# **TRADITIONAL MEDICINE IN NORTH EAST AFRICA:** RESEARCH ON TRADITIONAL HEALER PREPARATIONS AND HERBS

Editors: Atul Kaushik Jeevan Jyoti Kaushik

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## Traditional Medicine in North East Africa: Research on Traditional Healer Preparations and Herbs

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### FOREWORD

According to the World Health Organization, traditional medicine consists of health practices, approaches, knowledge, and beliefs that incorporate plant, animal, and mineral-based medicines, spiritual therapies, and manual techniques applied individually or in combination to treat, diagnose, and prevent illnesses or maintain well-being. Plants form the anchor of several medical and healthcare systems for preventing and treating humans as well as domestic animals. Plants are also increasingly being used for pest management in agriculture. The World Health Organization estimates that about 80% of the African population does not have access to essential modern medicines and health facilities and therefore depends on their traditional medicines. Traditional medicine is available and accessible as the first line of treatment. It is largely not integrated with modern medicine with the exception of a few countries where some steps/strides have been taken towards its integration. The traditional medicines in Africa have been developed over millennia and the practices are as old as mankind. Its long historical background dates to the Stoneage period, making it older than modern medicine. However, the origin of the knowledge of traditional medicine in Africa is uncertain since there was neither any documentation, nor was it organized like in India and China. Whatever the source of knowledge, the early users should have been able to recognize the previously used plants for future reuse. African traditional medicines that are classified as folk medicine, consist of numerous healing practices that are holistic in approach. Sickness is understood from an interaction of the physical, physiological, psycho-social, and spiritual factors in contrast to orthodox medicine where disease is considered from the physiopathological perspective. Thus, to address these challenges that are intertwined, the practitioners include bone setters, herbalists, traditional birth attendants (midwives), traditional psychologists, and other specialists based on contexts, geographic settings, and communities, due to the diversity of cultures.

Traditional Medicine in North East Africa with special reference to research on traditional healer preparations and herbs considers old age practices of traditional healers and the knowledge of medicinal plants. There is a diversity of African materia medica, but information about them is inadequate and yet there is a rush to exploit their healing properties by multinational companies. This book will contribute towards salvaging this old age information before it becomes extinct as the custodians die and the plants associated with them become extinct. The ever-increasing use of traditional herbal medicine has forced African governments to regulate and improve traditional medicine in their respective countries. This has had the overall effect of contributing to improved healthcare delivery since the communities trust traditional healers. The book specifically sheds more light on the traditional healer's claims to use various medicinal plants of North-East Africa, as well as the intricate relationship between traditional healing practices and the wealth of medicinal plants employed. It also bridges the gap between ancient wisdom and modern science and unravels the rich tapestry of traditional healing practices across a diversity of cultures in the region. The book has explored a wide range of topics including patient care, traditional approaches to disease cure, and scientific validation of plants. Natural products, especially those of plant origin, have always been a great source of medications due to various compounds that improve the quality of life, and, therefore, their phytochemistry has been highlighted. Additional topics addressed include: the toxicity profile of herbs; plants used in mind-altering and psychoactivity, and emergency medicine including the management of snake bites. Contrary to a commonly held myth that the safety and effectiveness of some traditional medicines are unknown, there are examples of effective traditional treatments and practices that have been investigated through clinical studies. Some of these were from local practices that are used to address global challenges: Prunus africana for prostate cancer, Argemone

*mexicana* for malaria, while *Aloe barbadensis* is renowned for wound healing. The safety of traditional medicine has been a thorny issue, especially in modern medicine. So, dose preparation and standardization of herbs used by practitioners are addressed in order to give the quality, safety, and efficacy required of the uses of herbs. Traditional medicines still remain a largely untapped health resource: they are not only sources of new leads for drug discoveries but can also provide novel approaches that may have direct public health and economic impacts. The book appeals to researchers, academicians, and practitioners as it offers comprehensive knowledge held by traditional healers that can be applied in modern medicine through research and development. The information here presented can be translated into vigorous research that adds value to traditional medicine, contributing to the curricula for training modern health practitioners, as well as curbing the destruction of natural ecosystems that house herbal medicines. Combined efforts for more scientific validation for quality, safety, and efficacy are required from respective national governments and several stakeholders to develop African traditional medicine and the associated practices to international standards

