضطرابات المرتبطة بالكبد والكلى والجهاز العصبي لدى سكان ولاية الوادي. اعتمدت الدراسة على جانب نظري تناول الخصائص النباتية والكيميائية والاستعمالات العلاجية والسمية لعدد من النباتات الطبية، وجانب ميداني تمثل في استبيان إثنوبوتاني شمل **200مشارك**.

أظهرت النتائج أن استعمال النباتات الطبية ما يزال واسع الانتشار في المجتمع المحلي، حيث صرّح **85%**من المشاركين بأنهم سبق لهم استعمال العلاج بالأعشاب، كما اعتبر **90.5%**أن استعمال النباتات الطبية شائع في محيطهم. وكانت أكثر النباتات توصية هي **الحلبة Trigonella foenum-graecum** بـ **142إجابة**، تليها **قشور الرمان Punica granatum** بـ **139إجابة**، ثم **النعناع Mentha spicata / Mentha piperita**بـ **138إجابة** .كما بينت النتائج أن **ألم المعدة** هو أكثر اضطراب تم علاجه بالنباتات، وبرزت **قشور الرمان** كأكثر نبات ارتبط بعلاج آلام المعدة بنسبة **52.5%**. وتؤكد الدراسة أهمية توثيق المعارف التقليدية علميًا، مع ضرورة إجراء دراسات دوائية وسمية لتأكيد فعالية وسلامة هذه النباتات .

الكلمات المفتاحية :النباتات الطبية، الاضطرابات الهضمية، الإثنوبوتاني، الحلبة، قشور الرمان، الطب التقليدي.

Résumé

Cette étude vise à documenter l'utilisation des plantes médicinales et aromatiques dans le traitement des troubles digestifs ainsi que de certains troubles liés au foie, aux reins et au système nerveux chez la population de la wilaya d'El Oued. Le travail repose sur une partie bibliographique portant sur les caractéristiques botaniques, chimiques, thérapeutiques et toxicologiques de plusieurs plantes médicinales, ainsi que sur une enquête ethnobotanique réalisée auprès de 200 participants.

Les résultats montrent que l'usage des plantes médicinales reste largement répandu dans la communauté étudiée. En effet, 85% des participants ont déclaré avoir déjà utilisé un traitement à base de plantes, tandis que 90,5% considèrent cet usage comme courant dans leur entourage. Les plantes les plus recommandées étaient le fenugrec Trigonella foenum-graecum avec 142 réponses, suivi des écorces de grenade Punica granatum avec 139 réponses, puis de la menthe Mentha spicata / Mentha piperita avec 138 réponses. Les douleurs gastriques représentaient l'indication thérapeutique la plus citée, et les écorces de grenade apparaissent comme la plante la plus associée au traitement des douleurs de l'estomac, avec 52,5%. Cette étude souligne l'intérêt de documenter scientifiquement les savoirs traditionnels et de réaliser des études pharmacologiques et toxicologiques afin de confirmer l'efficacité et l'innocuité de ces plantes.

Mots-clés : plantes médicinales, troubles digestifs, ethnobotanique, fenugrec, écorces de grenade, médecine traditionnelle.

Abstract

This study aims to document the use of medicinal and aromatic plants in the treatment of digestive disorders and some disorders related to the liver, kidneys, and nervous system among the population of El Oued Province. The work combines a bibliographic section dealing with the botanical, chemical, therapeutic, and toxicological characteristics of several medicinal plants, and an ethnobotanical survey conducted among 200 participants.

The results showed that the use of medicinal plants remains widespread in the studied community. 85% of the respondents reported previous use of herbal treatment, while 90.5% considered medicinal plant use common in their community. The most recommended plants were fenugreek Trigonella foenum-graecum with 142 responses, followed by pomegranate peel Punica granatum with 139 responses, and mint Mentha spicata / Mentha piperita with 138 responses. Stomach pain was the most frequently reported treated condition, and pomegranate peel was the plant most associated with the treatment of stomach pain, reaching 52.5%. The study highlights the importance of scientific documentation of traditional knowledge and recommends further pharmacological and toxicological studies to confirm the efficacy and safety of these plants.

Keywords: medicinal plants, digestive disorders, ethnobotany, fenugreek, pomegranate peel, traditional medicine.

Summary

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INTRODUCTION

Introduction

Medicinal and aromatic plants have occupied an important place in traditional medicine since ancient times because of their therapeutic and preventive properties against numerous diseases. Their medicinal importance is related to the presence of bioactive compounds such as alkaloids, flavonoids, tannins, terpenoids, and essential oils, which possess antimicrobial, antioxidant, anti-inflammatory, and digestive activities (Bruneton, 1999; WHO, 2009). In many countries, especially developing regions, medicinal plants remain an accessible and affordable therapeutic alternative widely used by populations.

Digestive disorders represent one of the most common health problems worldwide. These disorders include gastritis, constipation, diarrhea, bloating, ulcers, nausea, and dyspepsia, which may negatively affect human health and quality of life (Tarrerias, 2010). The digestive system and the intestinal microbiota play a major role in digestion, nutrient absorption, immunity, and maintaining physiological balance (Landman & Quévrain, 2015). Consequently, there has been growing scientific interest in medicinal plants and probiotics as natural approaches for digestive therapy and microbiota regulation (Guérin-Danan, 2013; Marteau, 2012).

Several medicinal plants such as Nigella sativa, Mentha piperita, Thymus vulgaris, Artemisia absinthium, and Rosmarinus officinalis are traditionally used for the treatment of digestive disorders because of their pharmacological and therapeutic properties (Ahmad et al., 2013; Dauqan & Abdullah, 2017). In Algeria, ethnobotanical knowledge concerning medicinal plants constitutes an important cultural heritage transmitted from generation to generation (Abbassi et al., 2015; Samara & Ferouhat, 2021).

The objective of this work is to study medicinal and aromatic plants used in digestive therapy and to evaluate their therapeutic importance through bibliographic and ethnobotanical approaches.

This dissertation is divided into two main parts:

The first part concerns the bibliographic synthesis and is composed of two chapters. The first chapter presents an overview of medicinal and aromatic plants used in digestive therapy, including their botanical description, chemical composition, therapeutic uses, pharmacological activities, and toxicological aspects. The second chapter focuses on generalities about the digestive system, digestive disorders, and the intestinal microbiota, as well as their relationship with human health.

The second part is devoted to the experimental study. The first chapter describes the materials and methods used in the ethnobotanical survey, including the study area, study population, survey tools, and data collection process. The second chapter presents the obtained results and their discussion, focusing on the socio-demographic characteristics of the participants, the medicinal plants most commonly used, preparation methods, therapeutic benefits, perceived effectiveness and safety, and the transmission of traditional knowledge related to medicinal plants.

Finally, this work aims to contribute to the valorization of traditional medicinal knowledge and to encourage further scientific studies on medicinal plants and their applications in digestive therapy.

FIRST PART

Bibliographic synthesis

CHAPTER I

Overview of Medicinal Plants

Overview of Medicinal and Aromatic Plants

Medicinal and aromatic plants represent an important natural resource that has been used for centuries in traditional medicine, nutrition, cosmetics, and pharmaceutical industries. These plants contain various bioactive compounds such as alkaloids, flavonoids, tannins, terpenoids, glycosides, and essential oils, which are responsible for their therapeutic and biological activities (Abbassi et al., 2015). Because of their richness in secondary metabolites, medicinal plants are considered a major source of natural antioxidants, antimicrobial agents, and anti-inflammatory compounds used in the prevention and treatment of numerous diseases (Saadaoui et al., 2021).

Plants also play a fundamental role in maintaining ecological balance and supporting life on Earth. Through the process of photosynthesis, plants produce oxygen and organic matter necessary for the survival of humans and animals. In addition to their ecological importance, medicinal plants contribute significantly to healthcare systems and economic development, especially in developing countries where traditional herbal medicine remains widely practiced (Ali, 2001).

Several medicinal and aromatic species are commonly used in Algerian traditional medicine, including Trigonella foenum-graecum, Nigella sativa, Artemisia absinthium, Mentha piperita, Thymus vulgaris, and Salvia rosmarinus. These plants are known for their antioxidant, antimicrobial, digestive, and anti-inflammatory properties due to the presence of phenolic compounds and volatile oils (Samara & Ferouhat, 2021).

Scientific interest in medicinal plants has increased considerably in recent years because of advances in phytochemical and pharmacological research. Modern analytical techniques such as High-Performance Liquid Chromatography (HPLC), Gas Chromatography–Mass Spectrometry (GC-MS), Fourier Transform Infrared Spectroscopy (FTIR), and molecular docking are widely used to identify and characterize plant bioactive compounds (Khalil & Ben Sedira, 2024). These scientific investigations contribute to the discovery of new natural therapeutic agents and support the valorization of medicinal flora.

1. *Trigonella foenum-graecum* (Fenugreek)

• Scientific Name: *Trigonella foenum-graecum*

• Classification: Family: Fabaceae; Genus: Trigonella.

• Definition: An annual herb native to the Mediterranean region and Western Asia, widely known for its protein-rich seeds and medicinal properties (Basch et al., 2003; Wichtl & Anton, 2003).

• Therapeutic Uses: Primarily used for its hypoglycemic effects (lowering blood sugar), galactagogue properties (increasing breast milk production), and as an anti-inflammatory agent for digestive issues (Bnouham et al., 2006; Basch et al., 2003).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Rosids
Order:	Fabales
Family:	Fabaceae
Subfamily:	Faboideae
Genus:	*Trigonella*
Species:	***T. foenum-graecum***
Binomial name	
Trigonella foenum-graecum L. (GBIF, 2026).	

1.1 Botanical Description

An annual plant that can reach 60 cm in height and whose roots have nodules due to a symbiosis with nitrogen-fixing bacteria of the genus *Rhizobium*. The flowers are axillary,

solitary or in pairs, of the papilionaceous type, pale yellow to light purple, and triangular in shape (hence the name *trigonella*) (Eberharder et al., 2005; Wichtl & Anton, 2003).

Figure I.1: The fenugreek plant Trigonella foenum-graecum. (Rouag, F. 2022).

1.2 Development Stages of the Fenugreek Plant

According to Deutsch and Small (2001) and FAO (2004), the development stages of fenugreek seeds can be summarized as follows:

• Flowering: Towards the end of summer, the plant produces small, fragrant, pale yellow flowers, sometimes white or tinted.

• After flowering: The plant produces long pods containing 10 to 20 seeds, initially green or reddish, then pale or light brown when mature.

• Fresh: The seeds have a taste and smell reminiscent of celery.

• Maturation: Once ground, the seeds have a very characteristic flavor: sweet, but also spicy and slightly bitter (Deutsch & Small, 2001; FAO, 2004).

1.3 Forms of Use of Fenugreek

Fenugreek has multiple uses, both in cooking and in human and veterinary medicine. This legume is traditionally consumed in the form of dry powder, dry extract in capsules for herbal medicine, but also as a decoction, infusion, or juice (drinkable ampoules) (Volpé et al., 2009).

According to Catherine and Jean (2001); Tiran (2003); Ruby (2005); Kaviarasan (2007); and Jeans et al. (2009), the methods of using fenugreek are:

1.3.1 External Use

- It has antiseptic properties.
- It has a calming effect on the skin and mucous membranes, relieving skin irritations and reducing swelling and pain (Bruneton, 1999).

1.3.2 Internal Use

- Stimulates uterine contractions and lactation (most common use).
- Contributes to the control of glucose and cholesterol levels.
- Appetite stimulant.
- Fortifying agent for convalescents, anorexic, anemic, or depressed individuals.
- Adjunctive treatment for dysentery, dyspepsia, chronic cough, bronchitis, and osteoarthritis (Basch et al., 2003; Bnouham et al., 2006).

2. Lawsonia inermis (Henna)

2.1 Scientific Name

Lawsonia inermis L.

2.2 Classification

• Family: Lythraceae

• Genus: Lawsonia

2.3 Definition

Lawsonia inermis, commonly known as henna, is a perennial shrub native to North Africa, the Middle East, and South Asia. It is widely cultivated for its leaves, which contain a natural dye (lawsone) used for cosmetic, medicinal, and textile purposes (Singh et al., 2015; Chaudhary et al., 2010).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Rosids
Order:	Myrtales

Family:	Lythraceae
Subfamily:	Lythroideae
Genus:	*Lawsonia* L.
Species:	***L. inermis***
Binomial name	
Lawsonia inermis L.	
Synonyms	
• *Alcanna spinosa* (L.) Gaertn. • *Casearia multiflora* Spreng. • *Lawsonia alba* Lam. nom. illeg. • *Lawsonia speciosa* L. • *Lawsonia spinosa* L. • *Rotantha combretoides* Baker (GBIF, 2026).	

2.4 Botanical Description

Lawsonia inermis is a small shrub or tree that can reach up to 6 meters in height under favorable conditions. The plant has small opposite leaves, fragrant white or yellowish flowers arranged in large panicles, smooth bark, and a fruit in the form of a capsule containing numerous seeds. The plant thrives in semi-arid and arid climates, which explains its wide distribution in North Africa, including Algeria (Orwa et al., 2009; Singh et al., 2015).

Figure I.2: The *Lawsonia inermis* L. plant Henna (Kadri, S, 2019).

2.5 Chemical Composition

The leaves contain several bioactive compounds including lawsone (main pigment), flavonoids, tannins, phenolic acids, and coumarins (Singh et al., 2015; Ali et al., 2016).

2.6 Therapeutic and Traditional Uses

2.6.1 External Uses

• Natural dye for skin, hair, and nails
• Antifungal and antibacterial properties
• Treatment of eczema and minor wounds
• Cooling effect on skin inflammations (Ali et al., 2016)

2.6.2 Internal Uses

• Mild astringent properties
• Used for digestive disorders
• Used for fever reduction (Singh et al., 2015)

2.7 Pharmacological Activities

Scientific studies report antimicrobial, antioxidant, anti-inflammatory, and wound-healing activities (Ali et al., 2016; Singh et al., 2015).

2.8 Toxicology / Safety

Generally considered safe when used externally. However, allergic reactions may occur, and excessive ingestion is not recommended (Ali et al., 2016).

3. Nigella sativa (Black Seed)

3.1 Scientific Name

Nigella sativa L.

3.2 Classification

• Family: Ranunculaceae
• Genus: Nigella

3.3 Definition

Nigella sativa, commonly known as black seed or black cumin, is an annual flowering plant widely distributed in the Mediterranean region, North Africa (including Algeria), and West Asia. It is highly valued for its seeds with strong medicinal properties, used in traditional and modern phytotherapy (Ahmad et al., 2013; Ali & Blunden, 2003).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Order:	Ranunculales
Family:	Ranunculaceae
Genus:	*Nigella*
Species:	***N. sativa***
Binomial name	
Nigella sativa L.	
Synonyms	
• *Nigella cretica* Mill. • *Nigella indica* Roxb. • *Nigella truncata* Viv. (GBIF, 2026).	

3.4 Botanical Description

Nigella sativa is a small herbaceous annual plant reaching 20–60 cm in height. It is characterized by finely divided, thread-like leaves, pale blue to white flowers with 5–10 petals, a distinctive inflated seed capsule, and small black triangular seeds contained inside the capsule. The plant grows well in dry and semi-arid climates, which makes it suitable for cultivation in Algerian regions (Ahmad et al., 2013).

Figure I.3: Nigella sativa (whole plant, Flower and seeds). (Saidi, M. 2020).

3.5 Chemical Composition

The seeds contain a rich phytochemical profile including thymoquinone (main active compound), thymohydroquinone, nigellone, alkaloids (nigellidine, nigellicine), fixed oils (ω-6 and ω-9 fatty acids), saponins, and flavonoids (Ahmad et al., 2013; Bruneton, 1999).

3.6 Therapeutic Uses

3.6.1 Traditional Uses

• Treatment of respiratory disorders (asthma, cough)

• Digestive stimulant and carminative

• Immune system booster

• Used in traditional Algerian herbal medicine for colds and fatigue (Ali & Blunden, 2003)

3.6.2 Internal Uses

• Anti-diabetic effects (regulation of blood glucose)

• Hepatoprotective action

• Antihypertensive support

• Anti-inflammatory effects in chronic diseases (Ahmad et al., 2013)

3.6.3 External Uses

• Treatment of skin infections and eczema

• Application in oils for wound healing

• Antibacterial skin care preparations (Ali & Blunden, 2003)

3.7 Pharmacological Activities

Scientific research confirms that Nigella sativa exhibits strong antioxidant activity, antimicrobial effects against bacteria, fungi, and parasites, anti-inflammatory properties, immunomodulatory effects, and potential anticancer activity under laboratory studies (Ahmad et al., 2013; Ali & Blunden, 2003).

3.8 Toxicology and Safety

Nigella sativa is generally safe when used in moderate doses. However, high doses may cause gastric irritation, and caution is advised during pregnancy in high concentrations. The essential oil must be diluted before external application (WHO, 2013).

4. Cuminum cyminum (Cumin)

4.1. Scientific Name

Cuminum cyminum L.

4.2. Classification

• Family: Apiaceae (Umbelliferae)

• Genus: Cuminum

4.3. Definition

Cuminum cyminum, commonly known as cumin, is an annual herb widely cultivated in Mediterranean countries, North Africa (including Algeria), India, and the Middle East. It is mainly valued for its aromatic seeds used as a spice and medicinal agent (Duke, 2002; Bettaieb et al., 2011).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids

Order:	Apiales
Family:	Apiaceae
Genus:	*Cuminum*
Species:	***C. cyminum***
Binomial name	
Cuminum cyminum L. (GBIF, 2026).	

4.4. Botanical Description

Cumin is a small annual herbaceous plant reaching 20–50 cm in height. It is characterized by slender, branched stems, fine thread-like dissected leaves, small white or pink flowers arranged in compound umbels (typical of Apiaceae family), and fruit that is an elongated schizocarp containing two aromatic seeds. The plant prefers warm, dry climates and is well adapted to semi-arid regions such as Algeria (Orwa et al., 2009; Bettaieb et al., 2011).

Figure I.4: Cuminum cyminum (Zitouni, H. 2018).

4.5. Chemical Composition

Cumin seeds contain a rich essential oil and bioactive compounds including cuminaldehyde (major volatile compound), γ-terpinene, p-cymene, β-pinene, flavonoids, phenolic acids, proteins, dietary fiber, and minerals such as iron, manganese, and calcium (Duke, 2002; Bettaieb et al., 2011).

4.6. Therapeutic Uses

4.6.1 Traditional Uses

• Widely used in Algerian and Mediterranean traditional medicine

• Treatment of digestive disorders (bloating, indigestion)

• Appetite stimulant

• Relief of colic and intestinal spasms (Bnouham et al., 2006)

4.6.2 Internal Uses

• Carminative and digestive aid

• Hypoglycemic potential (blood sugar regulation)

• Lipid-lowering effects (cholesterol reduction)

• Mild sedative and antispasmodic effects (Bnouham et al., 2006; Duke, 2002)

4.6.3 External Uses

• Used in poultices for skin inflammation

• Essential oil applied (diluted) for antimicrobial purposes (Bettaieb et al., 2011)

4.7. Pharmacological Activities

Scientific studies have shown that Cuminum cyminum exhibits antioxidant activity due to phenolic compounds, antimicrobial effects against bacteria and fungi, anti-inflammatory properties, gastroprotective effects, antidiabetic potential, and hypolipidemic effects (Bettaieb et al., 2011; Bnouham et al., 2006).

4.8. Toxicology and Safety

• Generally safe when used as food spice

• Excessive use of essential oil may cause irritation

• No significant toxicity reported at culinary doses (Duke, 2002)

5. Carum carvi (Caraway)

5.1. Scientific Name

Carum carvi L.

5.2. Classification

• Family: Apiaceae (Umbelliferae)

• Genus: Carum

5.3. Definition

Carum carvi, commonly known as caraway, is a biennial aromatic plant widely distributed in Europe, North Africa, and Western Asia. It is mainly cultivated for its fruits

(seeds), which are used as a spice and in traditional medicine, especially for digestive disorders (Evans, 2009; Bruneton, 1999).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Apiales
Family:	Apiaceae
Genus:	*Carum*
Species:	***C. carvi***
Binomial name	
Carum carvi (GBIF, 2026).	

5.4. Botanical Description

Caraway is a biennial herbaceous plant that can reach 30–80 cm in height. It is characterized by slender, grooved and branched stems, finely divided feathery leaves, small white flowers arranged in compound umbels, and crescent-shaped aromatic fruits (seeds) with a strong spicy odor (Evans, 2009).

Figure I.5: Carum carvi (Caraway) (Singh, N. 2018)

5.5. Chemical Composition

Caraway seeds contain an essential oil rich in carvone (major component), limonene, carveol, flavonoids, phenolic acids, proteins, fatty acids, and dietary fiber (Bruneton, 1999; Evans, 2009).

5.6. Therapeutic Uses

5.6.1 Traditional Uses

• Widely used in traditional Algerian and European herbal medicine
• Treatment of digestive disorders (gas, bloating, colic)
• Relief of intestinal spasms
• Appetite stimulant (Evans, 2009)

5.6.2 Internal Uses

• Carminative (reduces intestinal gas)
• Antispasmodic (relaxes smooth muscles)
• Mild antimicrobial effect in the digestive system
• Supports digestion after heavy meals (Bruneton, 1999)

5.6.3 External Uses

• Essential oil used (diluted) for abdominal massage
• Aromatherapy for relaxation (Evans, 2009)

5.7. Pharmacological Activities

Scientific studies have demonstrated that Carum carvi exhibits strong carminative activity, antioxidant properties, antimicrobial effects, antispasmodic action, and potential gastroprotective effects (Bruneton, 1999; Evans, 2009).

5.8. Toxicology and Safety

• Generally safe when used in food quantities
• Essential oil should be used with caution
• No significant toxicity reported in normal doses (Evans, 2009)

6. Mentha spicata / Mentha piperita (Mint species)

6.1. Scientific Name

• Mentha spicata L.
• Mentha × piperita L.

6.2. Classification

• Family: Lamiaceae

• Genus: Mentha

6.3. Definition

The genus Mentha includes aromatic perennial herbs widely distributed in temperate regions and cultivated in North Africa, including Algeria. These plants are highly valued for their essential oils rich in menthol and carvone, used in food, pharmaceuticals, and traditional medicine (Evans, 2009; WHO, 2013).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Lamiaceae
Subfamily:	Nepetoideae
Tribe:	Mentheae
Genus:	*Mentha* L.
Type species	
Mentha spicata (GBIF, 2026).	

6.4. Botanical Description

Mentha spicata is a perennial herb reaching 30–90 cm with lanceolate serrated leaves and purple to pink flowers arranged in terminal spikes. Mentha piperita is a hybrid species with a stronger aroma due to high menthol content, dark green leaves, and purple flowers. Both species grow well in humid soils and semi-shaded environments (Bruneton, 1999; Evans, 2009).

Figure I.6 : Mentha spicata / Mentha piperita**. (**Köhler, F. E. 1887**).**

6.5. Chemical Composition

Mentha spicata contains carvone, limonene, menthone, flavonoids, and rosmarinic acid, while Mentha piperita contains menthol, menthone, menthyl acetate, flavonoids, and phenolic acids (Evans, 2009; Bruneton, 1999).