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### PREFACE

In Northeast Africa, traditional medicine is deeply embedded in the region's culture. Communities have traditionally relied on traditional healers, passing on their wisdom for generations. This publication, "Traditional Medicine in North East Africa: Research on Traditional Healer Preparations and Herbs," aims to document and explore the rich history of traditional healing in this diverse region. This book emphasizes the traditionally claimed medicinal plants extensively used by the country's traditional healers/practitioners against various ailments/diseases. Readers of the book will go through the Plant's Introduction, Pharmacognosy, Pharmacology (Dynamics), Phytochemicals or Phytoconstituents, Validation of the claim and scientific findings. The work presented in this book will be most useful for undergraduate students, postgraduate students and faculties at various universities of the world. Medicinal plant researchers or biomedical scientists (Microbiology, Biotechnology and Pharmaceutical Sciences) will greatly benefit from the content as it covers various therapeutic potentials of medicinal herbs or trees. This publication will be a valuable resource for researchers, medical practitioners, policymakers, and anyone interested in the interconnectedness of traditional medicine, culture, and health in North East Africa. We hope it fosters ongoing discussions, investigations, and partnerships to protect, promote, and utilize the healing power of traditional medicine for the well-being of all.

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## **DEDICATION**

This book is dedicated to TRADITIONAL HEALER'S KNOWLEDGE & PRACTICES WHICH ILLUMINATE PATHS TO HOLISTIC WELL-BEING AND CULTURAL PRESERVATION

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## Wisdom and Practices of Indigenous Herbalists of Rural Areas of North East Africa

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**Abstract:** For a long time in the Northeastern part of Africa, most of the population relied on indigenous herbs and had many beliefs and faith in the wisdom of the local traditional healers. It is believed that the ability to diagnose an illness of an herbalist/practitioner is god-gifted and knowledge passed on by their forefathers. Traditional African medicine system involves conventional medical practitioners, midwives, herbalists, and diviners. They use many indigenous herbs or medicinally important plants available locally to cure various ailments. Their indigenous knowledge majorly depends upon the herb's color and special features of the plant like fragrance and animal behavior towards the plant. This chapter describes the role and wisdom of traditional healers or practitioners, various approaches to cure diseases, people's faith in the herbs, important herbs, and their indications. This chapter will also focus on the various dosage forms of herbs and preparation methodologies.

**Keywords:** Herbal remedies, Herbalists, Medicinal plants, Natural remedies, Traditional wisdom, Traditional healers.

#### **INTRODUCTION**

The North Eastern region of the African continent's health care system is incomplete without having traditional medical practitioners. These medical practices have been deeply rooted in the cultural and spiritual fabric of the society [1]. A traditional medical practitioner is a person who claims the ability to cure diseases by his supernatural power and knowledge gained from his or her forefathers [2]. The wisdom of healers is obvious in ways of identifying, seeing,

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#### 2 Traditional Medicine in North East Africa

knowing, and thinking that are gathered by their forefathers and passed down orally from generation to generation [3, 4]. Many people from North Eastern African nations rely on the wisdom of their traditional healers [5] as they lack modern health facilities in rural areas. Many researches [6 - 10] on the traditional medical practices in the region claimed that this wisdom is a heritage and can't be ignored and must be included parallel with modern medicine systems in the health care facilities [6, 9, 10]. Healers are providing health services for an enormous section of the population despite several challenges. Dominance of biomedicine, proliferation of quack healers, inheritance problems, absence of support from government authorities, and deforestation stand out as the major challenges for the progress and the very existence of indigenous medicine in general and herbal healers in particular [8 - 10].

#### Sources of the Healing Power of Herbalists in Sub-Saharan Africa

Herbalists' knowledge is deeply rooted in society and highly appreciated by the local people in the region (Fig. 1), who consider it god's gift. Healer's knowledge is developed through day-to-day experience and the existence of diverse cultures, languages, and beliefs among the people. However, since cultural systems are dynamic, the skills are fragile and easily forgettable as most of the indigenous knowledge transfer in the country is based on oral transmission only [11]. In some countries, early ancestors wrote the medicinal plant genealogy, preparations, prescriptions, and administrations. These hand-written medico-religious manuscripts are termed as *Etsedebdabe* (lit. letters of herbs), written by debteras who were among the few scholars trained in the literature of the church (could read and write Geez). These medical manuscripts have been kept as esoteric, which cannot be taught to the general public [7].



Fig. (1). Map showing the countries of North East Africa. (Source: http://www.nationsonline.org/oneworld/map/north-africa-map.htm).

## Practice and Prescribed Dosage forms by Traditional Healers in North East Africa

In African countries, people have very high faith in traditional medicine because of less toxicity and belief in being cured. Traditional healers prescribed medicinal plants or herbs in various dosage forms like decoction, pastes, lotions, solutions, and many more (Table 1). These drugs are being administered through oral, rectal, topical, respiratory, nasal, *etc.* [12].

S. No.	Plant Name	Plant Part	Plant Part Dosage Form Indication		References
1.	Lobelia spp.	Roots	Crushing/ powdering	Antimicrobial/anti-inflammatory	[32, 33]
2.	Allium cepa/sativa	Bulbs	Decoction/extract	antioxidant, analgesic, anti- inflammatory, anti-diabetic, hypolipidemic, anti-hypertensive, and immunoprotective effects	[21 - 23]
3.	Zingiberofficinale	Rhizomes	Extract/decoction	respiratory problems (including cough, influenza), pain, inflammation, and malaria	[24]
4.	Discorea species	Tubers	Extract	anti-cancer, anti-mutagenic, anti- inflammatory, anti-diabetic, anti-ageing lipid-lowering and hepatoprotective agents.	[25 - 27]
5.	Adansonia digitata	Bark	Bark Crushing/powdering Anti-abortion & eye infection		[26, 30 - 32]
6	Ruta chalepencis	Leaves	Crushed fresh leaves with water of or coffee is taken orally	Antipyretic/anti-inflammatory/analgesic/ common cold	[27 - 30]
7	Uapaca kirkiana	Fruit	Raw or riped	antioxidant, anti-inflammatory, anti- hyperglycaemic, lipid-lowering and antimicrobial action	[33]
8	Spilanthes spp.	Flower	Extract /Paste	Toothache/ external injury/snake bite and rheumatic fever	[34]
9	Agathosma species	Oil	Crude oil	antimicrobial, anti-inflammatory	[35]
10	Calotropis spp.	Latex	Mixed with honey/topical	Antimycotic/ wound healing/anti keloidal	[36]

#### Table 1. Plant & their parts used in african traditional medicine.

#### **CHAPTER 2**

## A Comprehensive Review on Bioactive Natural Products of *Moringa oleifera* Lam.: A 'Developmental Tree' of Sub-Saharan Africa

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Abstract: Moringa oleifera (Family Moringaceae), popularly called "drumstick" or "the tree of life" or "the miracle tree, is a vital medicinal plant due to its massive medicinal and non-medicinal applications. Moringa oleifera is native to the sub-Himalayan parts of Northern India and known to flourish in diverse soil types but grows best in tropical and subtropical regions. The plant is deciduous and grows fast, and has been employed for a long back for its high-quality nutritional, medicinal, and industrial values. For a very long time, people have been eating the leaves, blossoms, fruits, and roots of the Moringa tree as vegetables. For ages, the traditional medical system has employed *M. oleifera* in a variety of therapeutic purposes. Almost every part of the tree is the source of certain ingredients in traditional herbal medicines. In Africa, people affected with HIV/AIDS, diabetes, and hypertension frequently use this plant as a self-medication. The plant contains a diverse range of phytochemicals such as flavonoids, phenolic acids, steroids, tannins, terpenes, and saponins that are demonstrated to have an excellent plethora of bioactivity. The presence of diverse phytochemicals enables this tree to be a potential drug source to cure various clinical conditions. The main aim of this book chapter is to compile the distribution and botanical characteristics, phytochemical constituents, pharmacological characteristics, and potential therapeutic applications of the *Moringa* plant.