6.6. Therapeutic Uses

6.6.1 Traditional Uses

• Widely used in Algerian herbal medicine
• Treatment of digestive disorders (bloating, nausea)
• Relief of headaches and colds
• Used as refreshing tea (WHO, 2013)

6.6.2 Internal Uses

• Carminative and digestive
• Antispasmodic effect
• Mild sedative effect
• Relief of irritable bowel syndrome symptoms (Evans, 2009)

6.6.3 External Uses

• Essential oil used in aromatherapy
• Relief of muscular pain
• Nasal decongestant
• Cooling effect on skin inflammations (WHO, 2013)

6.7. Pharmacological Activities

Scientific studies report antioxidant, antimicrobial, analgesic, antispasmodic, gastroprotective, and anti-inflammatory effects (Evans, 2009; WHO, 2013).

6.8. Toxicology and Safety

• Safe in food and tea forms
• Essential oil must be diluted
• High doses may cause irritation
• Not recommended in excessive amounts for infants (WHO, 2013)

7. Mentha pulegium (Pennyroyal)

7.1. Scientific Name

Mentha pulegium L.

7.2. Classification

• Family: Lamiaceae
• Genus: Mentha

7.3. Definition

Mentha pulegium, commonly known as pennyroyal, is an aromatic perennial herb widely distributed in the Mediterranean basin, including Algeria. It is traditionally used in folk medicine for its digestive, antispasmodic, and antimicrobial properties, mainly in the form of herbal infusions (EMA, 2010; Bruneton, 1999).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales

Family:	Lamiaceae
Genus:	*Mentha*
Species:	***M. pulegium***
Binomial name	
Mentha pulegium (GBIF, 2026).	

7.4. Botanical Description

Mentha pulegium is a low-growing perennial plant reaching 10–40 cm in height. It has creeping or erect stems that root at nodes, small oval to lanceolate leaves with a strong mint-like odor, purple to lilac small flowers arranged in dense whorls, and a strong aromatic smell due to high essential oil content. It grows naturally in humid soils, riverbanks, and wet meadows in Mediterranean regions (EMA, 2010).

Figure I.7 : Mentha pulegium (Bouzidi, A. 2022).

7.5. Chemical Composition

The essential oil contains pulegone (major toxic/active compound), menthone, isomenthone, piperitenone, flavonoids, tannins, and phenolic acids (Bruneton, 1999; EMA, 2010).

7.6. Therapeutic Uses

7.6.1 Traditional Uses

• Used in Algerian traditional medicine as infusion for digestive disorders
• Treatment of colic and intestinal gas
• Used as menstrual regulator in folk medicine
• Relief of cold and respiratory congestion (EMA, 2010)

7.6.2 Internal Uses (restricted)

• Carminative effect
• Mild antispasmodic action
• Appetite stimulant in small doses (WHO, 2013)

7.6.3 External Uses

• Antiseptic washes for skin infections
• Insect repellent
• Aromatic baths for relaxation (EMA, 2010)

7.7. Pharmacological Activities

Scientific studies show antimicrobial, insecticidal, antioxidant, antispasmodic, and uterine stimulant effects linked to pulegone content (Bruneton, 1999; EMA, 2010).

7.8. Toxicology and Safety

Mentha pulegium is toxic in high doses due to pulegone. High intake may cause liver toxicity and neurological effects. Essential oil is not safe for internal use in high concentration and is contraindicated during pregnancy (EMA, 2010; WHO, 2013).

8. Marrubium vulgare (White Horehound)

8.1. Scientific Name

Marrubium vulgare L.

8.2. Classification

• Family: Lamiaceae

• Genus: Marrubium

8.3. Definition

Marrubium vulgare, commonly known as white horehound, is a perennial medicinal herb widely distributed in the Mediterranean basin, including Algeria. It is traditionally used in herbal medicine, especially for respiratory and digestive disorders due to its bitter compounds and bioactive metabolites (ESCOP, 2012; Bruneton, 1999).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Lamiaceae
Genus:	*Marrubium*
Species:	***M. vulgare***
Binomial name	
Marrubium vulgare (GBIF, 2026).	

8.4. Botanical Description

Marrubium vulgare is a perennial herb reaching 30–80 cm in height. It has square woody stems, opposite oval leaves covered with dense white woolly hairs, small white flowers grouped in dense axillary whorls, and a strong bitter taste with aromatic odor. It grows in dry, sunny, and disturbed soils in Mediterranean environments (ESCOP, 2012).

Figure I.8: Marrubium vulgare (Aissaoui, R. 2020).

8.5. Chemical Composition

The plant contains marrubiin (major diterpenoid compound), volatile oils, flavonoids, phenolic acids, tannins, and iridoids (Bruneton, 1999; ESCOP, 2012).

8.6. Therapeutic Uses

8.6.1 Traditional Uses

• Used in Algerian folk medicine as decoction or infusion
• Treatment of cough, bronchitis, and asthma
• Relief of digestive disorders
• Used as bitter tonic (ESCOP, 2012)

8.6.2 Internal Uses

• Expectorant
• Antispasmodic effect on respiratory tract
• Digestive stimulant
• Mild hypoglycemic potential (Bruneton, 1999)

8.6.3 External Uses

• Poultices for skin inflammation
• Wound cleansing preparations (ESCOP, 2012)

8.7. Pharmacological Activities

Scientific studies show expectorant, anti-inflammatory, antioxidant, antimicrobial, and gastroprotective effects (Bruneton, 1999; ESCOP, 2012).

8.8. Toxicology and Safety

Generally safe in traditional doses. Very high doses may cause gastrointestinal irritation due to bitterness. No major toxicity reported in normal herbal use (ESCOP, 2012).

9. Artemisia absinthium (Wormwood)

9.1. Scientific Name

Artemisia absinthium L.

9.2. Classification

• Family: Asteraceae (Compositae)
• Genus: Artemisia

9.3. Definition

Artemisia absinthium, commonly known as wormwood, is a perennial aromatic medicinal plant widely distributed in Europe, North Africa, and Asia. In Algeria, it is used in traditional medicine for its bitter taste and digestive, antiparasitic, and antimicrobial properties (WHO, 2009; Bruneton, 1999).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Asterales

Family:	Asteraceae
Genus:	*Artemisia*
Species:	***A. absinthium***
Binomial name	
Artemisia absinthium (GBIF, 2026).	

9.4. Botanical Description

It is a perennial herb or subshrub reaching 30–120 cm in height, with woody base and erect stems, gray-green leaves covered with silky hairs, strong aromatic bitter odor, and small yellow tubular flowers arranged in spherical capitula. It grows in dry, rocky, and semi-arid soils (WHO, 2009).

Figure I.9: Artemisia absinthium (Wormwood) (Belhadi, A. 2019).

9.5. Chemical Composition

Contains thujone (α- and β-thujone), absinthin, anabsinthin, flavonoids, phenolic acids, and essential oils such as cineole and camphor (Bruneton, 1999; WHO, 2009).

9.6. Therapeutic Uses

9.6.1 Traditional Uses

• Used in Algerian herbal medicine as infusion or decoction
• Treatment of digestive disorders

• Antiparasitic use

• Liver and gallbladder support (WHO, 2009)

9.6.2 Internal Uses

• Strong digestive stimulant

• Antispasmodic

• Traditional anthelmintic use

• Mild antimicrobial effects (Bruneton, 1999)

9.6.3 External Uses

• Poultices for skin infections

• Insect repellent

• Traditional cleansing applications (WHO, 2009)

9.7. Pharmacological Activities

Antiparasitic, antimicrobial, antioxidant, hepatoprotective, and appetite-stimulating effects have been reported (Bruneton, 1999; WHO, 2009).

9.8. Toxicology and Safety

Contains thujone which may be neurotoxic in high doses. Excessive intake may cause neurological effects. Essential oil is not safe for internal use without control (WHO, 2009).

10. Origanum majorana (Marjoram)

10.1. Scientific Name

Origanum majorana L.

10.2. Classification

• Family: Lamiaceae

• Genus: Origanum

10.3. Definition

Origanum majorana, commonly known as marjoram, is an aromatic perennial herb widely cultivated in the Mediterranean region, including North Africa. It is valued for its essential oils and medicinal properties, especially in digestive, respiratory, and nervous system disorders (Baser, 2008; WHO, 2013).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Lamiaceae
Genus:	*Origanum*
Species:	***O. majorana***
Binomial name	
Origanum majorana (GBIF, 2026).	

10.4. Botanical Description

Origanum majorana is a perennial herbaceous plant reaching 30–60 cm in height. It has erect branched stems, small oval gray-green leaves covered with fine hairs, small white to pink flowers grouped in compact clusters, and a pleasant aromatic fragrance. The plant prefers warm climates and well-drained soils typical of Mediterranean environments (Baser, 2008).

Figure I.10: Origanum majorana (Laaraj, K. 2022).

10.5. Chemical Composition

Marjoram contains essential oils such as terpinen-4-ol, sabinene hydrate, γ-terpinene, thymol (in small amounts), carvacrol, flavonoids, rosmarinic acid, and tannins (Baser, 2008; WHO, 2013).

10.6. Therapeutic Uses

10.6.1 Traditional Uses

• Used in Algerian traditional medicine as infusion
• Treatment of digestive problems
• Relief of anxiety and nervous tension
• Respiratory support (WHO, 2013)

10.6.2 Internal Uses

• Antispasmodic effect
• Mild sedative
• Digestive stimulant
• Helps regulate menstrual cycles (Baser, 2008)

10.6.3 External Uses

• Essential oil used in massage
• Antiseptic applications
• Aromatherapy for relaxation (WHO, 2013)

10.7. Pharmacological Activities

Scientific studies show antioxidant, antimicrobial, anti-inflammatory, sedative, and antispasmodic activities (Baser, 2008; WHO, 2013).

10.8. Toxicology and Safety

Generally safe in food and infusion forms. Essential oil must be diluted. Excessive use may cause mild irritation (WHO, 2013).

11. Solanum nigrum (Black Nightshade)

11.1. Scientific Name

Solanum nigrum L.

11.2. Classification

• Family: Solanaceae
• Genus: Solanum

11.3. Definition

Solanum nigrum, commonly known as black nightshade, is an annual or short-lived perennial herb widely distributed in temperate and tropical regions, including Algeria. It is known for its dual nature as a medicinal plant and potentially toxic species depending on dosage and plant part used (Edmonds & Chweya, 1997; WHO, 2013).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Solanales
Family:	Solanaceae
Genus:	*Solanum*
Species:	***S. nigrum***
Binomial name	
Solanum nigrum (GBIF, 2026).	

11.4. Botanical Description

Solanum nigrum is a herbaceous plant reaching 30–80 cm in height. It has erect branched stems, oval to lanceolate leaves with slightly wavy margins, small white star-shaped flowers with yellow stamens, and small round berries that turn black when ripe. It grows in disturbed soils and agricultural fields (Edmonds & Chweya, 1997).

Figure I.11: Solanum nigrum (Kassim, S. 2018).

11.5. Chemical Composition

Contains glycoalkaloids (solanine, solamargine, solasonine), saponins, flavonoids, tannins, vitamin C (in ripe fruits), and phenolic compounds (Edmonds & Chweya, 1997; WHO, 2013).

11.6. Therapeutic Uses

11.6.1 Traditional Uses

• Used in controlled traditional medicine
• Treatment of skin diseases
• Liver disorders
• Wounds and ulcers (WHO, 2013)

11.6.2 Internal Uses (caution)

• Anti-inflammatory effects
• Hepatoprotective potential
• Mild analgesic properties
• Gastric ulcer support (Edmonds & Chweya, 1997)

11.6.3 External Uses

• Poultices for skin infections
• Treatment of burns and wounds
• Anti-inflammatory skin applications (WHO, 2013)

11.7. Pharmacological Activities

Scientific studies report antioxidant, anti-inflammatory, hepatoprotective, antimicrobial, and anticancer potential (in vitro) (Edmonds & Chweya, 1997; WHO, 2013).

11.8. Toxicology and Safety

Unripe fruits and leaves contain toxic glycoalkaloids. Toxicity may cause nausea, vomiting, and neurological effects. Only ripe fruits are less toxic in small amounts. Use must be strictly controlled (WHO, 2013).

12. Thymus vulgaris (Thyme)

12.1. Scientific Name

Thymus vulgaris L.

12.2. Classification

• Family: Lamiaceae
• Genus: Thymus

12.3. Definition

Thymus vulgaris, commonly known as thyme, is a perennial aromatic plant widely distributed in the Mediterranean region, including Algeria. It is highly valued for its essential oils rich in thymol and carvacrol, giving it strong antimicrobial and antioxidant properties (Baser, 2008; WHO, 2013).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Lamiaceae
Genus:	*Thymus*
Species:	***T. vulgaris***
Binomial name	
Thymus vulgaris (GBIF, 2026).	

12.4. Botanical Description

Thymus vulgaris is a small perennial shrub reaching 20–40 cm in height. It has woody branching stems, small narrow gray-green leaves covered with fine hairs, strong aromatic fragrance, and small pink to purple flowers arranged in clusters. It grows in dry rocky soils and sunny environments (Baser, 2008).

Figure I.12 : Thymus vulgaris L (Dauqan, E. M. A., & Abdullah, A. 2017).

12.5. Chemical Composition

Contains thymol, carvacrol, p-cymene, γ-terpinene, flavonoids, rosmarinic acid, and tannins (Baser, 2008; WHO, 2013).

12.6. Therapeutic Uses

12.6.1 Traditional Uses

• Used in Algerian herbal medicine as infusion
• Treatment of respiratory infections
• Digestive stimulant
• Immune system support (WHO, 2013)

12.6.2 Internal Uses

• Antiseptic for respiratory tract
• Expectorant
• Antispasmodic
• Antimicrobial (Baser, 2008)

12.6.3 External Uses

• Antiseptic for wounds
• Mouthwash
• Aromatherapy inhalation (WHO, 2013)

12.7. Pharmacological Activities

Strong antimicrobial, antioxidant, anti-inflammatory, antifungal, and expectorant effects are reported (Baser, 2008; WHO, 2013).

12.8. Toxicology and Safety

Safe in food and infusion forms. Essential oil must be diluted. High doses of thymol may cause irritation (WHO, 2013).

13. Thymus capitatus / Thymus algeriensis (Wild Thyme)

13.1. Scientific Name

• Thymus capitatus (L.) Hoffmanns. & Link
• Thymus algeriensis Boiss. & Reut.

13.2. Classification

• Family: Lamiaceae
• Genus: Thymus

13.3. Definition

Thymus capitatus and Thymus algeriensis are wild thyme species native to the Mediterranean region, particularly abundant in Algeria. They are widely used in traditional medicine due to their high essential oil content with antimicrobial and antioxidant properties (Miguel, 2010; WHO, 2013).

Thymus algeriensis	
Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots

Clade:	Asterids
Order:	Lamiales
Family:	Lamiaceae
Genus:	*Thymus*
Species:	***T. algeriensis***
Binomial name	
Thymus algeriensis Boiss. & Reut.	
Synonyms	
• *Thymus tunetanus* Pomel • *Thymus zattarellus* Pomel	

13.4. Botanical Description

Thymus capitatus is a perennial shrub with woody stems, small narrow aromatic leaves, and pink to purple flowers in dense rounded heads. Thymus algeriensis is a smaller shrub adapted to arid environments with strong aromatic smell. Both grow in rocky dry soils (Miguel, 2010).

Figure I.13: Thymus algeriensis (Mansouri, S. 2021).

13.5. Chemical Composition

Rich in essential oils including carvacrol, thymol, p-cymene, γ-terpinene, flavonoids, and phenolic acids (Miguel, 2010; WHO, 2013).

13.6. Therapeutic Uses

Traditional use includes treatment of respiratory infections, digestive disorders, and antiseptic applications. Internal use includes expectorant and antispasmodic effects. External use includes wound antiseptic and pain relief (Miguel, 2010).

13.7. Pharmacological Activities

Strong antimicrobial, antioxidant, anti-inflammatory, and antifungal activities are reported (WHO, 2013).

13.8. Toxicology and Safety

Generally safe in infusion form. Essential oils must be diluted due to high phenolic content (WHO, 2013).

14. Rosmarinus officinalis (Salvia rosmarinus) (Rosemary)

14.1. Scientific Name

- **Salvia rosmarinus Spenn.** (updated name)
- Synonym: **Rosmarinus officinalis L.**

14.2. Classification

- Family: Lamiaceae
- Genus: Salvia (formerly Rosmarinus)

14.3. Definition

Rosmarinus officinalis, commonly known as **rosemary**, is a perennial aromatic shrub native to the Mediterranean region, including Algeria. It is widely used for its **essential oils and medicinal properties**, especially in digestive, neurological, and circulatory disorders. (Baser, 2008).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales

Family:	Lamiaceae
Genus:	*Salvia*
Species:	***S. rosmarinus***
Binomial name	
Salvia rosmarinus Spenn (GBIF, 2026).	

14.4. Botanical Description

Rosemary is a **woody perennial shrub** that can reach 50–150 cm in height. It is characterized by:

- Erect, highly branched stems
- Narrow, needle-like leaves (dark green above, whitish below)
- Strong aromatic odor
- Small blue, violet, or pale flowers

It grows naturally in **dry, rocky, and sunny Mediterranean environments**. (Baser, 2008).

Figure I.14: Salvia Rosmarinus (Halimi, N. 2020).

14.5. Chemical Composition

Rosemary contains a rich variety of bioactive compounds:

- Essential oils (1,8-cineole, camphor, α-pinene)
- Rosmarinic acid
- Carnosic acid
- Carnosol
- Flavonoids
- Phenolic diterpenes

14.6. Therapeutic Uses

14.6.1 Traditional Uses

- Widely used in Algerian herbal medicine
- Treatment of digestive disorders (indigestion, bloating)
- Used to improve memory and concentration
- Relief of fatigue and weakness

14.6.2 Internal Uses

- Digestive stimulant and carminative
- Hepatoprotective (supports liver function)
- Circulatory stimulant
- Mild cognitive enhancer (memory support)

14.6.3 External Uses

- Used in massage oils for muscle and joint pain
- Hair care (stimulates hair growth)
- Antiseptic applications for wounds
- Aromatherapy for mental stimulation (WHO, 2013).

14.7. Pharmacological Activities

Scientific studies have shown that rosemary exhibits:

- **Strong antioxidant activity** (carnosic acid, rosmarinic acid)
- **Antimicrobial effects**
- **Anti-inflammatory properties**
- **Neuroprotective effects** (memory and cognition)
- **Hepatoprotective activity**
- **Anticancer potential** (experimental studies)

14.8. Toxicology and Safety

- Safe in culinary and infusion forms
- Essential oil must be used diluted
- High doses may cause irritation or neurological effects
- Avoid excessive use during pregnancy (Baser, 2008).

15. Punica granatum (Pomegranate)

15.1. Scientific Name

Punica granatum L.

15.2. Classification

- Family: Lythraceae
- Genus: Punica

15.3. Definition

Punica granatum, commonly known as **pomegranate**, is a fruit-bearing shrub or small tree native to the Mediterranean region and widely cultivated in Algeria. It is highly valued for its **nutritional, medicinal, and antioxidant properties**, especially due to its rich content of polyphenols. (Viuda-Martos et al., 2010).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Rosids
Order:	Myrtales
Family:	Lythraceae
Genus:	*Punica*
Species:	***P. granatum***
Binomial name	
Punica granatum L. (GBIF, 2026).	

15.4. Botanical Description

Pomegranate is a **deciduous shrub or small tree** that can reach 2–5 meters in height. It is characterized by:

- Multiple branched stems, often with spines
- Glossy, narrow leaves arranged oppositely
- Bright red-orange flowers

- Round fruit with a thick rind containing numerous seeds surrounded by juicy arils

It thrives in **semi-arid and Mediterranean climates**. (Viuda-Martos et al., 2010).

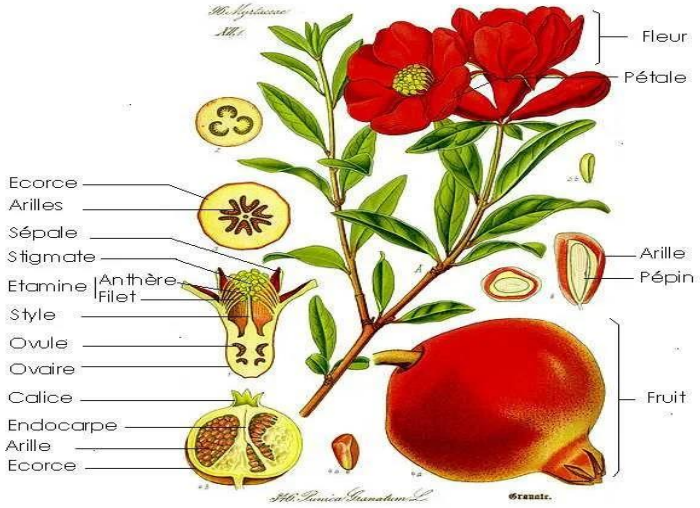

Figure I.15: Punica granatum (Hammadi, N. 2021).

15.5. Chemical Composition

Different parts of the plant contain bioactive compounds: (Viuda-Martos et al., 2010).

Fruits

- Polyphenols (ellagic acid, punicalagins)
- Flavonoids
- Anthocyanins
- Vitamin C

Peel (pericarp)

- High content of tannins
- Strong antioxidant compounds

Seeds

- Fatty acids (punicic acid)
- Phytosterols

15.6. Therapeutic Uses

15.6.1 Traditional Uses

- Widely used in Algerian traditional medicine
- Treatment of digestive disorders (diarrhea, dysentery)
- Used for cardiovascular health
- Strengthening the immune system

15.6.2 Internal Uses

- Powerful antioxidant
- Cardioprotective (reduces cholesterol and blood pressure)
- Anti-inflammatory effects
- Antidiabetic potential
- Supports digestive health

15.6.3 External Uses

- Peel extracts used for wound healing
- Antimicrobial applications for skin infections
- Oral hygiene (gargles for gum infections) (Viuda-Martos et al., 2010).

15.7. Pharmacological Activities

Scientific studies have shown that Punica granatum exhibits:

- **Strong antioxidant activity** (polyphenols)
- **Antimicrobial effects** (bacteria and fungi)
- **Anti-inflammatory properties**
- **Cardioprotective effects**
- **Anticancer potential** (in vitro and in vivo studies)
- **Bone health support** (stimulation of osteoblast activity and inhibition of osteoclasts)

15.8. Toxicology and Safety

- Generally safe when consumed as fruit or juice
- Peel extracts should be used in controlled doses
- No significant toxicity in normal dietary use
- Excessive intake of concentrated extracts may cause digestive discomfort (Seeram et al., 2006).

16. Citrus sinensis (Orange)

16.1. Scientific Name

Citrus sinensis (L.) Osbeck

16.2. Classification

- Family: Rutaceae
- Genus: Citrus

16.3. Definition

• Citrus sinensis, commonly known as **sweet orange**, is a fruit tree widely cultivated in Mediterranean regions, including Algeria. It is highly valued for its **nutritional richness, especially vitamin C**, and for its medicinal, antioxidant, and industrial uses.) (Duarte et al., 2016).

Classification Tropicos	
Règne	*Plantae*
Classe	*Magnoliopsida*
Sous-classe	*Magnoliidae*
Super-ordre	*Rosanae*
Ordre	*Sapindales*
Famille	*Rutaceae*
Genre	*Citrus*

Espèce

***Citrus sinensis* (L.)** (GBIF, 2026).

16.4. Botanical Description

Citrus sinensis is an **evergreen tree** that can reach 5–10 meters in height. It is characterized by:

- Dense, rounded canopy
- Glossy, dark green leaves with aromatic oil glands
- White fragrant flowers (orange blossoms)
- Round fruit with orange-colored peel and juicy pulp
- It grows best in **warm, subtropical to Mediterranean climates**.) (Duarte et al., 2016).

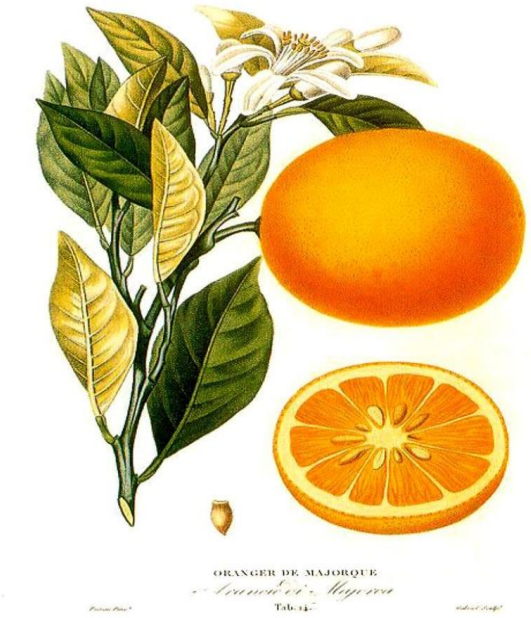

Figure I.16: Citrus sinensis (Conti F., Abbate G., Alessandrini A., Blasi C., 2005)

16.5. Chemical Composition

Fruit (Juice and Pulp)

- Vitamin C (ascorbic acid)
- Flavonoids (hesperidin, naringin)
- Sugars (glucose, fructose, sucrose)
- Organic acids (citric acid)

Peel

- Essential oils (limonene as major compound)
- Pectin
- Polyphenols) (Duarte et al., 2016).

16.6. Therapeutic Uses

16.6.1 Traditional Uses

- Widely consumed fresh or as juice in Algeria
- Used to boost immunity
- Treatment of fatigue and colds
- Digestive aid

16.6.2 Internal Uses

- Strengthens the immune system (vitamin C)
- Antioxidant protection

- Improves digestion
- Supports cardiovascular health
- Helps prevent vitamin deficiencies (e.g., scurvy)

16.6.3 External Uses

- Essential oil used in cosmetics and aromatherapy
- Skin care (brightening and antioxidant effect)
- Peel extracts used in topical preparations

16.7. Pharmacological Activities

Scientific studies indicate that Citrus sinensis exhibits:

- **Strong antioxidant activity**
- **Anti-inflammatory effects**
- **Antimicrobial properties**
- **Cardioprotective effects**
- **Anti-cancer potential** (due to flavonoids)
- **Neuroprotective activity** (in some studies) (Duarte et al., 2016).

16.8. Toxicology and Safety

- Safe when consumed as food
- Excessive consumption may cause gastric acidity in sensitive individuals
- Essential oil should be used diluted
- Possible photosensitivity with peel oil (limonene derivatives) (WHO, 2013).

17. Juniperus communis (Juniper)

17. 1. Scientific Name

Juniperus communis L.

17. 2. Classification

- Family: Cupressaceae
- Genus: Juniperus

17. 3. Definition

Juniperus communis, commonly known as **juniper**, is an evergreen coniferous shrub or small tree widely distributed in Europe, North Africa, and parts of Asia. In Algeria, it is found in mountainous and semi-arid regions and is valued for its **medicinal berries and essential oils** used in traditional and modern phytotherapy. (EMA, 2012).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Gymnospermae
Division:	Pinophyta
Class:	Pinopsida
Order:	Cupressales
Family:	Cupressaceae
Genus:	*Juniperus*
Section:	*Juniperus* sect. *Juniperus*
Subsection:	*Juniperus* subsect. *Juniperus*
Species:	***J. communis***
Binomial name	
Juniperus communis (GBIF, 2026).	

17. 4. Botanical Description

Juniperus communis is a **coniferous shrub or small tree** that can reach 1–10 meters in height. It is characterized by:

- Needle-like, sharp leaves arranged in whorls
- Evergreen foliage
- Small yellow male cones and green female cones
- Berry-like cones (juniper berries) that turn **blue-black when mature**

The plant grows in **rocky, dry, and mountainous soils**, adapting well to harsh climates. (EMA, 2012).

Figure I.17: Juniperus communis (Tahiri, A. 2020).

17. 5. Chemical Composition

Juniper berries contain various bioactive compounds :

- Essential oils (α-pinene, β-pinene, limonene, myrcene)
- Terpenoids
- Flavonoids
- Tannins
- Sugars
- Organic acids (EMA, 2012).

17. 6. Therapeutic Uses

17. 6.1 Traditional Uses

- Used in Algerian traditional medicine as **infusion or decoction**
- Treatment of urinary tract disorders
- Digestive aid for bloating and indigestion
- Used as antiseptic and detoxifying agent

17. 6.2 Internal Uses

- Diuretic (promotes urine production)
- Antiseptic for urinary tract
- Digestive stimulant and carminative

- Anti-inflammatory effects

17. 6.3 External Uses

- Essential oil used in massage for joint and muscle pain
- Antiseptic for skin infections

Aromatherapy applications (EMA, 2012).

17. 7. Pharmacological Activities

Scientific studies show that Juniperus communis exhibits: (WHO, 2013).

- **Antimicrobial activity**
- **Antioxidant properties**
- **Anti-inflammatory effects**
- **Diuretic activity**
- Potential **antidiabetic effects**
- Mild **analgesic properties**

17. 8. Toxicology and Safety

- Generally safe in moderate doses
- Excessive use may cause **kidney irritation**
- Not recommended during pregnancy
- Long-term use should be avoided without supervision (EMA, 2012).

18. Daucus carota (Carrot)

18. 1. Scientific Name

Daucus carota L.

18. 2. Classification

- Family: Apiaceae (Umbelliferae)
- Genus: Daucus

18. 3. Definition

Daucus carota, commonly known as **carrot**, is a biennial herb widely cultivated around the world, including Algeria. It is primarily valued as a **nutritional root vegetable**, rich in vitamins and bioactive compounds, with important medicinal and health-promoting properties. (Rubatzky et al., 1999).

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Apiales
Family:	Apiaceae
Subfamily:	Apioideae
Tribe:	Scandiceae
Subtribe:	Daucinae
Genus:	*Daucus* L. (1753)
Species	
See text	
Synonyms (GBIF, 2026).	

18. 4. Botanical Description

Daucus carota is a **biennial herbaceous plant** that completes its life cycle in two years:

- First year: develops a thick, fleshy **taproot** (the edible carrot)
- Second year: produces a flowering stem reaching up to 1 meter

Characteristics:

- Finely divided, feathery leaves
- White flowers arranged in **compound umbels**
- Small dry fruits (seeds)
- Root color varies (commonly orange due to carotenoids)

It grows best in **temperate climates with well-drained soils**. (Rubatzky et al., 1999).

Figure I.18: Daucus carota. (Quezel, P., & Santa, S. 1962)

18. 5. Chemical Composition

Root

- β-carotene (provitamin A)
- Vitamins (A, C, K, B-complex)
- Dietary fiber
- Sugars (glucose, sucrose)
- Minerals (potassium, calcium)

Seeds

- Essential oils (carotol, daucol)
- Flavonoids

Fatty acids (Rubatzky et al., 1999).

18. 6. Therapeutic Uses

18. 6.1 Traditional Uses

- Widely consumed in Algerian diet
- Used to improve vision and general health
- Digestive aid
- Used in traditional remedies for skin and liver health (WHO, 2013).

18. 6.2 Internal Uses

- Promotes **eye health** (due to β-carotene → vitamin A)
- Antioxidant activity
- Supports immune system
- Improves digestion (fiber content)
- Cardioprotective effects (WHO, 2013).

18. 6.3 External Uses

- Used in cosmetic preparations (skin care)
- Carrot oil used for skin hydration and regeneration
- Treatment of minor skin irritations (WHO, 2013).

18. 7. Pharmacological Activities

Scientific studies show that Daucus carota exhibits:

- **Strong antioxidant activity**
- **Anticancer potential** (due to carotenoids)
- **Hepatoprotective effects**
- **Cardioprotective properties**
- **Antimicrobial activity** (especially seed extracts) (Rubatzky et al., 1999).

18. 8. Toxicology and Safety

- Safe as a food
- Excessive consumption may cause **carotenemia** (yellowing of skin, harmless)
- No major toxicity in normal dietary use
- Seed essential oil should be used cautiously (WHO, 2013).

CHAPTER II

Generalities on the Digestive System

I. Generalities on the Digestive System

I.1. Definitions

The digestive system consists of the digestive tract and its accessory organs. The digestive tract is a tube that extends throughout almost the entire body. It is composed of seven compartments: the mouth, pharynx, esophagus, stomach, small intestine, large intestine, and anus (Fig. 01). The accessory organs of the digestive tract are the teeth, tongue, salivary glands, liver, gallbladder, and pancreas.

The digestive system ensures the transport of food and its digestion into smaller elements called nutrients. These nutrients, which can be assimilated by the body, as well as water and ions (calcium, sodium, etc.), also called electrolytes, are absorbed into the blood through the wall of the digestive tract and transported to the cells throughout the body (John et al., 2001).

Thus, the digestive tract is a set of organs through which food passes. These are successive passage sites where food undergoes transformations in order to be absorbed and nourish the body. Digestion consists of breaking down food into nutrients small enough to be absorbed (John et al., 2001).

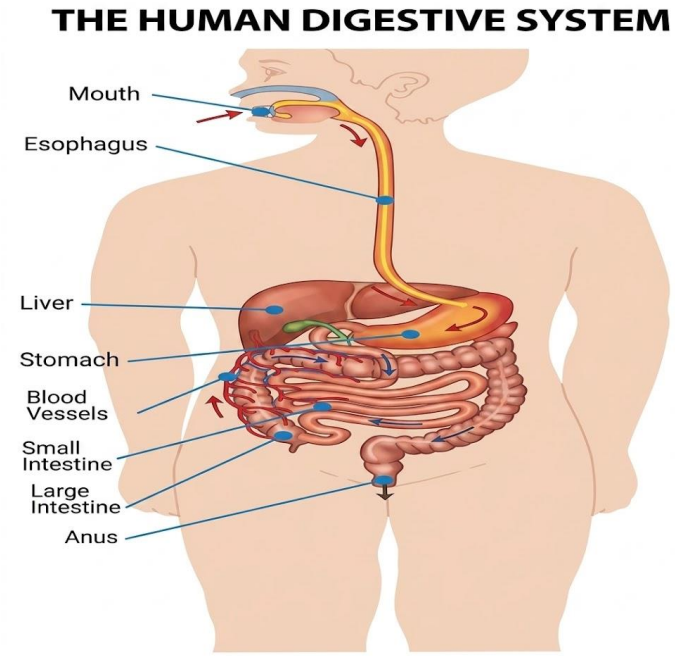

Figure II.1: Anatomy of the digestive tract (Cortel et al., 2016).

II. Digestive Disorders, Diagnosis, and Treatment

Digestive system diseases are among the most frequently cited reasons for medical consultations. They are also among the leading causes of medication consumption. Digestive problems are unfortunately very common and varied.

II.1. Diarrhea

Diarrhea results from inflammation of the walls of the small intestine, making the intestines unable to absorb fluids and nutrients. The colon then absorbs liquids, forming semi-solid stools. It is most often caused by viral or bacterial infections (John et al., 2001).

Treatment depends on the condition:

- **Acute diarrhea:** rehydration therapy and antibiotic treatment in cases of infectious diarrhea.
- **Chronic diarrhea:** treatment depends on the underlying cause; for example, a gluten-free diet is recommended in cases of celiac disease (John et al., 2001; Tarrerias, 2010).

II.2. Constipation

Constipation results from excessive absorption of water from food residues in the colon, leading to dry stools. It may be temporary or may indicate a serious health problem (Tarrerias, 2010).

Treatment is mainly based on hygienic and dietary measures, which have modest and variable effectiveness, as well as the use of laxatives (John et al., 2001).

II.3. Bloating

Bloating is the accumulation of gas in the stomach and intestines, often accompanied by abdominal pain of varying intensity. It is commonly caused by the ingestion of fatty foods (John et al., 2001).

Treatment includes the use of digestive protectants and antacids. Activated charcoal is also considered an effective remedy. In addition, capsules made from lemon balm leaves are effective against bloating (Eurekasante, 2023).

II.4. Gastritis

Gastritis is the result of damage to the protective mucus layer lining the inside of the stomach.

The gastric mucosa is then directly exposed to the highly corrosive acidic secretions of the stomach, which damages the mucus-secreting cells. Physicians distinguish between acute

gastritis, which appears suddenly, and chronic gastritis, which develops slowly and progressively, often over several years, and is further subdivided into types A, B, and C.

To support mucosal regeneration and accelerate healing in acute gastritis, physicians prescribe medications that either neutralize acidic secretions or reduce/suppress acid production. These substances include:

- Antacids (which neutralize acidic secretions and have a short duration of action)
- H2 receptor inhibitors (e.g., ranitidine, cimetidine)
- Proton pump inhibitors (e.g., omeprazole, pantoprazole, lansoprazole, etc.) (John et al., 2001).

II.5. Heartburn

Heartburn is a burning sensation caused by relaxation and weakening of the lower esophageal sphincter, allowing gastric acid to reflux into the esophagus (John et al., 2001).

Treatment is based on prescribing antacids and alginates (sodium alginate) (Creapharma, 2023).

II.6. Ulcers

Peptic ulcer disease generally develops on the basis of chronic gastritis, particularly when the stomach is constantly exposed to harmful factors such as alcohol, nicotine, or stress. This increases the risk of localized mucosal lesions with the formation of gastroduodenal ulcers. These ulcers may sometimes extend into the deeper layers of the stomach or duodenum (John et al., 2001; Univadis, 2005).

When the presence of *Helicobacter pylori* is confirmed through appropriate tests or tissue samples, physicians prescribe antibiotics as part of anti-ulcer therapy aimed at eradicating the bacterium. To reliably eliminate all *Helicobacter* bacteria, it is necessary to take two antibiotics simultaneously. An acid secretion inhibitor (e.g., a proton pump inhibitor) is also prescribed to promote the healing process (Creapharma, 2023).

II.7. Nausea and Vomiting

Nausea is the unpleasant sensation of being about to vomit, whereas vomiting is the forced expulsion of stomach contents caused by involuntary contractions of the abdominal muscles. They are most often caused by gastroenteritis and are not usually symptoms of a serious illness unless they persist and are accompanied by pain (John et al., 2001).

Treatment involves prescribing steroids, dopaminergic antagonists, H antihistamines, M1 antimuscarinics, anti-NK1 agents such as aprepitant, corticosteroids, and benzodiazepines (Quevauvilliers et al., 2007).

II.8. Dyspepsia

Dyspepsia is stomach pain or discomfort that may be symptomatic of other digestive disorders. Antispasmodics are prescribed to reduce muscular contractions, along with antacids (John et al., 2001).

III.1 Anatomy of the digestive system

The constituent elements of the digestive tract are as follows:

a) The esophagus, which ends in the cardia

b) The stomach, which includes the antrum and the pyloric canal

c) The intestines:

The small intestine (6-8 m), comprising:

- The duodenum

- The jejunum

- The ileum, which joins the cecum at the ileocecal junction. The large intestine or colon (1.5 m), consisting of 3 parts:

1) The cecum. The appendix is a rudimentary organ, a remnant of evolution, attached to the cecum.

2) The colon, which includes:

- The ascending colon

- The transverse colon

- The descending and sigmoid colon

3) The rectum which ends with the anus.

III.2 General Description of the digestive system:

The gastrointestinal tract is a complex ecosystem open to exogenous microorganisms. Its mucosa, estimated at 200-300 m², represents the largest surface area of the body in contact with the environment. The gastrointestinal ecosystem is generated by a stable alliance between the gastrointestinal epithelium, the immune system, and a significant microbial flora. If any of these three components of the ecosystem malfunctions, pathologies can arise. Interactions between microorganisms and the host can be of three

types: symbiosis, commensalism, or pathogenicity. The host is protected against pathogenic intestinal microflora by the chemical and physical barriers formed by the gastrointestinal epithelium (Ebel, 2018).

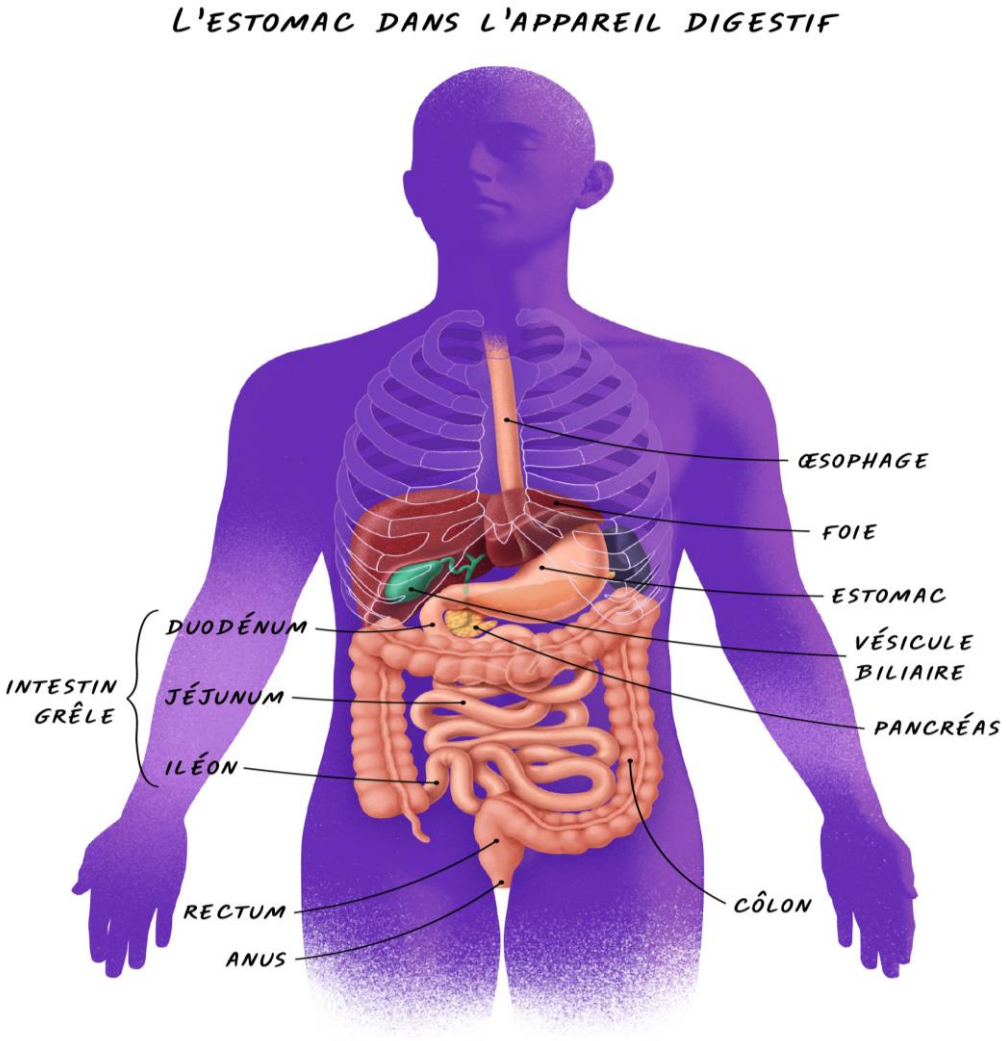

Figure II.2: Simplified diagram describing the compartments of the human digestive system and their microflora. (Institut National du Cancer – Anatomie de l'estomac, 2026)

Table I.1 :Simplified table of microflora in the different compartments of the digestive system:

Oesophagus	Microorganisms from food or the oral cavity are present.
Stomach	Acidic pH (pH<2), O2, enzymes, mucus. Microflora: 104 CFU/g: Candida albicans, Helicobacter pylori, Lactobacillus, Streptococcus.
Duodenum	Pancreatic and biliary secretions, mucus, low O2. Microflora: 10^3-104 CFU/g: Bacteroides, Candida albicans, Lactobacillus, Streptococcus.
Jejunum	Pancreatic and biliary secretions, mucus, peristalsis. Microflora: 105-107 CFU/g: Bacteroides, Candida albicans, Lactobacillus, Streptococcus.
Ileon	Anaerobic conditions, bile salts, enzymes. Microflora:

	107-108 CFU/g: Bacteroides, Clostridium, *Enterobacteriaceae*, Enterococcus, Lactobacillus,
Colon	Microflora: 1010-1011 CFU/g: Bacteroides, Bacillus, *Bifidobacterium*, Clostridium, Enterococcus, Eubacterium, Fusobacterium, Peptostreptococcus, Ruminococcus, Streptococcus. Anaerobic conditions (Eh=-200 to -300 mV), motility, bacterial enzymes, volatile fatty acids, ammonia…

Painting: *Microflora of the different compartments of the digestive system*

III.3 The gut microbiota

I.3.1 What is the gut microbiota?

A microbiota is the collection of microorganisms living in a specific environment. There are different microbiotas associated with the human body, the most studied being the gut microbiota. (Bertholom, 2017)

The gut microbiota represents the bacteria that populate our digestive tract (Abadie, 2015). Microbial diversity is currently estimated at approximately 10^3 bacterial species composing the dominant gut microbiota of an adult individual, with an abundance of 10^{14} bacteria, representing a bacterial genome of approximately 10^8 genes, or 100 to 150 times the human genome.

The composition of the gut microbiota is unique to each individual and evolves throughout life. Together, they constitute an ecosystem that functions as a fully-fledged organ, in close symbiosis with our body. It is essential for the digestion of food not assimilated by the body and necessary for various physiological functions in humans: a barrier against external pathogens, maturation of the immune system, fermentation of substrates, vitamin production, and more.

In certain pathological conditions, the microbiota is unbalanced and has an altered composition. Intestinal microbiota dysbiosis then appears as a predisposing factor for certain pathologies.

- Just a few years ago, the term microbiota was unknown to most doctors and even more so to the general public; only the term intestinal flora was used at the time.

However, our knowledge of the gut microbiota still needs to be expanded, as more than 70% of the microorganisms that compose it cannot be cultured using conventional methods. Molecular biology techniques have allowed us to better understand the microbiota as a whole, overcoming the limitations of culture. (Bertholom, 2017)

I.3.2 Methods for analyzing the gut microbiota:

I.3.2.1 Cultivation:

Among the techniques classically used to date to characterize the entire intestinal microbiota, culture stands out.

However, scientists have encountered a problem: most bacteria remain difficult to culture; it is estimated that 80% of the microbiota cannot be exploited in the laboratory. The most effective system currently available is a chamber containing carbon dioxide, nitrogen, and hydrogen in which no more than 5 ppm of oxygen should remain.

I.3.2.2 Molecular Biology:

Advances in molecular biology techniques have enabled a new approach to studying the gut microbiota. Most molecular techniques are based on the use of 16S ribosomal ribonucleic acid (16S rRNA). This structure is present in all bacteria; it contains highly conserved regions and others that are highly variable, so comparing these regions allows for species differentiation.

Major projects, such as MetaHit (Metagenomics of the Human Intestinal Tract) in Europe and the Human Microbiome Project (HMP), have used new sequencing techniques to create a database referencing the genes of the human intestinal metagenome. By comparing the sequences obtained with this database, it is possible to identify the bacteria present.

Sequencing involves extracting DNA from bacteria, then amplifying the 16S rDNA that codes for 16S rRNA, and sequencing it. (Frayssinhes, 2017)

I.3.2.2.1 Imprinting methods:

These methods primarily involve the PCR (Polymerase Chain Reaction) technique to amplify the gene encoding 16S rRNA. The fragments resulting from this amplification are then separated by denaturing gel electrophoresis.