Keywords: Africa, *Moringa*, Nutraceutical, Pharmacological, Phytochemicals, Seed.

#### INTRODUCTION

*Moringa oleifera* Lam. (syn. *M. ptreygosperma* Gaert.) is a small deciduous, drought-resistant, extensively popular medicinal tree of the family *Moringaceae*. This family is a monotypic family of single genera, *Moringa*, and comprises about thirty-three species [1]. Out of 33 species, 13 are well documented, which grow

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mostly in tropical and subtropical zones of the world [2]. The *M. oleifera* tree is indigenous to India but is cultivated and naturalized in many countries of the world, including Africa, Central and South America, and some countries of the Asian continent (Fig. 1). Among 13 species of *Moringa* shrubs and trees, *M. oleifera* (hereafter referred to as *Moringa*) also known as magic tree, drum stick, is most extensively studied for naturally occurring bioactive compounds, probably due to its fast growth, easy and simple cultivation process [3]. This species is also planted as an ornamental plant in fencing gardens. Each part of the plant is medicinally valuable and has been applied in various traditional and modern therapeutic applications. Extensive pharmacological applications, including antimicrobial, anticancerous, anti-inflammatory, hypotensive, hypoglycemic, and immunomodulatory have been reported from different preparations of *Moringa oleifera*. These pharmacological activities are due to the synthesis and accumulation of diverse phytochemicals in different parts of the plant [2].



Fig. (1). Distribution of *M. oleifera*.

*Moringa oleifera* is recognized for its substantial content of diverse biologically active compounds, including phenolics, flavonoids, steroids, tannins, and terpene. Plant is also an abundant source of dietary fiber, carbohydrates, proteins, fats, and

vitamins, including folate, thiamine, pantothenic acid, niacin, riboflavin, vitamin, vitamin K, and provitamin A [4, 5].

Past studies documented its traditional use in boosting fertility in males and for curing reproductive diseases in Nigerian women [6]. Leaves are the reservoir of several inorganic minerals, and organic nutrients such as protein, vitamins, and fatty acids [4, 5]. It is also considered an effective source of functional food and is eaten as fresh, cooked, or stored dried powder in several African countries. In some health projects in West African countries, Moringa leaf powder is applied to the meals of children and expecting women to alleviate their malnourishment [7]. In addition to the pharmacological and nutrition supplements, fruit or pod is a common vegetable. Seeds of *Moringa* can be used as water purifiers, coagulants of turbid water, seed oil as biofuel [8], the tree trunk as the source of gum producer, and the flowers for producing honey. This plant is utilized as a costeffective approach to improving human health. Given the diverse and multiple uses of the Moringa plant, the present chapter aims to review the studies conducted on botany, phytochemical constituents, and various health applications of Moringa oleifera, including its role in rural development and poverty eradication.

#### DISTRIBUTION AND BOTANICAL DESCRIPTION

Moringa oleifera is a perennial, medium-sized, fast-proliferating deciduous tree that grows in tropical and subtropical zones of the world up to 1000 m above sea level (Fig. 2A) [2]. The species is native to the sub-Himalayan region of the Indian continent, though clear evidence of the exact native range is lacking [2]. The plant is presently cultivated for its diverse and multiple applications in most tropical and subtropical regions, such as southern and eastern Asia, Africa, both North and South America, and Australia (Fig. 1) [8]. In 2006, Moringa oleifera cultivation was initiated in South African rural communities and gradually, its increasing popularity resulted in its cultivation in other regions of Africa, including Gauteng, Limpopo, Mpumalanga, and KwaZulu-Natal provinces [9]. This tree can adapt to diverse soil types, but it grows well in drained clay or clay loam, lacking prolonged waterlogging. The tree attains a height between 10 and 12 m. In South Africa, Moringa has gained extensive use with diverse applications, and its status has turned from a minor tree to a cultivated tree species over the last decade. A variety of food items derived from *Moringa* are accessible in local markets and rural communities [10]. To ensure large-scale cultivation, production of high-quality products, and proper utilization of this multiuse tree, several projects have been initiated in South Africa by stakeholders, including higher education institutions, government departments, and farmers. Taking into account the anticipated change in global climate, which is expected to have a

### **CHAPTER 3**

## Ethnobotanical and Pharmacological Studies on Medicinal Plants for Treating Cancer in Ethiopia

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**Abstract:** Ethiopia has a vast array of different types of flora. Most of these plants haven't been studied scientifically. The usage of plants as medicinal agents has long been a family tradition that has been passed down by word of mouth and well-held secrets. Worldwide, the incidence of cancer is rising quickly, even in underdeveloped nations. The majority of anticancer medications are known to be expensive and have undesirable side effects, which is why the current trend in cancer therapy calls for the use of herbal remedies. Most of the medicinal plants (MPs) used for cancer treatment were not deeply investigated from a drug discovery point of view. It is projected that there are 60,960 cases of cancer in Ethiopia each year, with a mortality rate of over 44,000 cases. With 30.2% of cases, breast cancer is the most frequent type of cancer. Cervical (13.4%) and colorectal (5.7%) cancers follow. It is possible to increase trust in the effectiveness of medicinal herbs by looking at how they are used ethnobotanically to identify patterns that are conserved across society. In light of this, drug development efforts may give priority to therapeutic theories originating from the convergent use of MPs. In Africa, a sizable portion of the populace bases their health behaviors on cultural and traditional beliefs. Instead of being overlooked, the potential for safe and successful cancer prevention, screening, and management measures offered by religious communities and traditional medicine, including traditional health practitioners, should be fully utilized. More than 250 ethnobotanical, phytochemical, and in vitro cytotoxicity studies and a few pharmacological studies were reviewed in this chapter.

Keywords: Antiproliferative, Cancer, Cytotoxicity, Ethnobotany.

#### INTRODUCTION

Globally, cancer is the leading cause of mortality. Worldwide, there were over 9.6 million cancer-related deaths and 18.1 million new cases of cancer in 2020. The

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incidence and mortality rate from cancer are rising, mostly as a result of aging populations, rising cancer risk factors, and low public knowledge of the disease [1]. In Sub-Saharan Africa (SSA), the cancer burden has increased. In SSA, there were over 506,000 cancer-related fatalities and 752,000 new cancer diagnoses in 2018. The most frequent cancer in the SSA is breast cancer, which is followed in frequency by malignancies of the liver, colon, prostate, and cervix. Incidence and mortality from cancer are rising quickly in the area, and between 2010 and 2030, it is predicted that the number of cancer fatalities will increase by 77% [2]. Ethiopia is experiencing an increase in cancer cases, much like other SSA nations. An estimated 60.960 instances of cancer are expected to occur in the country each year, with a death toll of over 44,000. With 30.2% of cases, breast cancer is the most frequent cancer in Ethiopia. Cervical (13.4%) and colorectal (5.7%) cancers follow in order of incidence [3]. Ethiopia, like many other nations, is going through a period of fast economic growth, urbanization, and greater globalization of the markets for consumer goods and unhealthy food. These modifications raised the incidence of modifiable cancer risk factors, like alcohol and tobacco use, in Ethiopia, which is predicted to raise the nation's cancer burden. Limited knowledge about cancer risks and prevention strategies was widespread, but certain factors, such as age, gender, and personal experience with the disease, were found to influence an individual's likelihood of adopting cancer-preventive behaviors. Researchers led by Bantie identified key strategies for increasing cancer awareness and promoting preventive behaviors [4].