I.3.2.2.2 In situ hybridization coupled with flow cytometry:

The FISH (Florescence in situ hybridization) method relies on the detection of nucleic acids from targeted 16S rRNA strands (specific to a genus or bacterial species). It uses fluorescent oligonucleotide probes capable of fusing exclusively with the targeted sequence.

I.3.2.2.3 Quantitative PCR (qPCR):

In the detection of DNA and RNA, quantitative PCR is one of the most widely used techniques. It comprises several steps, including DNA denaturation, hybridization with primers specific to the sequence to be amplified (thus targeting certain bacterial groups), and elongation by a DNA polymerase

.I.3.2.2.4 Critical analysis of methods:

All of these molecular methods offer a fairly accurate assessment of the microbiota's composition, but they remain incomplete. Indeed, based on the observations only partially gathered in vitro, it is difficult to define the role played by these bacterial communities within the digestive tract.

I.3.2.2.5 Metagenomics of the gut microbiota:

Metagenomics allows us to characterize a set of genes from a community.**(Frayssinhes, 2017)**

Is an analytical method based on a sequencing technique capable of studying the microbiota, that is, all the microorganisms (bacteria, viruses, fungi, yeasts) that predominate in a specific environment. The result obtained is the abundance (a relative quantification) and biodiversity of the microorganisms present in a specific sample. It should be noted that more than 95% of microorganisms are not culturable. Thus, for the first time, we are able to determine the presence and relative quantity of these microorganisms.

Two analytical methods can be performed:

- **16S RNA**(more targeted and most used): complete or partial sequencing of bacterial ribosomal RNA in a sample or the genomic portion corresponding to the identity card of each bacterial family and species
- **Shotgun (rifle)**: complete DNA sequencing of all microorganisms present in a sample (viruses, fungi, bacteria, parasites, yeasts)

III.4 Composition of the intestinal microbiota:

For the study of the gut microbiota, research relies on the biomolecular analysis of 16S bacterial RNA subunits and on in situ hybridization of rRNA using fluorescent probes. These techniques have allowed researchers to determine:

- A rough estimate of the abundance of bacteria.
- This proves that bacteria synthesize rRNA, therefore they are biologically active.
- The identification of several bacterial phyla or branches.
- The determination of different microbiomes: a dominant one, a sub-dominant one and a transient one.

As previously mentioned, the quantity of bacteria increases from the mouth to the anus, but it also varies qualitatively, particularly depending on oxygen levels. Indeed, there is a progressive decrease in aerobic bacteria (in the upper digestive tract: stomach, duodenum, jejunum) in favor of anaerobic bacteria in the ileum and colon. Consequently, the bacteria present throughout the digestive tract are not the same.

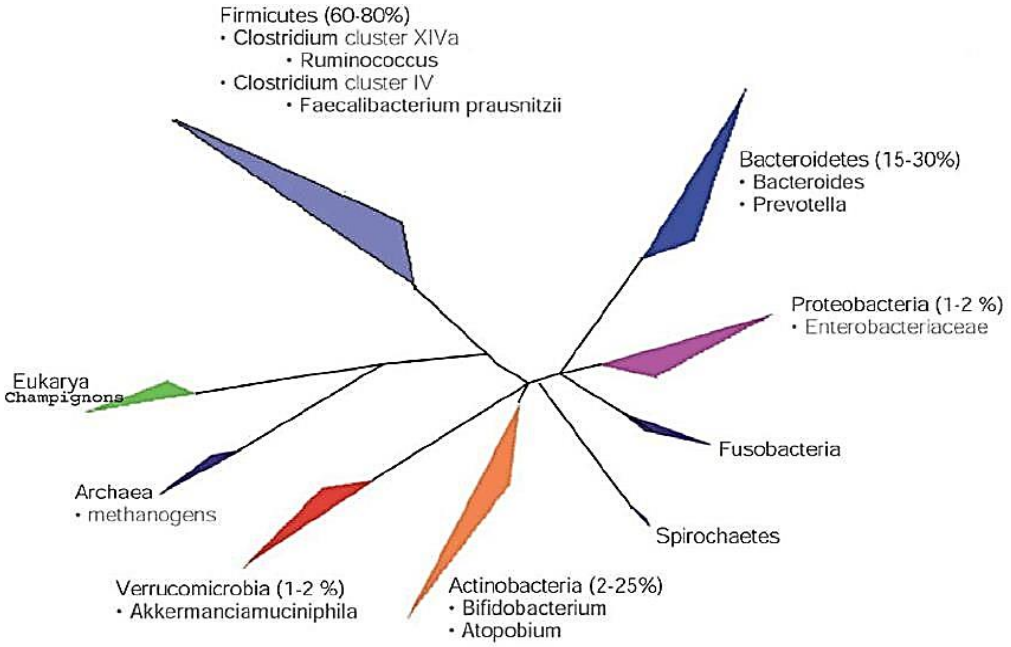

Figure II.3 : Schematic representation of the phylogenetic tree of bacteria (Guérin-Danan, C, 2013)

A. A DOMINANT FLORA:

(N > 109 CFU/g) which is stable and performs the essential functions of the microbiota; it is composed of 3 bacterial branches:

• *FIRMICUTES* This is the most prevalent phylum, representing between 60 and 80% of the gut microbiota and composed of Gram-positive bacteria. (Sayro, 2020)

This phylum includes the group sometimes called Clostridium cluster XIVa or Eubacterium rectale-Clostridium coccoides. The Firmicutes also include the Clostridium cluster IV group or the Clostridium leptum group, to which the species Faecalibacterium prausnitzii albus and Ruminococcus belong. (Joly, 2017)

• *BACTEROIDETES*: this is the second major group, representing approximately 15 to 30% of the flora and mainly includes the genus Bacteroides, comprising anaerobic GRAM negative bacteria.

• *ACTINOBACTERIA*: this group represents less than 10% of the intestinal microbiota and includes anaerobic GRAM positive bacteria, notably of the Bifidobacterium genus.

B. A SUBDOMINANT FLORA

(106 > N > 108 CFU/g), composed of:

• PROTEOBACTERIA with the genera Escherichia or Klebsiella which are facultative anaerobic GRAM negative bacteria.

• Three other less represented phyla: FUSOBACTERIA, VERRUCOMICROBIA or SPIROCHAETES.

 A FLORA PASSING BY (N < 10^6 CFU/g) composed of lactic acid bacteria, a fungal microbiota (consisting of fungi and yeasts), and a virola (microbiota composed of viruses). (Sayro, 2020)

III.5 Distribution of bacteria in the digestive tract

- The stomach:

The stomach is characterized by its high acidity (pH = 1-2) and also by the presence of oxygen brought in during swallowing. Given this, it offers very few conditions favorable to bacterial growth. Only acid-tolerant bacteria such as Streptococcus or Lactobacillus reside and persist in this part of the digestive tract. (Raphaelle, 2015)

- The small intestine:

The small intestine harbors very few bacteria, except for facultative anaerobic microorganisms. The factors responsible for this deficiency are numerous; digestive secretions (bile salts, pancreatic secretions, etc.) and, more specifically, peristalsis are the main contributors to this antibacterial effect. Therefore, it contains...

Streptococcus, Lactobacillus, Enterobacteriaceae (facultative anaerobes) but also Bacteroides and Clostridia (strict anaerobes).

- The colon:

In this last compartment, bacterial diversity reaches its maximum. The absence of oxygen, along with slower transit, promotes microbial proliferation. Thus, the gut microbiota becomes extremely complex at this level. A strict anaerobic flora, represented by Bacteroides, Clostridium, and Bifidobacterium, predominates in this large intestine, and this is even more pronounced as one approaches the distal colon. Indeed, there is a 100-fold increase in bacteria from the proximal to the distal colon. Facultative anaerobic bacteria (Lactobacillus, Streptococcus, etc.) are much less representative of the colonic compartment (approximately 25% of the dominant flora).

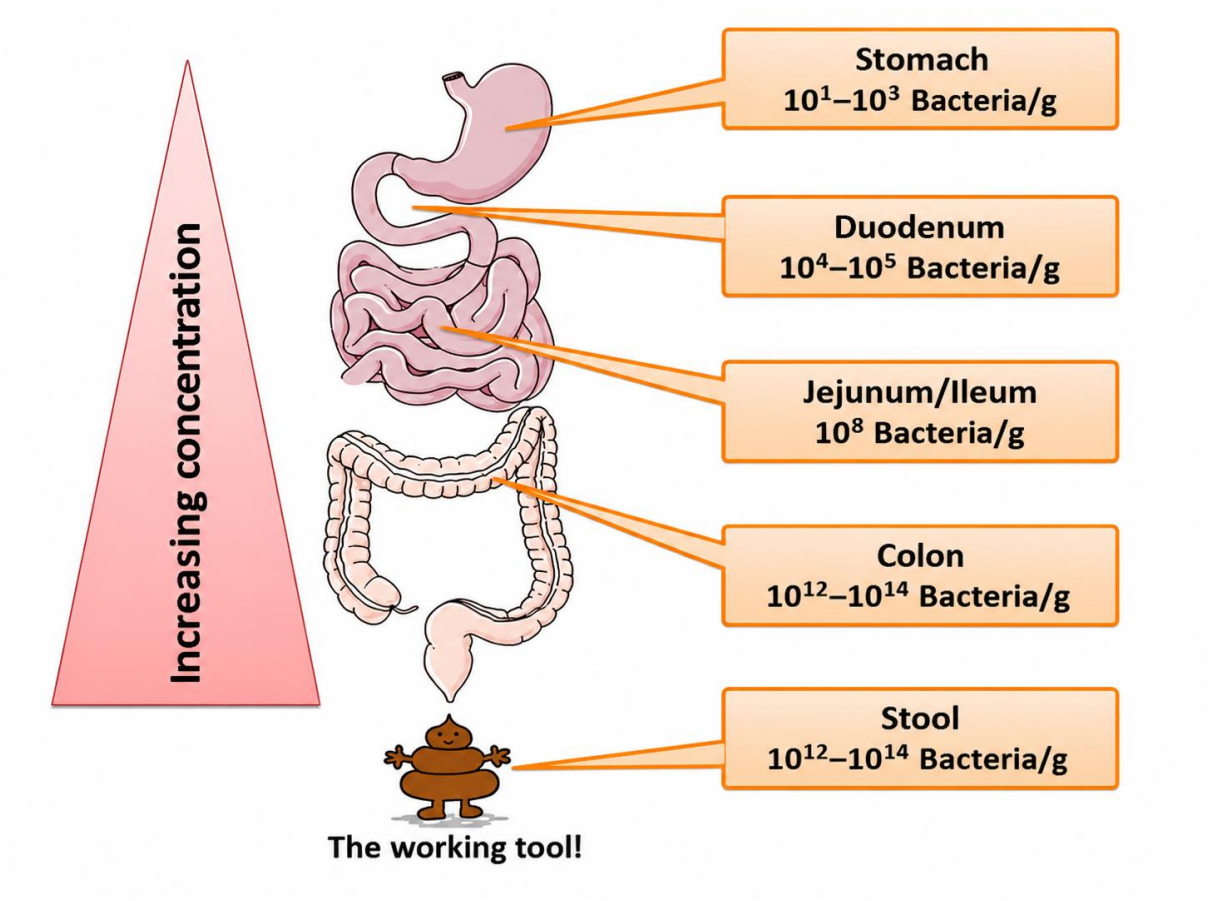

Figure II.4: Distribution of the quantity of bacteria along the digestive tract (SVT Collège – Microbiote, 2026)

SECOND PART

Experimental Analysis

CHAPTER I

Materials and methods

I.1. Characterization by survey

I.1.1. Aim of the survey

This questionnaire aims to study the traditional uses of medicinal plants among local communities, particularly in the treatment of disorders of the digestive system, liver, kidneys, and nervous system, while documenting their methods of use and preparation.

It also seeks to highlight the importance of these plants in traditional medicine, the extent of their use by local populations, and their contribution to preserving this body of knowledge, as well as providing scientific data for future studies.

I.1.2. Description and delimitation of the study area

The study area is located in the Wilaya of El Oued, One of the main oases of the Algerian northern Sahara. The study area covers 12 municipalities (El Oued; El Bayadha; Reguiba; Hassi Khalifa; Tarifaoui; Nakhla; Debila; Robbah; Sidi Aoun; Ogla; Taleb Larbi and Douar El Ma). **(Abdelmonem and Bouallem, 2012)**. The administrative boundaries of the Wilaya of El Oued are: North Tébessa and Khenchla, East Tunisia, South Ouargla and West Beskra and Ouargla. An area of approximately 11200 Km^2, limited by the following geographical coordinates: Longitude: 06 ° 20 'and 07 ° 50' East and latitudes; 32 ° 50 'and 34 ° 30' North.

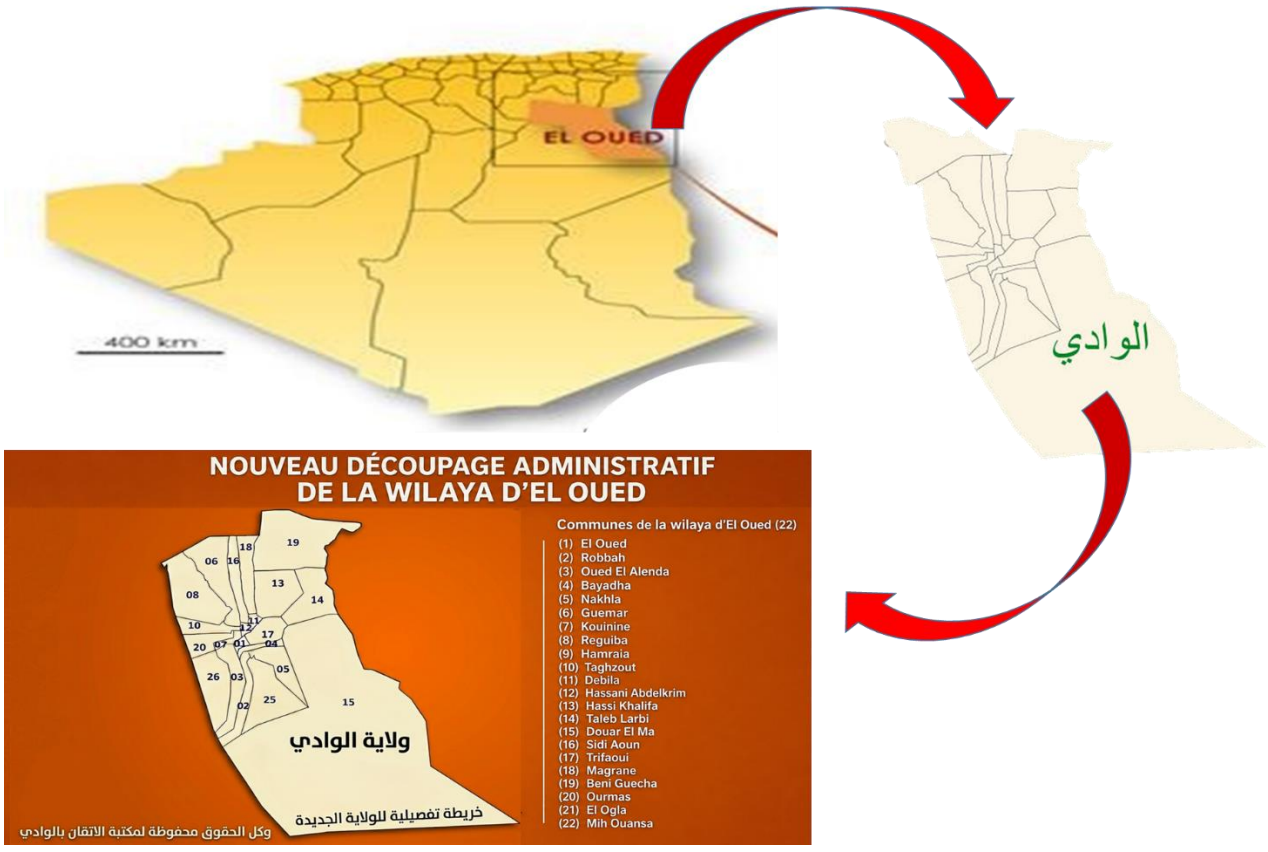

Figure I.1: Geographical map of the Wilaya of El-Oued **(Library alitkan,** *2026***)**.

The region of El Oued is characterized by an arid climate of the Sahara desert type, in winter the temperature drops below 0 °C while in summer it reaches 50 °C; the average rainfall varies between 80 and 100 mm / year (period from October to February). The climate in ElOued resembles that of the Sahara with the particularity that the nights are cooler than elsewhere given the difference in temperature felt across the large expanses of sand.

The soil of the Souf region is typical of the Saharan regions. It is a soil poor in organic matter, with a sandy texture and a structure characterized by very high water. The soil of Souf takes two aspects. The most dominant is the dune set. These are large sandy accumulations. The region of Oued Souf is characterized by light soils, predominantly sandy, with a particular structure. These soils are known for their low organic matter content, high salinity, alkaline pH and good aeration.

I.1.3. Study population

This survey study was conducted across 12 municipalities and targeted different categories of the population, including herbal sellers (herbalists), elderly people due to their experience in traditional herbal medicine, as well as the general population. A set of questions was designed for these groups in order to collect information about the use of medicinal plants in the treatment of digestive, hepatic, renal, and neurological disorders.

The study relied on two types of questionnaires: an electronic questionnaire distributed to most participants and a paper questionnaire mainly intended for herbalists. At the end of the study, a total of 200 responses were collected. The distribution of participants according to the municipalities of the province will be presented in the Results and Discussion section.

I.1.4. Survey Tools

The questionnaire was standardized for both herbalists and the general population, and all questions were closed-ended. The questions were formulated in a simple and clear manner in order to reduce the duration of the interview and facilitate participants' understanding. The paper questionnaires were filled out by the researchers themselves during the interviews.

As for the electronic questionnaire, the Arabic language was used to facilitate communication with participants and ensure the clarity of the questions. The questionnaire consisted of 22 questions, including a section related to the participant's personal information, while the remaining questions focused on the selected medicinal plants and their methods of use. The interview or questionnaire completion time ranged from 10 to 15 minutes.

I.1.5. Survey process

Before conducting the field survey, a preliminary test of the questionnaire was carried out on a sample of approximately 20 individuals in order to:

* Ensure the clarity and comprehensibility of the questions.

* Verify the consistency and coherence of the questionnaire sections.

* Remove unnecessary questions.

* Add or modify certain suggestions in multiple-choice questions.

* Reformulate unclear questions.

The field study was conducted from January to April. The electronic questionnaire was distributed through social media platforms, while the paper questionnaire was administered directly to the targeted participants.

I.1.6. Difficulties encountered during the survey

Several difficulties were encountered during the data collection process. In the paper questionnaires, some herbalists showed little interest in the survey questions and did not take them seriously. Some also considered the interviews to be a disturbance to customers and a waste of time, especially during the crowded market period in Ramadan.

Another challenge was that some participants, including certain herbalists, were unfamiliar with some of the medicinal plants mentioned in the questionnaire. Regarding the electronic questionnaire, it was largely ignored by many people, which made the process of collecting responses more difficult.

CHAPTER II

Results and discussion

Introduction

The analysis is based on 200 valid questionnaires. In this revised version, each variable is presented in an independent table so that the descriptive structure remains clear and each table can be directly converted into a graph. This organization also helps distinguish between single-response variables, such as gender or educational level, and multiple-response variables, such as therapeutic benefits, plant parts, and preparation methods.

The following results describe the socio-demographic structure of the sample, the general health profile of respondents, the most frequently recommended plants, therapeutic indications, plant parts, methods of use, perceived safety, perceived effectiveness, and the social transmission of medicinal-plant knowledge.

2.1. Socio-demographic characteristics of the sample

1. Residence area

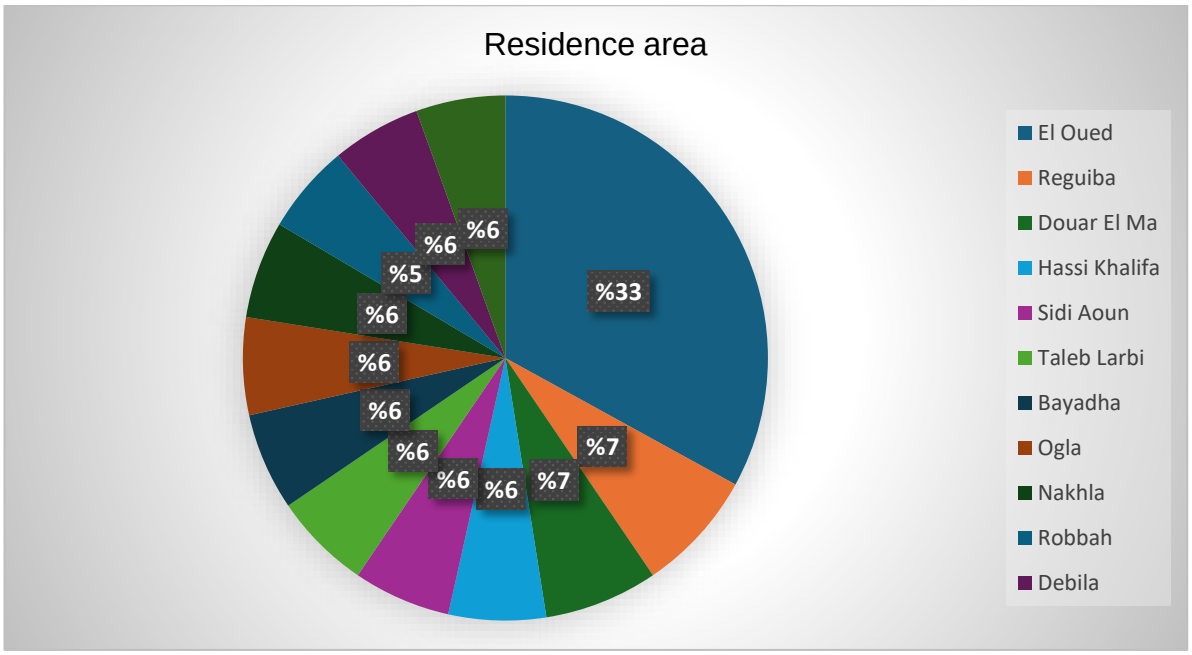

Figure II.1: Residence area - Pie chart (%)

Comment: The graph shows that respondents were distributed across several localities, with El Oued representing the largest proportion of the sample (66 respondents; 33.0%). The remaining localities were represented by smaller and relatively close proportions.

Analysis and discussion: From an ethnobotanical perspective, this distribution indicates that the recorded knowledge mainly reflects the practices of El Oued while still including surrounding communities. Differences between localities may influence plant availability, access to herbal markets, and household therapeutic habits. Therefore, the dominance of one locality should be considered when generalizing the findings to the whole region.

2. Age group

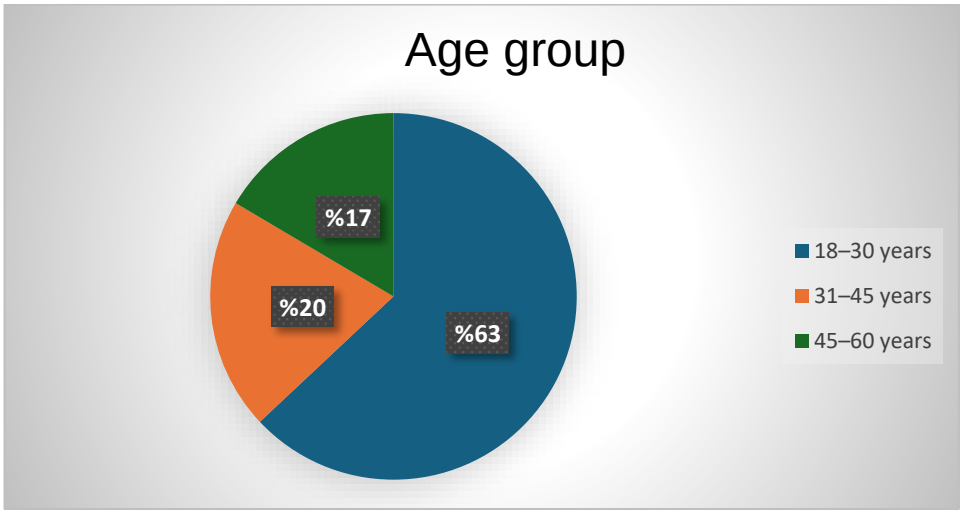

Figure II.2: Age group - Pie chart (%)

Comment: The age distribution is dominated by the 18-30 year group (126 respondents; 63.0%), followed by the 31-45 year group (20.5%) and the 45-60 year group (16.5%).

Analysis and discussion: This pattern is consistent with the electronic method of data collection, which usually reaches younger participants more easily. Biologically and culturally, the data reflect the perception of a young adult population rather than the full depth of knowledge held by older traditional users. Since older respondents may possess more detailed information about harvesting periods, contraindications, and preparation standards, future surveys should include them in greater numbers.

3. Gender

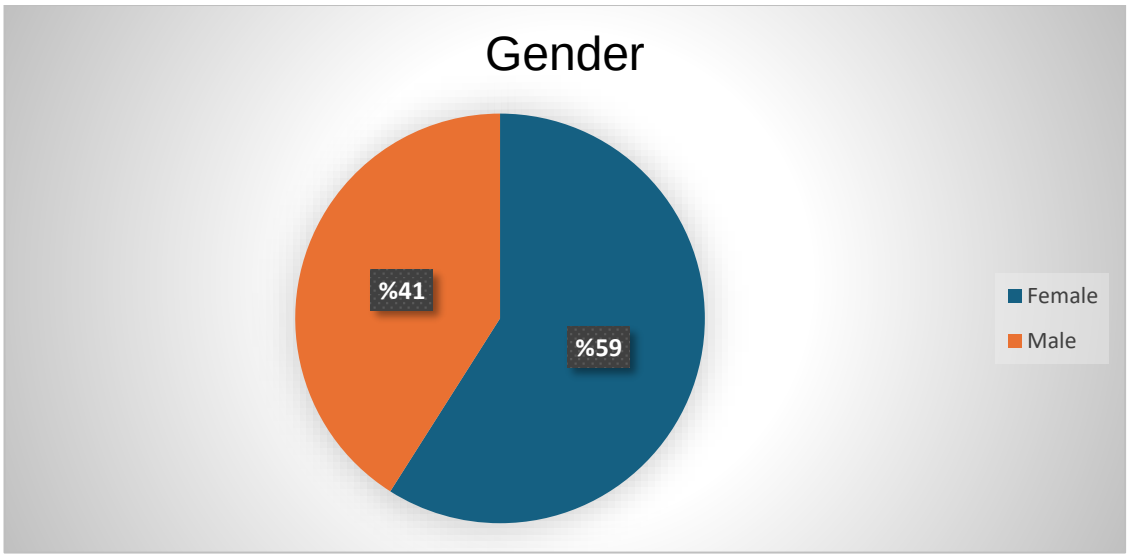

Figure II.3: Gender - Pie chart (%)

Comment: The graph indicates that females represented 59.0% of the sample, whereas males represented 41.0%. The sample is therefore moderately female-dominant.

Analysis and discussion: In ethnobotanical research, female participation is important because women are often involved in household care, preparation of herbal remedies, and transmission of practical plant knowledge within families. However, this result describes the composition of the sample only and should not be interpreted as proof that females use medicinal plants more than males. A specific comparative analysis would be required to test gender-related differences in plant use.

4. Educational level

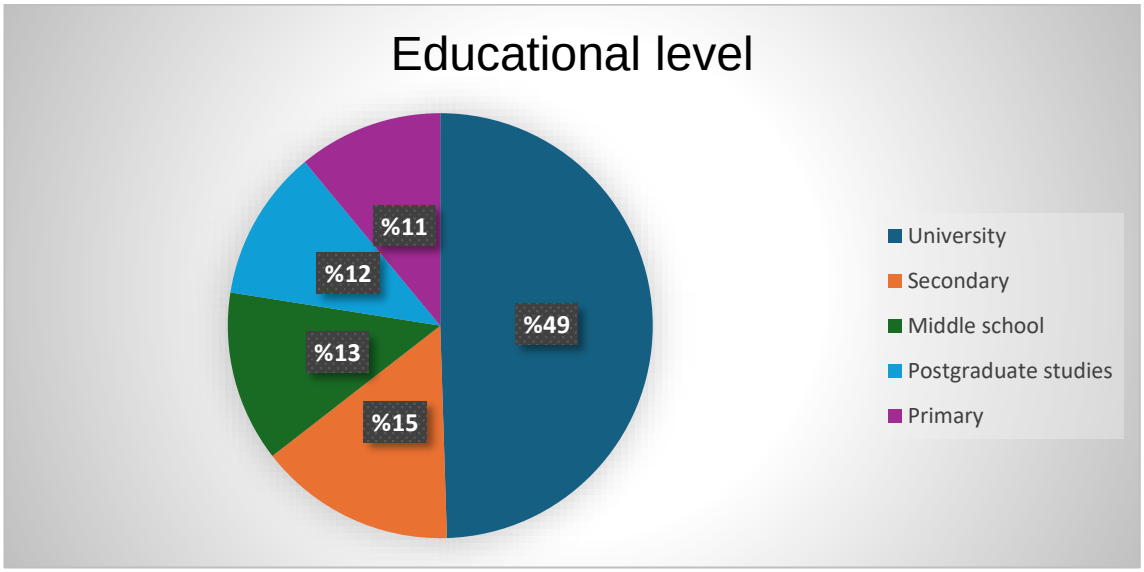

Figure II.4: Educational level - Pie chart (%)

Comment: University-level respondents formed the largest group (99 respondents; 49.5%), while the remaining categories were distributed among secondary, middle-school, postgraduate, and primary levels.

Analysis and discussion: The high educational level of respondents may improve the clarity of answers and the acceptance of scientific documentation. At the same time, it may introduce a methodological bias because orally transmitted plant knowledge is not limited to educated groups. The result suggests that the dataset combines traditional knowledge with a relatively academic awareness of health, safety, and documentation.

Residence area, age group, gender, and educational level are presented as separate variables. This structure avoids mixing different demographic indicators in a single table and makes the data easier to interpret statistically and graphically.

The sample was mainly composed of young respondents, with the 18-30 year age group representing the largest proportion. This distribution suggests that the survey was particularly accessible to younger individuals, which is consistent with the electronic mode of data collection. The predominance of respondents with university education indicates that the dataset reflects a relatively educated segment of the community. This factor may influence the way medicinal plants are described, evaluated, and justified by respondents.

Females were more represented than males. In ethnobotanical studies, this pattern may be relevant because women often play an important role in household health care, preparation of remedies, and transmission of practical plant knowledge. However, the observed gender distribution should not be interpreted as evidence that women use medicinal plants more frequently unless this is specifically tested.

2.2. Health profile and previous experience with medicinal plants

5. General health status

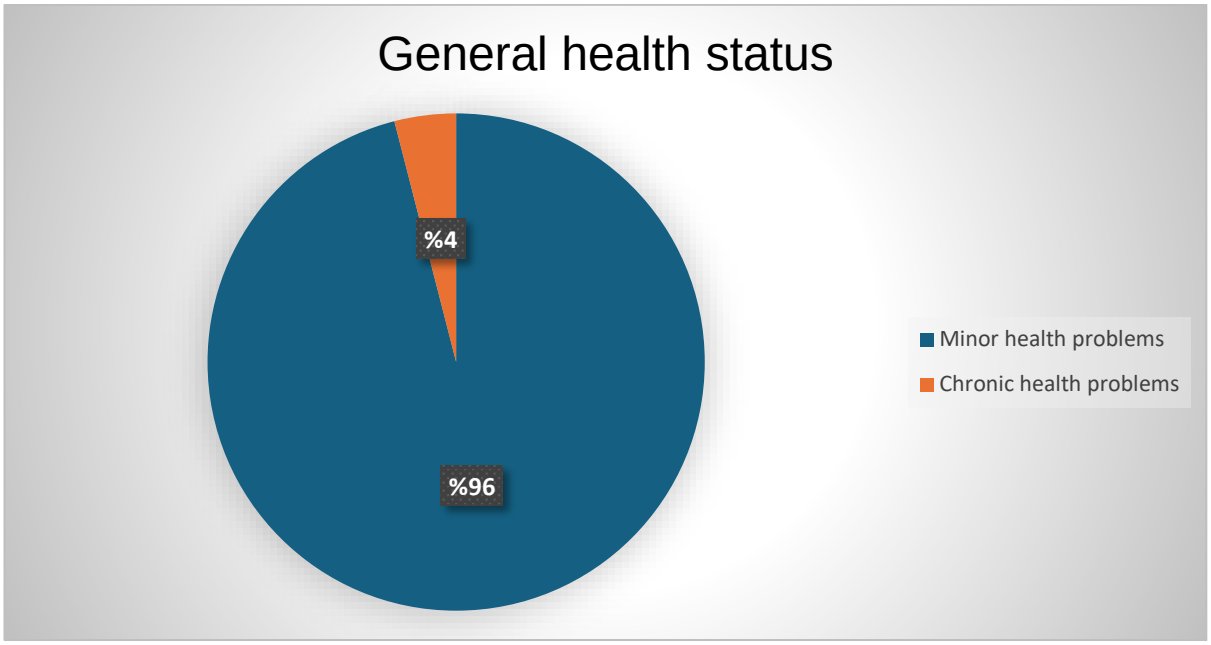

Figure II.5: General health status - Pie chart (%)

Comment: Most respondents reported minor health problems (192 respondents; 96.0%), whereas chronic health problems were reported by only 8 respondents (4.0%).

Analysis and discussion: This distribution shows that medicinal plants in the surveyed community are mainly associated with everyday self-care rather than severe chronic disease management. From a biological safety perspective, this is important because plants used for minor symptoms may still contain active compounds capable of producing physiological effects

after repeated use. The low proportion of chronic cases means that conclusions about plant use in serious diseases should remain cautious.

6. Previous surgery related to liver, kidneys, digestive or nervous system

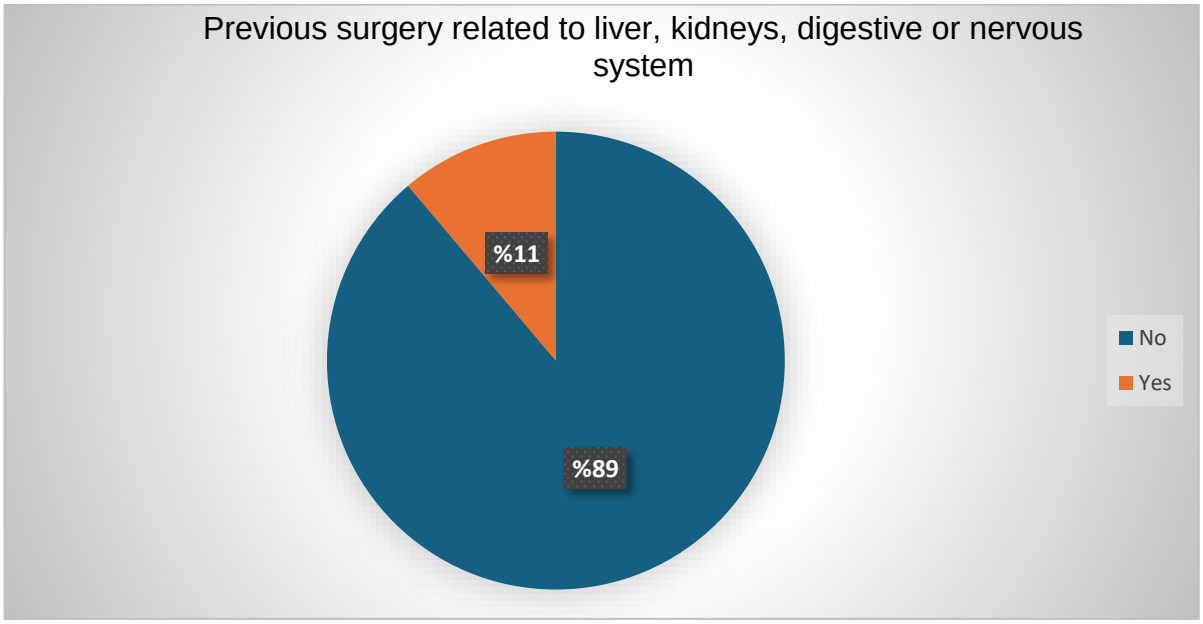

Figure II.6: Previous surgery related to liver, kidneys, digestive or nervous system - Pie chart (%)

Comment: Most valid respondents declared that they had not undergone surgery related to the liver, kidneys, digestive system, or nervous system. Only a smaller proportion reported previous surgery.

Analysis and discussion: The limited number of respondents with relevant surgical history suggests that the survey mainly reflects general community practices rather than post-operative or clinically complex situations. Herbal use in individuals with previous surgery requires particular caution because some plants may affect bleeding risk, hepatic metabolism, renal elimination, or interactions with prescribed medication. Therefore, traditional use in such cases should be evaluated medically.

7. Previous use of herbal treatment

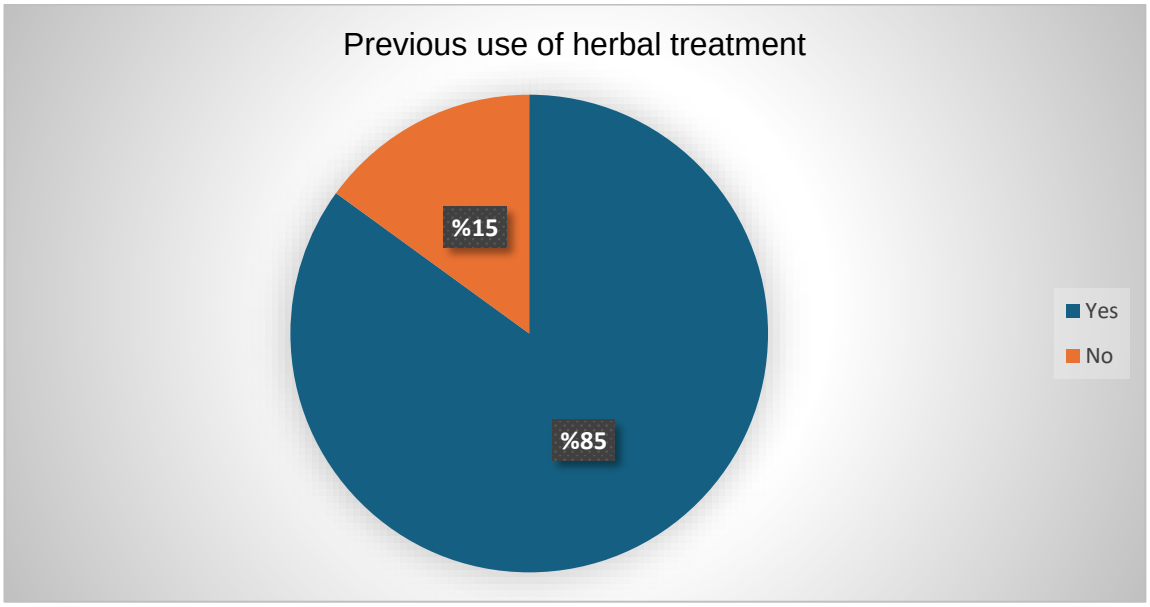

Figure II.7: Previous use of herbal treatment - Pie chart (%)

Comment: A large majority of respondents reported previous use of herbal treatment (170 respondents; 85.0%), while only 15.0% reported no previous use.

Analysis and discussion: This high percentage confirms that phytotherapy remains strongly present in local health behavior. Biologically, frequent exposure to medicinal plants increases the importance of correct plant identification, appropriate dose, and safe preparation method. It also highlights the need to distinguish between perceived symptom relief and scientifically confirmed pharmacological activity.

8. Common use of medicinal plants in the community

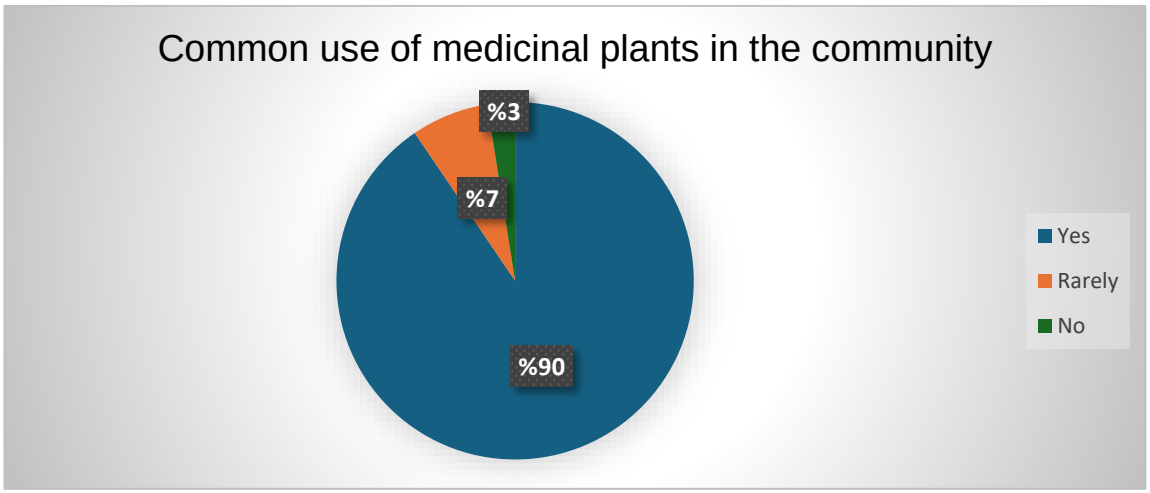

Figure II.8: Common use of medicinal plants in the community - Pie chart (%)

Comment: The graph shows that 90.5% of respondents considered medicinal-plant use common in their community, while rare or absent use was reported by much smaller proportions.

Analysis and discussion: This result demonstrates that medicinal-plant use is not only an individual practice but also a socially normalized form of health management. Such widespread use supports the value of ethnobotanical documentation, because community practices can guide the selection of plants for future phytochemical and pharmacological research. However, common use should not be confused with guaranteed safety or standardized efficacy.

Most respondents reported minor health problems, whereas only a small proportion reported chronic health problems. This pattern indicates that medicinal plants in the studied community are mainly associated with everyday symptoms and self-care practices rather than with exclusive treatment of severe chronic disease.

The high proportion of respondents who had previously used herbal treatment demonstrates the continuing importance of phytotherapy in the local cultural and health context. In addition, most respondents stated that medicinal-plant use is common in their community, confirming that these practices are not isolated individual behaviors but socially recognized forms of traditional health management.

From a biological and medical perspective, this finding is important because frequent plant use increases the need for accurate identification, safe preparation, and awareness of possible interactions with conventional drugs. Even when plants are used for minor symptoms, repeated exposure to bioactive compounds may have physiological effects, especially in vulnerable individuals.

2.3. Most recommended medicinal plants

9. Recommended medicinal plants

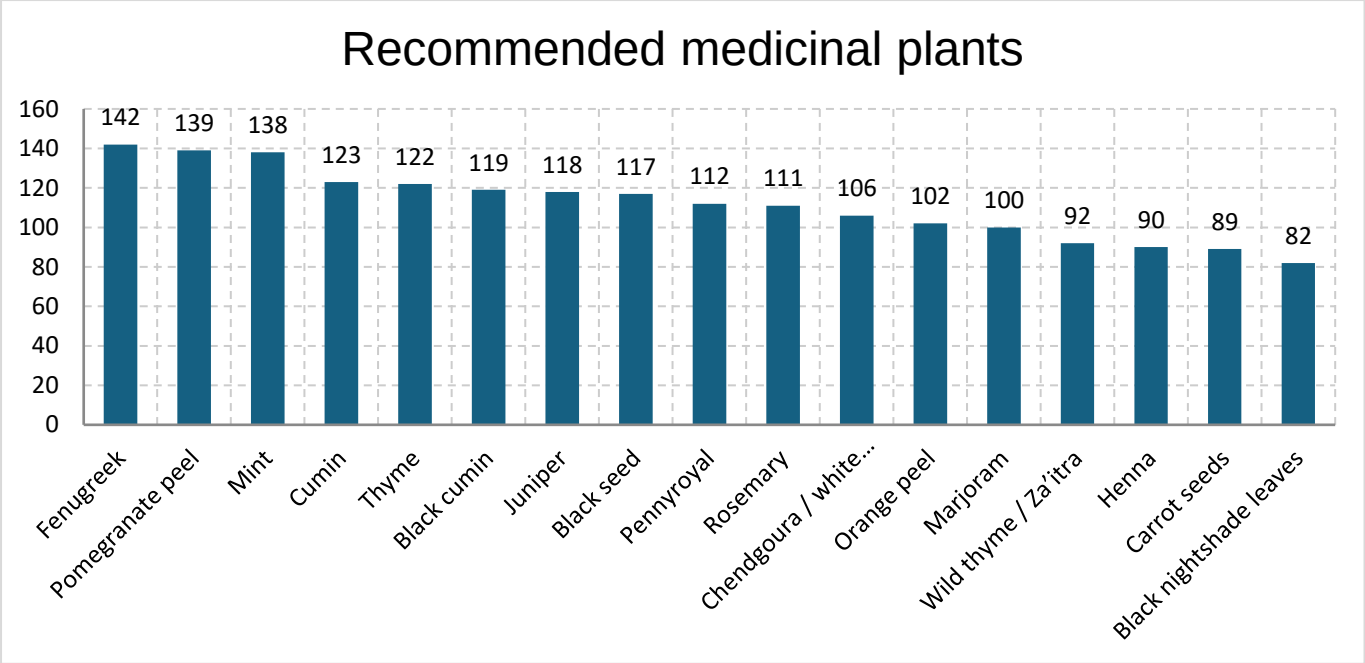

Figure II.9: Recommended medicinal plants - Pie chart (%)

Comment: The most frequently recommended plants were fenugreek, pomegranate peel, mint, cumin, thyme, black cumin, juniper, black seed, pennyroyal, and rosemary. These plants therefore represent the core of the local ethnobotanical repertoire recorded in this survey.

Analysis and discussion: The dominance of these plants may be explained by their availability, culinary familiarity, and long history of household use. Many of them are aromatic herbs, seeds, spices, or fruit peels that are easy to prepare at home. From a biological research perspective, highly recommended plants should be prioritized for botanical authentication, phytochemical screening, antispasmodic or gastroprotective assays, toxicity testing, and evaluation of herb-drug interactions.

Fenugreek, pomegranate peel, mint, cumin, thyme, black cumin, juniper, black seed, pennyroyal, and rosemary were among the most frequently recommended plants. High recommendation frequencies indicate that these plants occupy a central place in local therapeutic knowledge.

The dominance of these plants may be explained by their availability in households, familiarity in food or traditional remedies, ease of preparation, and long-term cultural transmission. However, frequency of recommendation must be separated from scientific proof

of efficacy. A plant may be highly recommended because it is culturally familiar, not necessarily because its pharmacological activity has been clinically validated.

The highest-ranked plants should therefore be considered priorities for future biological research. Such research should include botanical authentication, phytochemical screening, dose standardization, toxicity evaluation, and assessment of possible interactions with commonly used medicines.