Ethnobotanical studies focus on how locals use, identify, and manage the plants that are available to them in order to understand better how they interact with the natural environment. In order to maintain knowledge, it is imperative that traditional medicinal plant usage be documented [5]. Traditional medicine, according to the World Health Organization, is the entirety of knowledge and methods that can be formally explained or applied in the prevention and treatment of physical, mental, or social imbalances, with sole reliance on firsthand knowledge and observation passed down orally or in writing from generation to generation [6]. Rich biological diversity was facilitated by the diverse climatic and geographic conditions found throughout the nation. Roughly 6,000 species of higher plants or 12% of them are endemic, are thought to be found in Ethiopia. Ethiopia has a long history of employing herbal remedies to treat illnesses, and it has created methods for doing so. Traditional medicinal herbs are used as primary healthcare by a significant proportion of the population in Ethiopian societies [2].

Because there are insufficient early cancer detection approaches, trained healthcare workers, treatment facilities, anticancer drugs available, and treatment costs that are higher in Ethiopia, patients often choose to use traditional plant medicines as stand-alone or adjunct treatments [7]. This study is based on a

review of the literature published in scientific journals, books, theses, proceedings, and reports. Excel spreadsheet were used to summarize and analyze relevant ethno-botanical/medicinal information using descriptive statistics, frequency, percentage, and graphs [8].

#### ETHNOBOTANICAL STUDIES IN ETHIOPIA

The multidisciplinary field of ethnobotany is concerned with documenting, analyzing, and utilizing indigenous peoples' traditional knowledge, beliefs, and practices about plant resources [9]. For thousands of years, traditional plant-based therapies have been employed by several cultures and civilizations to treat a wide range of diseases, including cancer and tumors.

The use of medicinal plants for cancer treatment is deeply rooted in Ethiopian culture and has been practiced for centuries. Ethnobotanical research has uncovered several plants historically employed in Ethiopia to treat various cancer types. The commonly used medicinal plants for cancer treatment in Ethiopia are listed in Table **1**. More than 144 medicinal plant species from 122 genera and 60 botanical families have been documented as being used to treat cancer and tumor in Ethiopia. The use of congeneric medicinal herbs to treat indications that are similar to one another is more common, according to research that attempts to methodologically analyze ethnobotanical trends among taxonomically related plants [10]. When it comes to treating cancer and related illnesses, the following botanical families have a higher representation of medicinal plant species: Fabaceae (13%), Euphorbiaceae (11%), Asteraceae (11%) and Lamiaceae (9%) (Fig. **1**).

Family	Scientific Name	Local name	GL	GF	PU	Type of Cancer	Method of Preparation	RA	Refs.																	
	Barleriaeranthemoides R. Br. ex C.B. Clarke,	Yesetaf (A.)	MPE	Sh	R	tumor	Dried or fresh root powder with water	0	[17]																	
Acanthaceae	<i>Justiciaschimperiana</i> (Hochst. ex Nees) T. Anderson	Kitkit, Gulbana	SE	Sh -	R	Lung cancer	Fresh roots crashed, boiled and the cool decoction drunk before the meal.	0	[13]																	
					L	Skin cancer	Fresh leaves pounded, and the juice was applied to the affected area.	Т	[13]																	
	Aloe spp. Gr	Gurta waqota Riet	SE																				Skin cancer	Fresh roots crashed, and the sap applied to the affected area	Т	[13]
Aloaceae				Sh	R	Abdominal pain & Cancer	3 Fresh leaves crushed and mixed with 1 kg of honey, 1 teaspoonful a day for 30 consecutive days.	0	[18]																	

Table 1.	. Ethnobotanical	studies for th	he treatment of	cancer/tumor in	ethiopia.
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## Ethnomedicinal Plants used for Snakebite in Africa: A Comprehensive Study