2.4. Therapeutic benefits and treated conditions

10. Overall therapeutic benefits / treated conditions

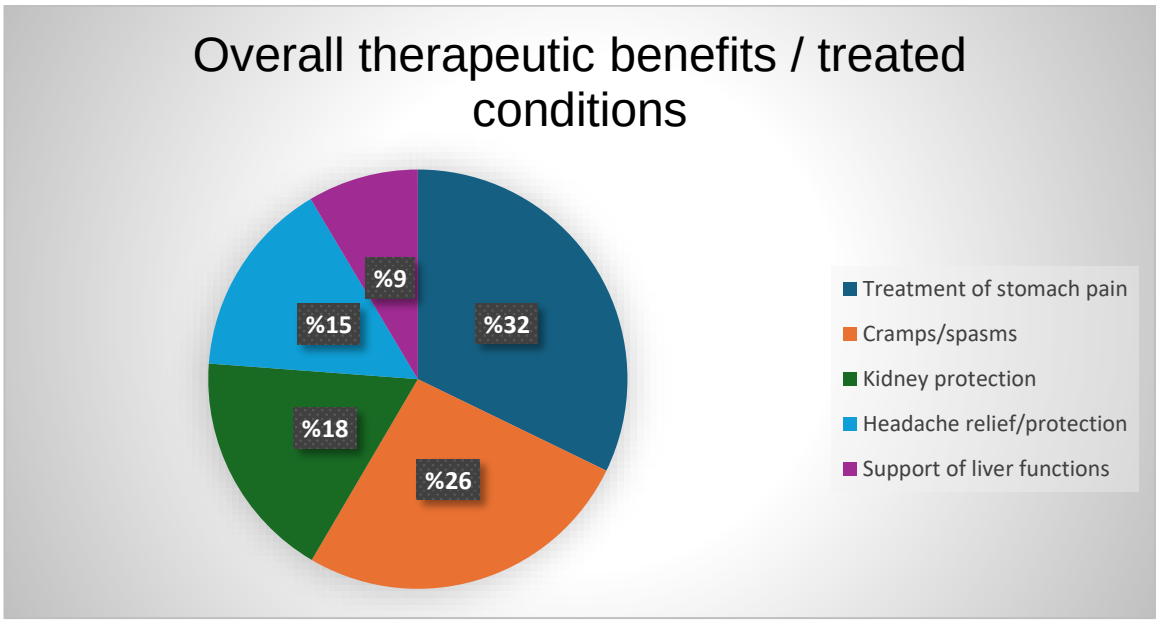

Figure II.10: Overall therapeutic benefits / treated conditions - Pie chart (%)

Comment: The graph shows that treatment of stomach pain was the most frequently cited indication, followed by cramps or spasms. Kidney protection, headache relief, and support of liver functions were cited less frequently.

Analysis and discussion: The results indicate that traditional plant use in the studied community is mainly directed toward digestive complaints. This is biologically plausible because many household plants are prepared as infusions, decoctions, or powders that act first on the gastrointestinal tract. Uses related to the kidneys, liver, and nervous system require greater caution because these organs are highly sensitive to bioactive compounds, metabolic load, and possible toxicity.

The most frequently cited therapeutic indication was treatment of stomach pain, followed by cramps or spasms. Kidney protection, headache relief or protection, and support of liver functions were also reported, but with lower frequencies.

This distribution shows that the traditional use of medicinal plants in the studied community is primarily oriented toward digestive complaints. Digestive symptoms are common, recurrent, and often treated at home, which may explain why aromatic herbs, seeds, peels, and spices are frequently used for stomach pain and intestinal spasms.

Uses related to kidneys, liver, and the nervous system require more cautious interpretation. These organs are central to metabolism, detoxification, elimination, and neurophysiological regulation. Consequently, plant use in these contexts should not be generalized without scientific evaluation of safety, dosage, and contraindications.

2.5. Plant parts used

11. Overall plant parts used

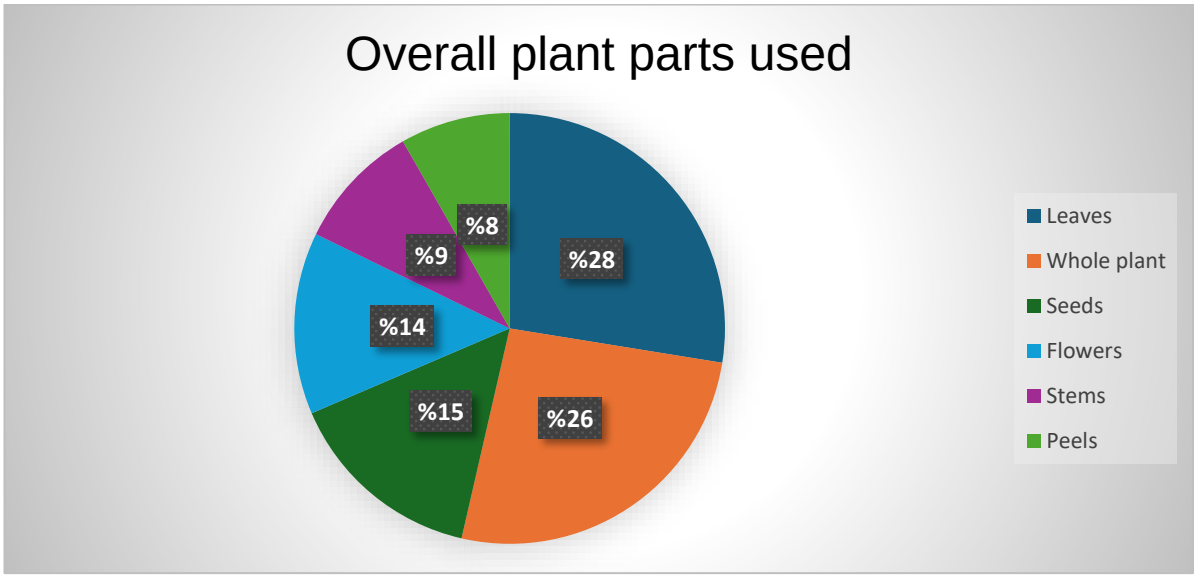

Figure II.11: Overall plant parts used - Pie chart (%)

Comment: Leaves and whole plants were the most frequently reported plant parts, followed by seeds, flowers, stems, and peels.

Analysis and discussion: The plant part used is a key biological variable because secondary metabolites are not evenly distributed within the plant. Leaves may contain volatile oils, flavonoids, phenolic acids, and other photosynthesis-related compounds, whereas seeds and peels may contain fixed oils, tannins, fibers, or other concentrated metabolites. The frequent

use of whole plants may broaden the chemical profile of remedies but also increases variability and uncertainty in dosage.

Leaves and whole plants were the most frequently reported plant parts, followed by seeds, flowers, stems, and peels. This pattern reflects both the availability of plant material and the simplicity of traditional collection and preparation methods.

From a biological perspective, the selected plant part is highly important because secondary metabolites are not distributed uniformly throughout the plant. Leaves may contain volatile oils, phenolic compounds, and photosynthesis-related metabolites, whereas seeds and peels may contain different classes of compounds such as fixed oils, alkaloids, tannins, or fibers.

The use of whole plants may increase the diversity of extracted compounds but may also increase variability and uncertainty in dosage. For this reason, future studies should record the exact plant part, harvesting period, drying conditions, and preparation procedure.

2.6. Preparation and methods of use

12. Overall preparation and methods of use

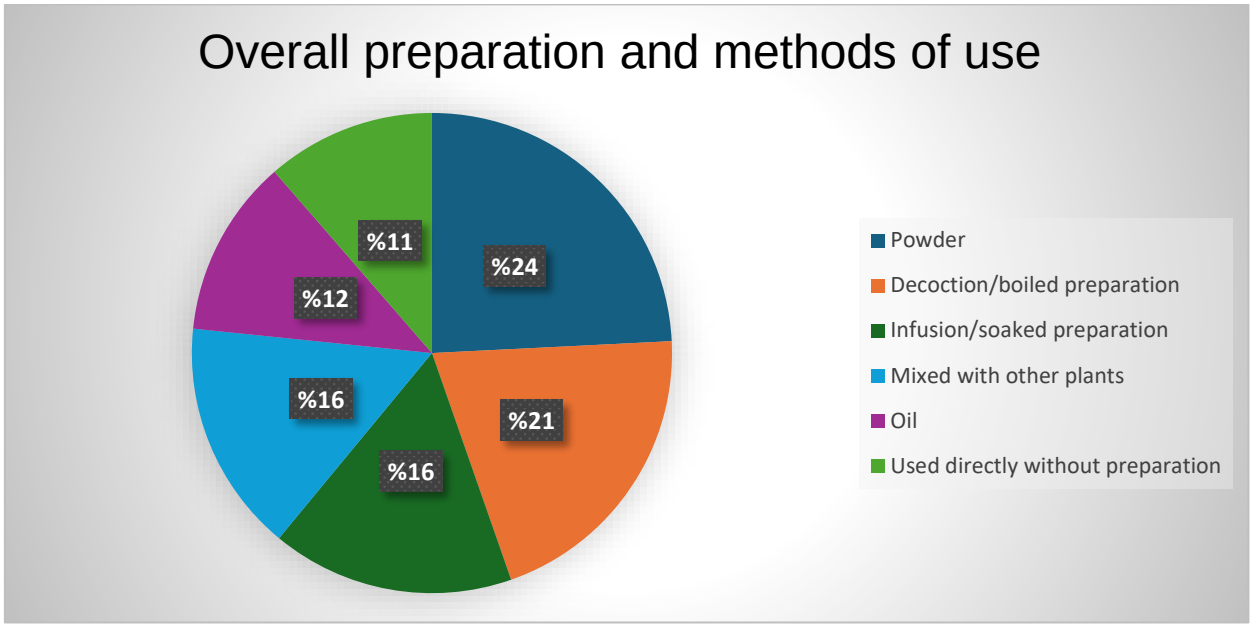

Figure II.12: Overall preparation and methods of use - Pie chart (%)

Comment: Powder was the most frequent method of use, followed by decoction, infusion, mixing with other plants, oil use, and direct use without preparation.

Analysis and discussion: Preparation method strongly influences extraction efficiency and biological activity. Decoction favors the extraction of water-soluble and heat-stable compounds, while infusion may better preserve some volatile constituents. Powdered

preparations expose the user to the whole plant matrix and may increase dose variability. Mixtures of plants may be culturally valued, but they also raise the risk of cumulative effects, interactions, and unpredictable toxicity.

Powder, decoction or boiling, and infusion were the dominant preparation methods. Mixing plants with other plants was also common, while oil use and direct use without preparation were less frequent.

Preparation method is a key biological variable because it determines which compounds are extracted and in what approximate concentration. Decoction may extract water-soluble and heat-stable compounds, whereas infusion is generally milder and may preserve some volatile components. Powdered preparations may contain the full plant material and therefore expose the user to a broader chemical profile.

Plant mixtures are particularly important from a safety perspective. Although mixtures may be valued traditionally because of perceived synergy, they can also increase the risk of unpredictable interactions, cumulative toxicity, or inaccurate dosing. These concerns are especially relevant for individuals with hepatic or renal impairment and for people using modern medication.

2.7. Perceived safety and therapeutic effectiveness

13. Perceived side effects by plant

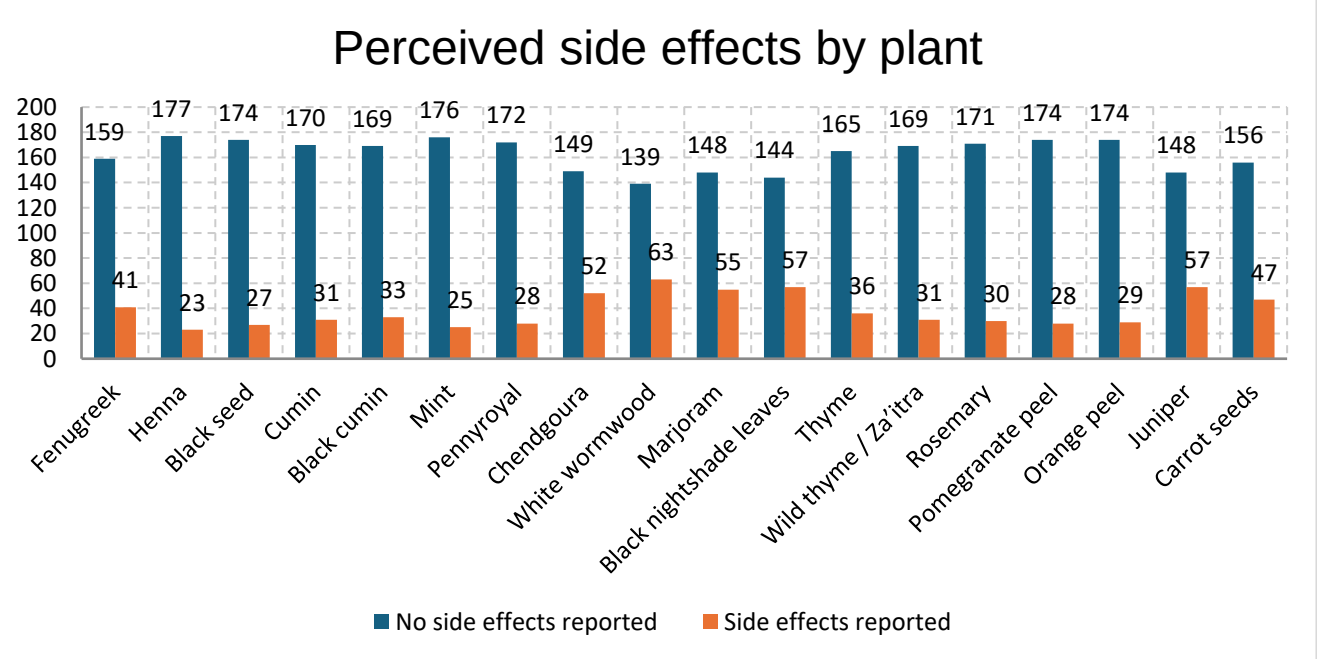

Figure II.13: Perceived side effects by plant - Pie chart (%)

Comment: For all investigated plants, the number of respondents reporting no side effects was higher than the number reporting side effects. However, side effects were relatively more frequent for white wormwood, black nightshade leaves, juniper, marjoram, chendgoura, carrot seeds, and fenugreek.

Analysis and discussion: This graph is important because it shows that local perception does not treat all plants as equally safe. From a toxicological viewpoint, perceived absence of side effects is not equivalent to confirmed safety, especially when dose, duration, pregnancy status, age, liver function, kidney function, and medication use are not controlled. Plants with relatively higher adverse reports should be prioritized for toxicity evaluation and pharmacovigilance-oriented studies.

14. Perceived effectiveness by plant

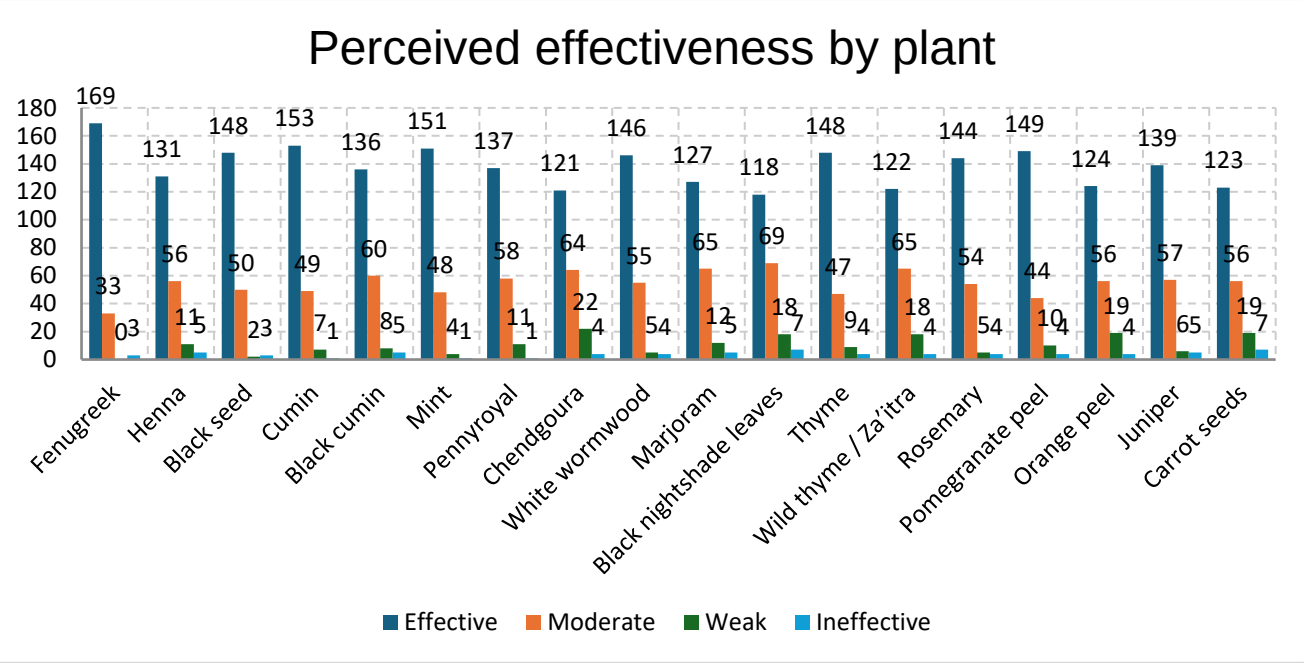

Figure II.14: Perceived effectiveness by plant - Pie chart (%)

Comment: The dominant rating for most plants was "Effective", with particularly high values for fenugreek, cumin, mint, pomegranate peel, black seed, thyme, white wormwood, and rosemary.

Analysis and discussion: The graph reflects perceived therapeutic effectiveness rather than experimentally measured efficacy. Respondents may base their judgment on symptom relief, family experience, repeated use, or cultural reputation. These perceptions are valuable for selecting candidate plants for future research, but objective confirmation requires controlled

biological assays, identification of active compounds, dose standardization, and clinical evaluation where appropriate.

Most plants were perceived as having no side effects by many respondents, and 'Effective' was the dominant effectiveness rating for several plants. These results are important because they describe the community's therapeutic confidence in medicinal plants.

Nevertheless, perceived safety is not equivalent to toxicological safety. Some plants may be tolerated under certain conditions but harmful at high doses, after prolonged use, in pregnancy, in children, or in people with chronic liver or kidney disease. The relatively higher reporting of side effects for plants such as white wormwood, black nightshade leaves, juniper, marjoram, chendgoura, and carrot seeds indicates that local experience already recognizes variation in plant tolerability.

The effectiveness data should also be interpreted as subjective therapeutic perception. Respondents may evaluate effectiveness based on symptom relief, family experience, cultural reputation, or repeated use. Laboratory assays and clinical studies would be required to determine mechanisms of action, active compounds, therapeutic dose, and objective efficacy.

2.8. Knowledge transmission and attitudes toward scientific documentation

15. Intergenerational transmission of plant knowledge

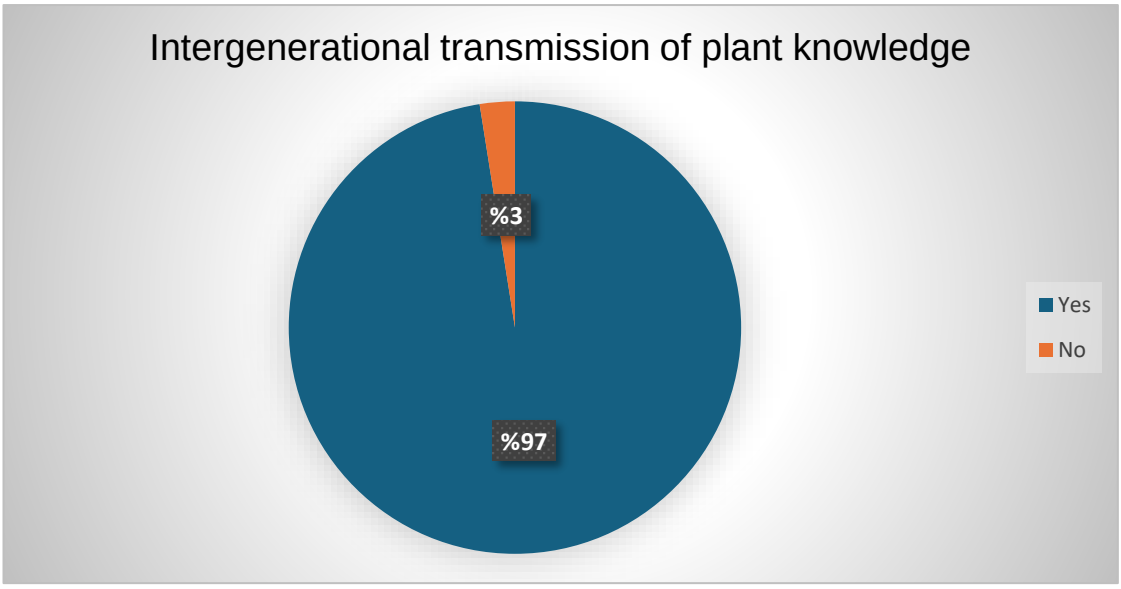

Figure II.15: Intergenerational transmission of plant knowledge - Pie chart (%)

Comment: The graph shows a very high level of intergenerational transmission, with 97.5% of respondents reporting that medicinal-plant knowledge is transmitted between generations.

Analysis and discussion: This result confirms that medicinal-plant use is embedded in family memory and cultural continuity. Intergenerational transmission can preserve useful empirical observations about preparation, indications, and caution, but it may also transmit unverified assumptions. Scientific documentation is therefore necessary to protect valuable local knowledge while evaluating its botanical accuracy, biological activity, and safety limits.

16. Position of traditional plant-based medicine

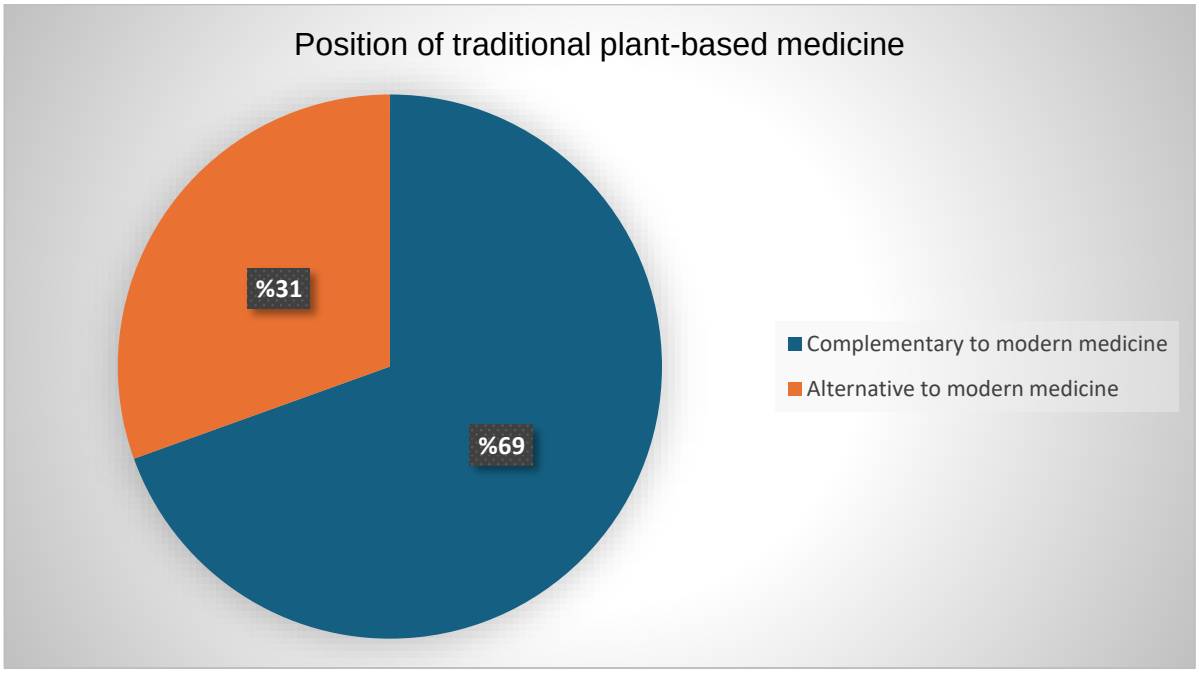

Figure II.16: Position of traditional plant-based medicine - Pie chart (%)

Comment: Most respondents considered traditional plant-based medicine complementary to modern medicine (69.5%), while 30.5% viewed it as an alternative.

Analysis and discussion: This finding supports an integrative interpretation of traditional medicine. Considering medicinal plants as complementary rather than substitutive reduces the risk of delaying biomedical diagnosis or treatment, especially for liver, kidney, digestive, or nervous-system disorders. The result also indicates that future public-health education can encourage safe use, medical consultation, and disclosure of herbal remedies to healthcare professionals.

17. Support for documenting medicinal plants scientifically

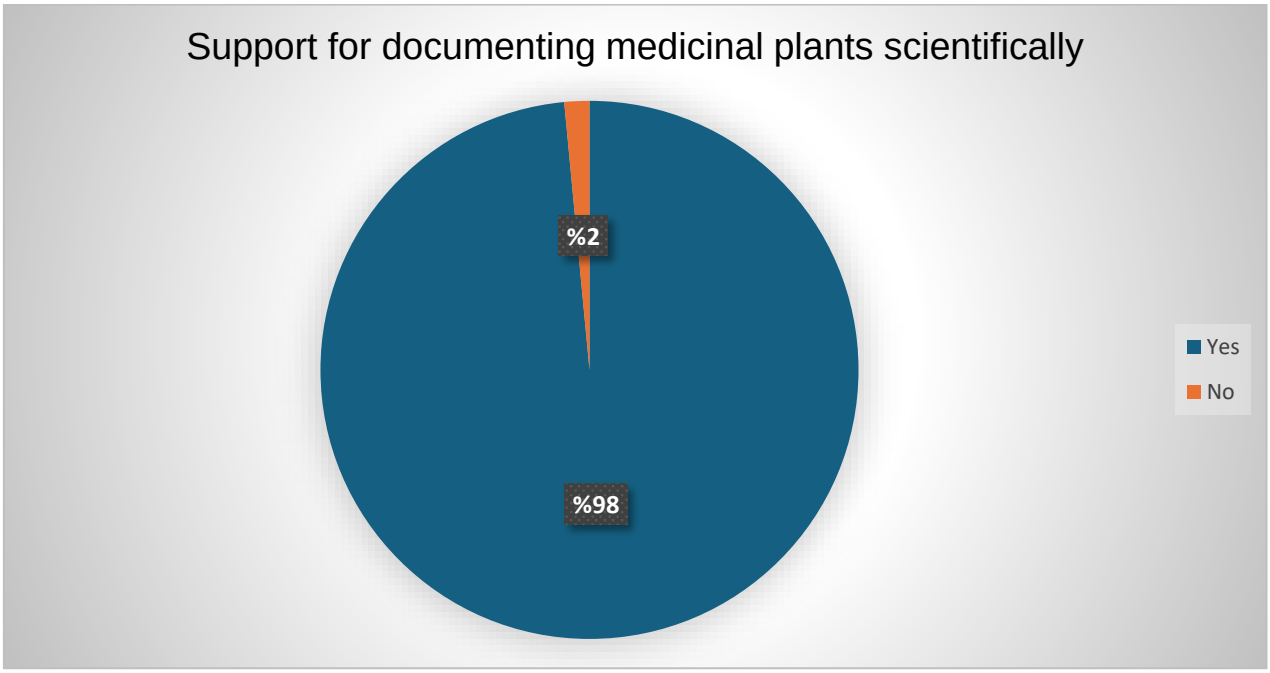

Figure II.17: Support for documenting medicinal plants scientifically - Pie chart (%)

Comment: Support for scientific documentation was very high, with 98.5% of respondents answering "Yes".

Analysis and discussion: This strong support is academically important because it shows community openness to transforming oral knowledge into organized scientific data. Scientific documentation can include botanical voucher specimens, taxonomic confirmation, phytochemical analysis, pharmacological testing, and safety assessment. Such documentation helps preserve local heritage while preventing the uncritical use of potentially risky plant materials.

A very high proportion of respondents reported that knowledge about medicinal plants is transmitted between generations. Family inheritance was the most frequent source of knowledge, followed by personal experience. Traditional healers, media, books, and herbalists were less frequent sources.

These findings show that medicinal-plant knowledge functions as a socially transmitted body of practical health information. The family appears to be the main space where plant names, preparation methods, and indications are learned. Personal experience then reinforces or modifies inherited knowledge through repeated use.

Most respondents considered traditional plant-based medicine complementary to modern medicine rather than a complete alternative. This is scientifically important because it supports an integrative interpretation: traditional knowledge can be documented and evaluated without rejecting biomedical care. The very strong support for scientific documentation also indicates that the community is receptive to academic validation, botanical identification, and safety assessment.

18. Source of knowledge about medicinal plants

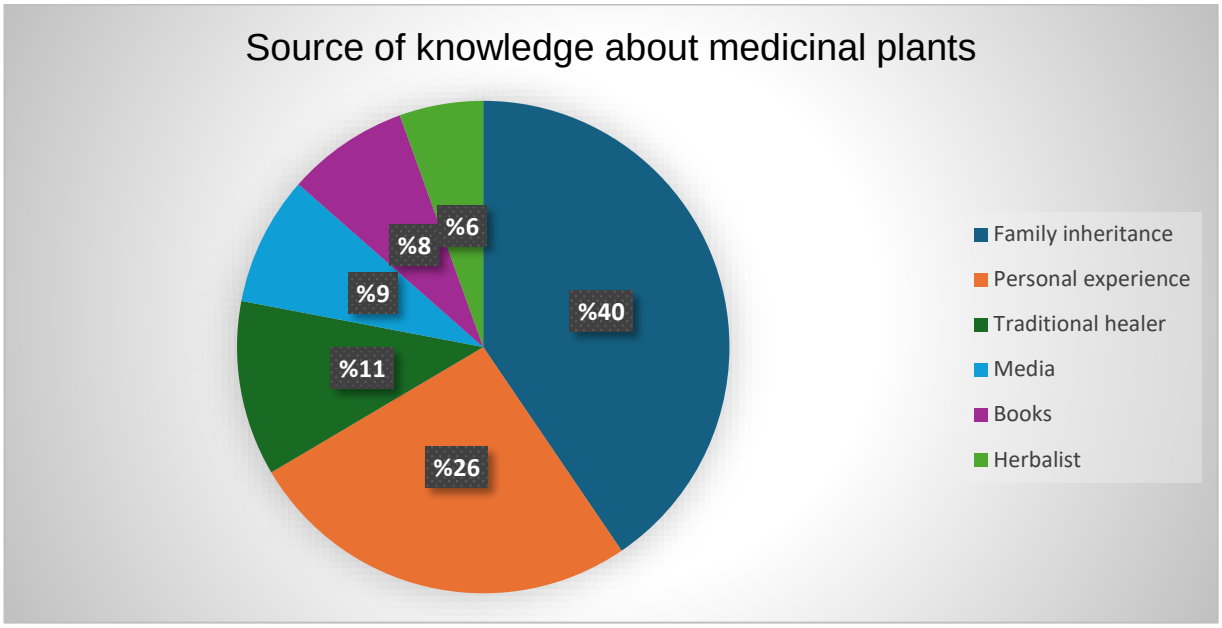

Figure II.18: Source of knowledge about medicinal plants - Pie chart (%)

Comment: Family inheritance was the main source of knowledge (40.5%), followed by personal experience (26.0%). Traditional healers, media, books, and herbalists represented smaller sources.

Analysis and discussion: The predominance of family inheritance confirms that medicinal-plant knowledge is mainly learned in the domestic and social environment. Personal experience then reinforces or modifies inherited practices through repeated use. From a methodological point of view, this means that ethnobotanical data should be interpreted as a mixture of cultural transmission, individual observation, and non-standardized therapeutic experience.

2.9. Qualitative coding of open responses

19. Qualitative coding: importance of plant properties

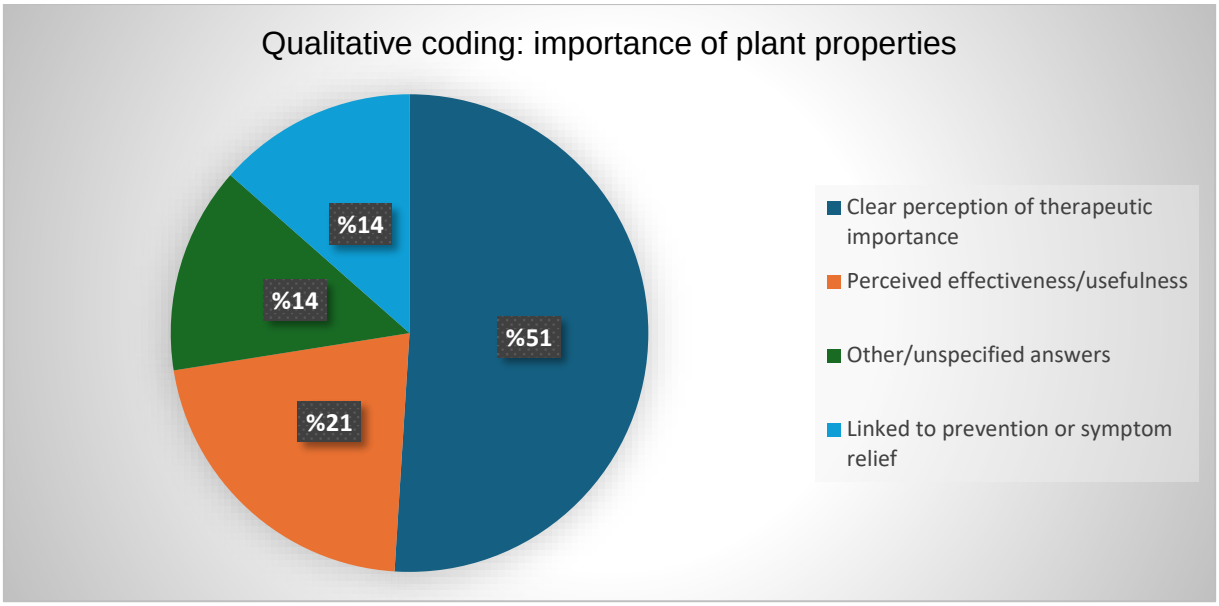

Figure II.19: Qualitative coding: importance of plant properties - Pie chart (%)

Comment: The qualitative coding shows that many respondents clearly perceived medicinal plants as therapeutically important, while other answers emphasized effectiveness, usefulness, prevention, or symptom relief.

Analysis and discussion: These qualitative categories show how respondents conceptualize plants as biologically active therapeutic resources rather than as ordinary household materials. The emphasis on effectiveness and symptom relief can guide future pharmacological questions, particularly regarding antispasmodic, anti-inflammatory, antimicrobial, gastroprotective, nephroprotective, or neuroprotective properties. Nevertheless, qualitative perception must be interpreted as reported experience and not as direct experimental evidence.

20. Qualitative coding: perceived safety of plants

Comment: The qualitative safety answers showed that respondents did not evaluate plant safety in a single way. Some answers presented medicinal plants as safe because they are natural, whereas others emphasized dose, moderation, caution, or did not provide a clear safety evaluation.

Analysis and discussion: This result is important because it reveals a partial awareness of the limits of traditional plant use. In biological terms, safety depends on plant identity, part used, preparation method, dose, duration of exposure, physiological status, and possible

interaction with conventional medicines. Therefore, the perceived natural origin of a plant should not be considered sufficient proof of toxicological safety.

The qualitative results show that many respondents associated plant importance with therapeutic usefulness, prevention, and symptom relief. Safety answers ranged from considering plants safe because they are natural to emphasizing caution, dose, and moderation.

This qualitative pattern is biologically and culturally meaningful. It shows that respondents do not perceive medicinal plants only as botanical materials but also as therapeutic agents embedded in family memory, everyday practice, and local health culture. At the same time, mentions of dose and caution indicate partial awareness that natural products can have limits and adverse effects.

For future research, these qualitative categories can help design more precise pharmacological questions. For example, plants frequently associated with stomach pain should be evaluated for antispasmodic, anti-inflammatory, antimicrobial, or gastroprotective properties, depending on their botanical identity and traditional preparation.

2.10. Summary inventory of the studied medicinal plants

Table 21. Local plants, standardized scientific names, methods of use, and treated conditions

Plant	Standardized scientific name	Most used part(s)	Most frequent preparation method(s)	Most cited treated conditions / benefits
Fenugreek	*Trigonella foenum-graecum L.*	Whole plant (92; 46.0%); Seeds (76; 38.0%); Leaves (22; 11.0%)	Decoction/boiled preparation (89; 44.5%); Infusion/soaked preparation (71; 35.5%); Powder (63; 31.5%)	Treatment of stomach pain (91; 45.5%); Cramps/spasms (55; 27.5%); Headache relief/protection (45; 22.5%)
Henna	*Lawsonia inermis L.*	Leaves (129; 64.5%); Whole plant (45; 22.5%); Stems (20; 10.0%)	Powder (97; 48.5%); Mixed with other plants (39; 19.5%); Infusion/soaked preparation (32; 16.0%)	Headache relief/protection (78; 39.0%); Cramps/spasms (56; 28.0%); Treatment of stomach pain (46; 23.0%)
Black seed	*Nigella sativa L.*	Seeds (72; 36.0%); Whole plant (67; 33.5%); Leaves (34; 17.0%)	Powder (55; 27.5%); Used directly without preparation (45; 22.5%); Oil (40; 20.0%)	Treatment of stomach pain (67; 33.5%); Cramps/spasms (63; 31.5%); Kidney protection (52; 26.0%)
Cumin	*Cuminum cyminum L.*	Seeds (70; 35.0%); Whole plant (62; 31.0%); Flowers (37; 18.5%)	Powder (79; 39.5%); Mixed with other plants (52; 26.0%); Decoction/boiled preparation (42; 21.0%)	Treatment of stomach pain (103; 51.5%); Cramps/spasms (69; 34.5%); Kidney protection (34; 17.0%)
Black cumin	*Carum carvi L.*	Seeds (75; 37.5%); Whole plant (52; 26.0%); Flowers (37; 18.5%)	Powder (62; 31.0%); Used directly without preparation (58; 29.0%); Mixed with other plants (43; 21.5%)	Treatment of stomach pain (85; 42.5%); Cramps/spasms (63; 31.5%); Kidney protection (39; 19.5%)

Mint	*Mentha spicata L. / Mentha piperita L.*	Leaves (92; 46.0%); Whole plant (62; 31.0%); Flowers (31; 15.5%)	Decoction/boiled preparation (72; 36.0%); Infusion/soaked preparation (53; 26.5%); Powder (46; 23.0%)	Treatment of stomach pain (92; 46.0%); Cramps/spasms (80; 40.0%); Headache relief/protection (39; 19.5%)
Pennyroyal	*Mentha pulegium L.*	Leaves (95; 47.5%); Whole plant (53; 26.5%); Flowers (30; 15.0%)	Decoction/boiled preparation (64; 32.0%); Infusion/soaked preparation (56; 28.0%); Powder (49; 24.5%)	Cramps/spasms (79; 39.5%); Treatment of stomach pain (74; 37.0%); Headache relief/protection (42; 21.0%)
Chendgoura	*Marrubium vulgare L. / local confirmation required*	Leaves (71; 35.5%); Whole plant (55; 27.5%); Flowers (38; 19.0%)	Powder (57; 28.5%); Infusion/soaked preparation (49; 24.5%); Decoction/boiled preparation (46; 23.0%)	Treatment of stomach pain (79; 39.5%); Cramps/spasms (62; 31.0%); Kidney protection (38; 19.0%)
White wormwood	*Artemisia absinthium L.*	Not available in the responses file	Powder (70; 35.0%); Decoction/boiled preparation (53; 26.5%); Mixed with other plants (41; 20.5%)	Treatment of stomach pain (88; 44.0%); Cramps/spasms (59; 29.5%); Kidney protection (42; 21.0%)
Marjoram	*Origanum majorana L.*	Leaves (73; 36.5%); Whole plant (59; 29.5%); Flowers (37; 18.5%)	Decoction/boiled preparation (55; 27.5%); Powder (48; 24.0%); Infusion/soaked preparation (41; 20.5%)	Treatment of stomach pain (68; 34.0%); Cramps/spasms (60; 30.0%); Kidney protection (48; 24.0%)
Black nightshade leaves	*Solanum nigrum L. / local confirmation required*	Leaves (108; 54.0%); Whole plant (45; 22.5%); Flowers (31; 15.5%)	Powder (49; 24.5%); Decoction/boiled preparation (49; 24.5%); Infusion/soaked preparation (42; 21.0%)	Treatment of stomach pain (63; 31.5%); Cramps/spasms (59; 29.5%); Kidney protection (54; 27.0%)

Thyme	*Thymus vulgaris L.*	Leaves (67; 33.5%); Whole plant (65; 32.5%); Flowers (41; 20.5%)	Decoction/boiled preparation (70; 35.0%); Powder (43; 21.5%); Infusion/soaked preparation (39; 19.5%)	Treatment of stomach pain (70; 35.0%); Cramps/spasms (67; 33.5%); Headache relief/protection (45; 22.5%)
Wild thyme / Za'itra	*Thymus capitatus L. / Thymus algeriensis Boiss. & Reut. / local confirmation required*	Not available in the responses file	Decoction/boiled preparation (65; 32.5%); Powder (49; 24.5%); Mixed with other plants (38; 19.0%)	Treatment of stomach pain (59; 29.5%); Cramps/spasms (59; 29.5%); Kidney protection (48; 24.0%)
Rosemary	*Rosmarinus officinalis L. (syn. Salvia rosmarinus Spenn.)*	Whole plant (71; 35.5%); Leaves (70; 35.0%); Flowers (30; 15.0%)	Decoction/boiled preparation (65; 32.5%); Powder (59; 29.5%); Mixed with other plants (42; 21.0%)	Treatment of stomach pain (75; 37.5%); Cramps/spasms (66; 33.0%); Kidney protection (38; 19.0%)
Pomegranate peel	*Punica granatum L.*	Peels (62; 31.0%); Whole plant (53; 26.5%); Leaves (44; 22.0%)	Powder (76; 38.0%); Decoction/boiled preparation (49; 24.5%); Infusion/soaked preparation (46; 23.0%)	Treatment of stomach pain (105; 52.5%); Cramps/spasms (56; 28.0%); Kidney protection (32; 16.0%)
Orange peel	*Citrus sinensis (L.) Osbeck*	Peels (65; 32.5%); Whole plant (54; 27.0%); Leaves (42; 21.0%)	Powder (75; 37.5%); Decoction/boiled preparation (52; 26.0%); Infusion/soaked preparation (37; 18.5%)	Treatment of stomach pain (81; 40.5%); Cramps/spasms (58; 29.0%); Kidney protection (41; 20.5%)

Juniper	*Juniperus communis L.*	Whole plant (64; 32.0%); Leaves (60; 30.0%); Flowers (32; 16.0%)	Powder (75; 37.5%); Decoction/boiled preparation (40; 20.0%); Mixed with other plants (39; 19.5%)	Treatment of stomach pain (85; 42.5%); Cramps/spasms (62; 31.0%); Kidney protection (44; 22.0%)
Carrot seeds	*Daucus carota L.*	Seeds (69; 34.5%); Whole plant (51; 25.5%); Leaves (34; 17.0%)	Powder (52; 26.0%); Decoction/boiled preparation (49; 24.5%); Mixed with other plants (40; 20.0%)	Kidney protection (71; 35.5%); Cramps/spasms (55; 27.5%); Treatment of stomach pain (52; 26.0%)

This inventory combines local plant names, standardized scientific names, most frequently used parts, dominant preparation methods, and the most cited treated conditions. It can be used as an ethnobotanical reference table for the studied community.

The table highlights the central role of digestive-system uses, especially stomach pain and cramps, while also documenting uses related to kidneys, liver, and headache relief. The presence of standardized scientific names improves the academic value of the inventory, but taxonomic caution remains necessary for ambiguous local names such as chendgoura, Za’itra, mint, local black cumin, and black nightshade leaves.

3. Discussion

The present ethnobotanical survey showed that medicinal plants occupy an important position in local therapeutic practices in the Wilaya of El Oued. The high proportion of respondents who had previously used herbal treatment confirms that phytotherapy remains a common form of self-care in the studied community. This finding is consistent with previous Algerian ethnobotanical studies reporting the persistence of traditional medicinal-plant use, particularly in southern and Saharan regions where plant-based remedies are culturally transmitted and easily accessible (Abbassi et al., 2015; Samara & Ferouhat, 2021). However, the present study differs from some previous works because it focused mainly on plants used for digestive disorders and related conditions, while other Algerian studies investigated broader therapeutic uses such as fertility, general traditional medicine, or aromatic plant diversity (Abbassi et al., 2015; Samara & Ferouhat, 2021).

The socio-demographic structure of the sample was dominated by young respondents, especially the 18–30 year age group, and by participants with a university educational level. This pattern may be explained by the use of an electronic questionnaire, which usually reaches younger and educated individuals more easily. In comparison, classical ethnobotanical surveys often give greater weight to elderly informants, herbalists, and traditional healers because they are considered important holders of oral medicinal knowledge (Ali, 2001; Samara & Ferouhat, 2021). Therefore, the present results reflect both traditional knowledge and the perception of a younger, more educated population. This difference should be considered when comparing the present data with field-based ethnobotanical studies relying mainly on older informants.

The predominance of female respondents may also be relevant from an ethnobotanical point of view. Women are often involved in household healthcare, preparation of herbal remedies, and transmission of practical knowledge within families. This observation is compatible with the general ethnobotanical literature, which frequently emphasizes the domestic role of women in maintaining traditional therapeutic practices (Ali, 2001; Samara & Ferouhat, 2021). Nevertheless, this result should not be interpreted as proof that women use medicinal plants more than men, because the present study did not perform a statistical comparison between gender and frequency of use.

The most frequently recommended plants in the present survey included fenugreek, pomegranate peel, mint, cumin, thyme, black cumin, black seed, pennyroyal, rosemary, juniper, and orange peel. This composition is comparable to previous studies on Mediterranean and North African medicinal plants, where aromatic herbs, seeds, spices, and fruit peels are

frequently reported because of their availability, low cost, culinary familiarity, and digestive properties (Bruneton, 1999; Duke, 2002; Evans, 2009). In the Algerian context, the presence of plants such as Mentha spp., Thymus spp., Rosmarinus officinalis, Artemisia absinthium, and Nigella sativa agrees with previous reports describing these taxa as important components of traditional phytotherapy (Samara & Ferouhat, 2021; Saadaoui et al., 2021).