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Abstract: Snakebite envenoming is a significant, often overlooked public health challenge globally, particularly in regions with limited access to medical care and antivenoms. Despite affecting millions of people annually and causing permanent injuries, snakebite envenoming remains neglected by health authorities and policymakers worldwide. This neglect is partly attributed to a lack of awareness and attention to the problem. In regions like Africa, where snakebite incidents are prevalent, various venomous snake species contribute to the majority of bites, including the puff adder, Gabon viper, mambas, forest cobra, and black-necked spitting cobra. The complexity of snake venom, comprising various compounds such as polypeptides, proteins, amino acids, organic acids, sugars, lipids, nucleosides, nucleotides, biogenic amines, water, cellular debris, and bacteria ions, poses significant challenges for treatment. Currently, serum antivenom immunotherapy derived from horse or sheep serum is the primary treatment for snake envenomation. However, antivenoms have limitations, including ineffectiveness in neutralizing local tissue damage, adverse reactions, and availability issues. This has led to a growing interest in complementary treatments for snakebites, including the use of medicinal plants. Traditional remedies utilizing plants have been employed in rural areas for managing snakebites, although their scientific basis and effectiveness vary. Pharmacological studies are necessary to comprehend the mechanisms of action of these plants and their potential to provide symptomatic relief or directly neutralize venom. While growing antivenom plants around homes may serve as a preventive measure by repelling snakes, the direct use of medicinal plants as remedies for snakebites through topical or oral administration requires careful consideration and scientific evaluation. The compilation of information on traditional knowledge and practices regarding snakebite management in Africa can contribute to a better understanding of potential treatments and guide further research in this area. Efforts to address snakebite envenoming should include raising awareness among health authorities, policymakers, and communities, improving access to effective antivenom treatments, conducting research on alternative treatments such as medicinal plants, and promoting measures for prevention and education regarding sna-

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kebite prevention and management. Collaboration between local communities, healthcare professionals, researchers, and policymakers is crucial in addressing this neglected global health problem.

Keywords: Antivenom, Decoction, Herbal antidotes, Infusion, Reptilia, Traditional knowledge.

#### **INTRODUCTION**

Snakebite envenoming is a major public health hazard in many regions of the world, particularly among people with limited access to medical care and antivenom [1]. Between 1.2 and 5.5 million people are thought to get bitten by snakes annually, with over 400,000 suffering lifelong injuries. However, the World Health Organization (WHO) considers it to be a neglected global health issue due to a lack of awareness and attention by national and international health authorities and politicians [2]. There are about 600 identified species of poisonous snakes in the world [1]. The African snake fauna is incredibly diverse. 572 species inhabit the African mainland, with hotspots located in East, West, and South Africa. Some are harmless or rare; whereas the puff adder (Bitis arietans), Gabon viper (Bitis gabonica), green or Jameson's mamba (Dendroaspis jamesoni), black mamba (Dendroaspis polylepis), forest cobra (Naja melanoleuca) and blacknecked spitting cobra (Naja naja nigricollis) accounts for most venomous bites in different African Community [3 - 6]. The problem of snakebite envenomation poses a serious threat to public health, especially in areas with limited access to anti-venom and medical care. The complexity of snake venom, containing various compounds such as proteins, polypeptides, and enzymes, presents challenges for effective treatment. Common snake venom toxins include snake venom metalloproteinases (SVMPs), phospholipases A2 (PLA2s), and snake venom serine proteinases (SVSPs), among others, each contributing to specific clinical effects such as tissue damage, coagulation disorders, cardiovascular and renal alterations, neurotoxicity, and rhabdomyolysis [5 - 8].

While serum antivenom immunotherapy derived from horse or sheep serum remains the primary treatment, it has limitations, including ineffectiveness in neutralizing local tissue damage and availability issues [9, 10]. Therefore, there is growing interest in complementary treatments with the use of medicinal plants. Various cultivated and wide plants are traditionally used for treating snakebites, and experimental studies have demonstrated the neutralizing capacity of numerous plant species in opposition to snake venom toxins. Secondary metabolites present in these plants are aristolochic acid, ellagic acid, flavonoids, retinoids, *etc.* have been isolated and shown to inhibit certain venom toxins like phospholipases A2 [10, 11].