Digestive complaints, especially stomach pain and cramps or spasms, were the most cited therapeutic indications. This result is biologically plausible because many of the most recommended plants contain essential oils, phenolic compounds, tannins, flavonoids, or bitter principles that may act on digestion, intestinal gas, gastric discomfort, and smooth-muscle spasms (Bruneton, 1999; Evans, 2009; WHO, 2013). Similar uses have been reported for cumin, caraway, mint, thyme, rosemary, and wormwood, which are traditionally described as carminative, antispasmodic, digestive, or appetite-stimulating plants (Duke, 2002; Evans, 2009; WHO, 2009; WHO, 2013). Thus, the present findings are consistent with pharmacognostic references that associate aromatic plants with gastrointestinal relief.

Fenugreek was one of the most frequently cited plants in the present study. This result agrees with previous pharmacological and ethnomedicinal reports describing Trigonella foenum-graecum as a plant rich in bioactive constituents and traditionally used for digestive stimulation, metabolic regulation, inflammation, and general strengthening (Basch et al., 2003; Bnouham et al., 2006). In the present survey, its frequent association with stomach pain and spasms supports its local importance in digestive self-care. However, compared with studies that emphasize its hypoglycemic and galactagogue effects, the present data highlight a more digestive-oriented use of fenugreek in the studied community (Basch et al., 2003; Bnouham et al., 2006).

Mint was also highly recommended, mainly for stomach pain and cramps. This result corresponds well with pharmacognostic references that describe Mentha spicata and Mentha piperita as carminative, antispasmodic, digestive, and mildly sedative plants (Evans, 2009; WHO, 2013). The agreement between the present ethnobotanical data and the literature is strong, because mint is widely used in Mediterranean households as an infusion for bloating, nausea, and digestive discomfort. Nevertheless, the distinction between Mentha spicata, Mentha piperita, and other local mint species remains important, since chemical composition and essential-oil profile may vary between taxa (Bruneton, 1999; Evans, 2009).

Cumin and black cumin or caraway were frequently cited for stomach pain and intestinal spasms. This is consistent with previous studies showing that Cuminum cyminum and Carum carvi are traditionally used as carminative and antispasmodic remedies, particularly for gas, bloating, indigestion, and colic (Duke, 2002; Evans, 2009; Goyal et al., 2018). Their frequent use in powder or decoction form in the present study may be explained by the fact that these seeds are common household spices and are easily prepared. However, local vernacular names should be carefully verified because "black cumin" may refer to different species depending on the region, including Carum carvi or Nigella sativa.

Pomegranate peel was among the most recommended plant materials and was frequently associated with stomach pain. This agrees with the known richness of Punica granatum peel in tannins, polyphenols, ellagic acid derivatives, and punicalagins, which are associated with antioxidant, antimicrobial, anti-inflammatory, and astringent effects (Seeram et al., 2006; Viuda-Martos et al., 2010). The use of pomegranate peel for digestive disorders, especially diarrhea or intestinal discomfort, is therefore consistent with its phytochemical composition. Compared with studies focusing on pomegranate fruit juice and cardiovascular or antioxidant effects, the present results emphasize the local medicinal value of the peel as a traditional digestive remedy (Seeram et al., 2006; Viuda-Martos et al., 2010).

Thyme, wild thyme, and rosemary were also frequently reported. These findings agree with previous studies describing Thymus vulgaris, Thymus algeriensis, Thymus capitatus, and Rosmarinus officinalis as Mediterranean aromatic species rich in thymol, carvacrol, rosmarinic acid, carnosic acid, and other phenolic compounds (Baser, 2008; Miguel, 2010; WHO, 2013). Their traditional use for digestive and respiratory disorders is widely documented, and their antimicrobial, antioxidant, anti-inflammatory, and antispasmodic properties support their selection by local users (Dauqan & Abdullah, 2017; Miguel, 2010). The present study therefore confirms the importance of Lamiaceae species in traditional therapy in southern Algeria.

The use of wormwood and pennyroyal requires particular caution. Although Artemisia absinthium and Mentha pulegium are traditionally used for digestive disorders, both contain potentially toxic constituents when consumed in high doses or concentrated forms. Wormwood contains thujone, which may produce neurotoxic effects at excessive doses, while pennyroyal contains pulegone, which is associated with hepatic toxicity and is contraindicated during pregnancy (EMA, 2010; WHO, 2009). Therefore, the presence of these plants among the cited remedies confirms their ethnobotanical importance, but also highlights the need for dose control, toxicological evaluation, and public-health awareness.

Leaves and whole plants were the most frequently used plant parts, followed by seeds, flowers, stems, and peels. This result is comparable to many ethnobotanical surveys where leaves are often dominant because they are easy to collect, renew rapidly, and contain high concentrations of secondary metabolites such as flavonoids, phenolic acids, and essential oils (Bruneton, 1999; Evans, 2009). However, the frequent use of the whole plant may increase chemical variability and make dosage less precise. This point is important because the biological activity and toxicity of a medicinal plant may differ according to the plant part used, as seen in species such as Solanum nigrum, where leaves and unripe fruits may contain toxic glycoalkaloids (Edmonds & Chweya, 1997; WHO, 2013).

Powder, decoction, and infusion were the dominant preparation methods. These results are consistent with traditional phytotherapeutic practices reported in North African and Mediterranean contexts, where simple household preparations are preferred because they require no specialized equipment (Bruneton, 1999; Samara & Ferouhat, 2021). From a biological perspective, preparation method directly influences the extracted compounds: decoction favors water-soluble and heat-stable constituents, infusion may preserve some volatile molecules, while powder exposes the user to the entire plant matrix. Consequently, comparison with previous studies must take into account not only the plant species but also the preparation method and the plant part used.

The perception of effectiveness was generally high for several plants, particularly fenugreek, cumin, mint, pomegranate peel, black seed, thyme, wormwood, and rosemary. These perceptions are compatible with the known pharmacological activities of many of these plants, including antioxidant, antimicrobial, antispasmodic, anti-inflammatory, and gastroprotective effects (Ahmad et al., 2013; Bruneton, 1999; Evans, 2009; WHO, 2013). However, perceived effectiveness remains subjective and may be influenced by cultural reputation, repeated family use, placebo effect, or spontaneous resolution of minor digestive symptoms. Therefore, these results should be considered as ethnobotanical indicators that can guide future laboratory and clinical research rather than as direct proof of therapeutic efficacy.

The reported absence of side effects for most plants indicates a generally positive perception of plant safety among respondents. This result is common in ethnobotanical surveys because natural products are often perceived as safer than synthetic drugs (WHO, 2009; WHO, 2013). Nevertheless, the present data also showed relatively higher side-effect reporting for plants such as white wormwood, black nightshade leaves, juniper, marjoram, chendgoura, carrot seeds, and fenugreek. This observation is important because it shows that local users do

not consider all medicinal plants equally safe. It is also consistent with pharmacological references warning that certain plants may produce toxicity depending on dose, duration, plant part, physiological status, or interaction with conventional medication (EMA, 2010; EMA, 2012; WHO, 2013).

Knowledge transmission was mainly intergenerational, and family inheritance was the principal source of information. This finding strongly agrees with previous Algerian ethnobotanical studies describing medicinal-plant knowledge as an oral heritage transmitted within families and communities (Ali, 2001; Abbassi et al., 2015; Samara & Ferouhat, 2021). The high support for scientific documentation in the present study is therefore significant. It indicates that the local population is receptive to transforming oral knowledge into structured scientific data through botanical authentication, voucher specimens, phytochemical screening, pharmacological assays, and toxicological studies.

Most respondents considered traditional plant-based medicine complementary to modern medicine rather than an alternative. This result is scientifically important because it supports an integrative approach to phytotherapy. Similar recommendations are found in international references, which emphasize that traditional medicine can contribute to healthcare when it is documented, evaluated, and used safely (WHO, 2009; WHO, 2013). In the context of digestive, hepatic, renal, and nervous-system disorders, this complementary position is particularly important because delayed medical diagnosis or uncontrolled plant use may expose patients to complications.

Overall, the present study agrees with previous ethnobotanical and pharmacognostic literature in showing that medicinal plants remain central to local healthcare practices, especially for digestive disorders. Its main contribution is the documentation of plants used in the Wilaya of El Oued, their perceived indications, used parts, preparation methods, safety perception, and knowledge-transmission pathways. However, the study also has methodological limits, including the predominance of young educated respondents, the absence of botanical voucher specimens, possible confusion in vernacular names, and reliance on perceived rather than experimentally measured efficacy. Future studies should therefore combine ethnobotanical surveys with botanical identification, phytochemical analysis, biological testing, dose standardization, and toxicological evaluation.

Conclusion

Conclusion

This study explored the role of medicinal and aromatic plants in traditional healthcare practices, with a particular focus on their use in the management of digestive disorders and related health conditions. The work combined a bibliographic synthesis with an ethnobotanical field survey based on 200 valid questionnaires, in addition to a scientific discussion of the digestive system and the intestinal microbiota.

The bibliographic chapter highlighted the richness of medicinal plants and their bioactive compounds, including phenolics, flavonoids, tannins, alkaloids, and essential oils, which are responsible for a wide range of pharmacological activities such as antioxidant, antimicrobial, anti-inflammatory, antispasmodic, and gastroprotective effects. These properties explain the widespread traditional use of plants such as Trigonella foenum-graecum, Nigella sativa, Mentha spicata, Thymus vulgaris, and Rosmarinus officinalis.

The second bibliographic chapter provided an overview of the digestive system, digestive disorders, and the intestinal microbiota. It emphasized the importance of gut health in overall physiological balance and highlighted the emerging scientific interest in the microbiota as a key factor in human health. This section also underlined the growing relevance of natural approaches, including medicinal plants and probiotics, in supporting digestive function and managing gastrointestinal disorders.

The experimental ethnobotanical survey revealed that medicinal plants are still widely used in the studied community, mainly for treating stomach pain, intestinal cramps, and other digestive symptoms. The most commonly used plant parts were leaves and whole plants, while powder, decoction, and infusion were the dominant preparation methods. The study also showed that knowledge of medicinal plants is mainly transmitted through family inheritance and personal experience, confirming the cultural continuity of traditional phytotherapy.

Socio-demographic results indicated a predominance of young and educated respondents, which reflects both the data collection method and the increasing interest of educated groups in documenting traditional knowledge. Women were slightly more represented than men, which is consistent with their important role in household healthcare practices and the preparation of herbal remedies.

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Annexes

Annex 01. Questionnaire Sheets

Survey 01

Traditional Use of Medicinal Plants for the Treatment of Digestive, Liver, Kidney, and Nervous-System Disorders in Local Communities

I. Socio-demographic and health information

1. What is your place of residence?

Select one answer only.

☐ El Oued	☐ Bayadha	☐ Reguiba
☐ Hassi Khalifa	☐ Trifaoui	☐ Nakhla
☐ Debila	☐ Robbah	☐ Sidi Aoun
☐ Ogla	☐ Taleb Larbi	☐ Douar El Ma

2. What is your age group?

Select one answer only.

☐ 18–30 years	☐ 31–45 years	☐ 45–60 years

3. What is your sex?

Select one answer only.

☐ Female	☐ Male

4. What is your educational level?

Select one answer only.

☐ Primary	☐ Middle school	☐ Secondary
☐ University	☐ Postgraduate studies	

5. What is your general health status?

Select one answer only.

☐ Minor health problems	☐ Chronic health problems

6. Have you ever undergone surgery related to the liver, kidneys, digestive system, or nervous system?

Select one answer only, then specify if the answer is Yes.

☐ Yes	☐ No

If yes, specify the type of surgery:

.....

7. Have you ever used herbal treatment?

Select one answer only.

☐ Yes	☐ No

8. How and when do you usually use herbal treatment?

Open answer.

.....

.....

II. Medicinal plants included in the questionnaire

Code	**Common English name**	**Scientific name**	**Observation**
P1	Fenugreek	Trigonella foenum-graecum	—
P2	Henna	Lawsonia inermis	—
P3	Black seed / Nigella	Nigella sativa	Nigella arvensis L. may be checked locally if used under the same vernacular name.
P4	Green cumin	Cuminum cyminum	—
P5	Black cumin / Caraway	Carum carvi	Local confirmation required because the vernacular name may vary.
P6	Mint	Mentha spicata / Mentha piperita	According to the local type used.
P7	Pennyroyal	Mentha pulegium	—
P8	Chendgoura	Marrubium vulgare	Requires local botanical confirmation.
P9	Wormwood	Artemisia absinthium	—
P10	Marjoram	Origanum majorana	—
P11	Black nightshade leaves	Solanum nigrum	Requires local botanical confirmation.

P12	Thyme	Thymus vulgaris	—
P13	Wild thyme / Za'itra	Thymus capitatus / Thymus algeriensis	Wild type; species should be checked locally.
P14	Rosemary	Rosmarinus officinalis (Salvia rosmarinus)	Salvia rosmarinus is the currently accepted name in many modern taxonomic references.
P15	Pomegranate peel	Punica granatum	—
P16	Orange peel	Citrus sinensis	—
P17	Juniper	Juniperus communis	—
P18	Carrot seeds	Daucus carota	—

III. Questions on traditional medicinal-plant use

9. Which of the following medicinal plants do you recommend for use as herbal remedies?

Select all applicable answers.

☐ P1 Fenugreek (Trigonella foenum-graecum)	☐ P2 Henna (Lawsonia inermis)
☐ P3 Black seed / Nigella (Nigella sativa)	☐ P4 Green cumin (Cuminum cyminum)
☐ P5 Black cumin / Caraway (Carum carvi)	☐ P6 Mint (Mentha spicata / Mentha piperita)
☐ P7 Pennyroyal (Mentha pulegium)	☐ P8 Chendgoura (Marrubium vulgare)
☐ P9 Wormwood (Artemisia absinthium)	☐ P10 Marjoram (Origanum majorana)
☐ P11 Black nightshade leaves (Solanum nigrum)	☐ P12 Thyme (Thymus vulgaris)
☐ P13 Wild thyme / Za'itra (Thymus capitatus / Thymus algeriensis)	☐ P14 Rosemary (Rosmarinus officinalis (Salvia rosmarinus))
☐ P15 Pomegranate peel (Punica granatum)	☐ P16 Orange peel (Citrus sinensis)
☐ P17 Juniper (Juniperus communis)	☐ P18 Carrot seeds (Daucus carota)

10. What are the perceived medicinal benefits of each plant?

Select all applicable answers for each plant.

Plant code / medicinal plant	Protection from headache	Kidney protection	Treatment of stomach pain	Cramps/spasms	Support of liver functions
P1. Fenugreek (Trigonella foenum-graecum)	☐	☐	☐	☐	☐
P2. Henna (Lawsonia inermis)	☐	☐	☐	☐	☐
P3. Black seed / Nigella (Nigella sativa)	☐	☐	☐	☐	☐
P4. Green cumin (Cuminum cyminum)	☐	☐	☐	☐	☐
P5. Black cumin / Caraway (Carum carvi	☐	☐	☐	☐	☐
P6. Mint (Mentha spicata / Mentha piperita)	☐	☐	☐	☐	☐
P7. Pennyroyal (Mentha pulegium)	☐	☐	☐	☐	☐
P8. Chendgoura (Marrubium vulgare)	☐	☐	☐	☐	☐
P9. Wormwood (Artemisia absinthium)	☐	☐	☐	☐	☐
P10. Marjoram (Origanum majorana)	☐	☐	☐	☐	☐

P11. Black nightshade leaves (Solanum nigrum)	☐	☐	☐	☐	☐
P12. Thyme (Thymus vulgaris)	☐	☐	☐	☐	☐
P13. Wild thyme / Za'itra (Thymus capitatus / Thymus algeriensis)	☐	☐	☐	☐	☐
P14. Rosemary (Rosmarinus officinalis (Salvia rosmarinus)	☐	☐	☐	☐	☐
P15. Pomegranate peel (Punica granatum)	☐	☐	☐	☐	☐
P16. Orange peel (Citrus sinensis)	☐	☐	☐	☐	☐
P17. Juniper (Juniperus communis)	☐	☐	☐	☐	☐
P18. Carrot seeds (Daucus carota)	☐	☐	☐	☐	☐

11. Is the use of medicinal plants common in your community?

Select one answer only.

☐ Yes	☐ No	☐ Rarely

12. Which part(s) of each medicinal plant are usually used?

Select all applicable answers for each plant.

Plant code / medicinal plant	Whole plant	Seeds	Peels	Stems	Flowers	Leaves
P1. Fenugreek (Trigonella foenum-graecum)	☐	☐	☐	☐	☐	☐

P2. Henna (Lawsonia inermis)	☐	☐	☐	☐	☐	☐
P3. Black seed / Nigella (Nigella sativa)	☐	☐	☐	☐	☐	☐
P4. Green cumin (Cuminum cyminum)	☐	☐	☐	☐	☐	☐
P5. Black cumin / Caraway (Carum carvi)	☐	☐	☐	☐	☐	☐
P6. Mint (Mentha spicata / Mentha piperita)	☐	☐	☐	☐	☐	☐
P7. Pennyroyal (Mentha pulegium)	☐	☐	☐	☐	☐	☐
P8. Chendgoura (Marrubium vulgare)	☐	☐	☐	☐	☐	☐
P9. Wormwood (Artemisia absinthium)	☐	☐	☐	☐	☐	☐
P10. Marjoram (Origanum majorana)	☐	☐	☐	☐	☐	☐
P11. Black nightshade leaves (Solanum nigrum)	☐	☐	☐	☐	☐	☐
P12. Thyme (Thymus vulgaris)	☐	☐	☐	☐	☐	☐
P13. Wild thyme / Za'itra (Thymus capitatus / Thymus algeriensis)	☐	☐	☐	☐	☐	☐
P14. Rosemary (Rosmarinus officinalis (Salvia rosmarinus))	☐	☐	☐	☐	☐	☐
P15. Pomegranate peel (Punica granatum)	☐	☐	☐	☐	☐	☐
P16. Orange peel (Citrus sinensis)	☐	☐	☐	☐	☐	☐
P17. Juniper (Juniperus communis) =	☐	☐	☐	☐	☐	☐

P18. Carrot seeds (Daucus carota)	☐	☐	☐	☐	☐	☐

13. How are these medicinal plants usually prepared or used?

Select all applicable answers for each plant.

Plant code / medicinal plant	Infusion/soaked preparation	Powder	Oil	Decoction/boiled preparation	Mixed with other plants	Used directly without preparation
P1. Fenugreek (Trigonella foenum-graecum)	☐	☐	☐	☐	☐	☐
P2. Henna (Lawsonia inermis)	☐	☐	☐	☐	☐	☐
P3. Black seed / Nigella (Nigella sativa)	☐	☐	☐	☐	☐	☐
P4. Green cumin (Cuminum cyminum)	☐	☐	☐	☐	☐	☐
P5. Black cumin / Caraway (Carum carvi)	☐	☐	☐	☐	☐	☐
P6. Mint (Mentha spicata / Mentha piperita)	☐	☐	☐	☐	☐	☐
P7. Pennyroyal (Mentha pulegium)	☐	☐	☐	☐	☐	☐
P8. Chendgoura (Marrubium vulgare)	☐	☐	☐	☐	☐	☐
P9. Wormwood (Artemisia absinthium)	☐	☐	☐	☐	☐	☐
P10. Marjoram (Origanum majorana)	☐	☐	☐	☐	☐	☐
P11. Black nightshade leaves (Solanum nigrum)	☐	☐	☐	☐	☐	☐
P12. Thyme (Thymus vulgaris)	☐	☐	☐	☐	☐	☐

P13. Wild thyme / Za'itra (Thymus capitatus / Thymus algeriensis)	☐	☐	☐	☐	☐	☐
P14. Rosemary (Rosmarinus officinalis (Salvia rosmarinus))	☐	☐	☐	☐	☐	☐
P15. Pomegranate peel (Punica granatum)	☐	☐	☐	☐	☐	☐
P16. Orange peel (Citrus sinensis)	☐	☐	☐	☐	☐	☐
P17. Juniper (Juniperus communis)	☐	☐	☐	☐	☐	☐
P18. Carrot seeds (Daucus carota)	☐	☐	☐	☐	☐	☐

14. How important are the properties of these plants in treatment?

Open answer.

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15. Is knowledge about medicinal plants transmitted between generations?

Select one answer only.

☐ Yes	☐ No

16. Do these medicinal plants have side effects?

Select Yes or No for each plant.

Plant code / medicinal plant	**Yes**	**No**
P1. Fenugreek (Trigonella foenum-graecum)	☐	☐
P2. Henna (Lawsonia inermis)	☐	☐
P3. Black seed / Nigella (Nigella sativa)	☐	☐
P4. Green cumin (Cuminum cyminum)	☐	☐
P5. Black cumin / Caraway (Carum carvi)	☐	☐
P6. Mint (Mentha spicata / Mentha piperita)	☐	☐
P7. Pennyroyal (Mentha pulegium)	☐	☐

P8. Chendgoura (Marrubium vulgare)	☐	☐
P9. Wormwood (Artemisia absinthium)	☐	☐
P10. Marjoram (Origanum majorana)	☐	☐
P11. Black nightshade leaves (Solanum nigrum)	☐	☐
P12. Thyme (Thymus vulgaris)	☐	☐
P13. Wild thyme / Za'itra (Thymus capitatus / Thymus algeriensis)	☐	☐
P14. Rosemary (Rosmarinus officinalis (Salvia rosmarinus))	☐	☐
P15. Pomegranate peel (Punica granatum)	☐	☐
P16. Orange peel (Citrus sinensis)	☐	☐
P17. Juniper (Juniperus communis)	☐	☐
P18. Carrot seeds (Daucus carota)	☐	☐

17. How safe are these medicinal plants in treatment?

Open answer.

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18. How do you evaluate the therapeutic effectiveness of each plant?

Select one answer for each plant.

Plant code / medicinal plant	**Effective**	**Moderate**	**Weak**	**Ineffective**
P1. Fenugreek (Trigonella foenum-graecum)	☐	☐	☐	☐
P2. Henna (Lawsonia inermis)	☐	☐	☐	☐
P3. Black seed / Nigella (Nigella sativa)	☐	☐	☐	☐
P4. Green cumin (Cuminum cyminum)	☐	☐	☐	☐
P5. Black cumin / Caraway (Carum carvi)	☐	☐	☐	☐
P6. Mint (Mentha spicata / Mentha piperita)	☐	☐	☐	☐
P7. Pennyroyal (Mentha pulegium)	☐	☐	☐	☐
P8. Chendgoura (Marrubium vulgare)	☐	☐	☐	☐
P9. Wormwood (Artemisia absinthium)	☐	☐	☐	☐
P10. Marjoram (Origanum majorana)	☐	☐	☐	☐

P11. Black nightshade leaves (Solanum nigrum)	☐	☐	☐	☐
P12. Thyme (Thymus vulgaris)	☐	☐	☐	☐
P13. Wild thyme / Za'itra (Thymus capitatus / Thymus algeriensis)	☐	☐	☐	☐
P14. Rosemary (Rosmarinus officinalis (Salvia rosmarinus))	☐	☐	☐	☐
P15. Pomegranate peel (Punica granatum)	☐	☐	☐	☐
P16. Orange peel (Citrus sinensis)	☐	☐	☐	☐
P17. Juniper (Juniperus communis)	☐	☐	☐	☐
P18. Carrot seeds (Daucus carota)	☐	☐	☐	☐

19. Do you consider traditional plant-based medicine to be:

Select one answer only.

☐ Complementary to modern medicine
☐ Alternative to modern medicine
☐ Ineffective

20. Do you support documenting medicinal plants in scientific studies?

Select one answer only.

☐ Yes	☐ No

21. What is the main source of your knowledge about medicinal plants?

Select one answer only.

☐ Family inheritance	☐ Traditional healer	☐ Books
☐ Media	☐ Herbalist	☐ Personal experience