#### Ethnomedicinal Plants

In regions like Asia, Central America, and Africa where snakebites are prevalent, there's an effort to preserve traditional knowledge of plant remedies used for snakebites. Understanding the scientific basis behind the use of these plants involves pharmacological studies that explore their direct anti-venom actions or effects that provide symptomatic relief. These studies may encompass tests for tranquilizing, sedative, or anxiolytic effects, immunostimulant activities, anti-inflammatory or analgesic effects, effects on blood coagulation, and modulation of nerve transmission. Research has been centered on snake venom metalloproteinases (MPs) as potential targets for plant remedies against snakebites. Additionally, some plants may serve as preventive measures by repelling snakes when grown around homes. Therefore, investigation into the pharmacological properties of plants used in traditional medicine for snakebites can provide valuable insights into their efficacy and potential as alternative or complementary treatments for snake envenomation [10, 11].

#### **Snake Venom**

Snakes have been used symbolically to represent various concepts such as war and peace, love and hate, God and the devil, as well as life and death. They often embody contradictory symbols within the same civilization. Snakes are carnivorous vertebrates classified under the class Reptilia, order Squamata, and sub-order Serpentes. They belong to several families, including Colubridae, Boidae, Elapidae, Pythonidae, and Viperidae [1, 12]. Snake venom is a complex mixture containing various solid compounds, with 70 to 90% being polypeptides and proteins and additionally, different biomolecules like sugars, lipids, free amino acids, nucleosides, nucleotides, biogenic amines, organic acids, water, cellular debris, and bacteria ions. Snakebites pose significant medical, social, and economic challenges, particularly in tropical and subtropical regions. There are approximately 2 million snakebites annually, resulting in up to 125,000 deaths and 400,000 permanent disabilities. Venomous snakebites can lead to severe complications such as systemic myolysis, flaccid paralysis, coagulopathy and hemorrhage, cardiotoxicity, renal damage and failure, and local tissue injury at the bite site. Snake venoms contain at least 25 enzymes, contributing to their complex medical effects [2, 13].

This passage highlights the importance of understanding snakes, their venom, and the medical consequences of snakebites, especially in regions where access to treatment is limited.

#### Status of the World's Snake

The global diversity of snakes is indeed remarkable, with approximately 3,619 species distributed across various habitats worldwide, excluding Antarctica [14].

## **Exploring Obesity Associated Antidiabetic Activity** in Indigenous African Plants: A Comprehensive Review

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Abstract: Diabetes mellitus (DM) stands as a major global health issue characterized by chronic hyperglycemia due to either inadequate insulin production or the body's inability to use insulin effectively. Affecting an estimated 25% of the global population, diabetes leads to severe complications, including damage to vital organs, resulting in disability and premature death. The onset of diabetes is influenced by a mix of genetic and environmental factors, with obesity significantly contributing to insulin resistance and the exacerbation of the disease. The exploration of indigenous African plants in the management of diabetes, particularly those associated with obesity, presents a promising avenue for developing effective, accessible treatments. These plants, steeped in traditional medicinal practices, offer a rich repository of natural remedies with potential antidiabetic properties. There's a growing interest in harnessing the therapeutic potential of these plants, driven by their active compounds that could play a crucial role in glucose metabolism and insulin sensitivity. Scientific investigations into the efficacy of these plants include a range of studies from *in-vitro* and *in-vivo* to clinical trials, aiming to evaluate their safety, potential side effects, and overall therapeutic viability. The intersection of traditional knowledge with modern scientific research in this field highlights the importance of developing novel, culturally respectful, and sustainable healthcare solutions. This focus on the antidiabetic activity of African medicinal plants not only underscores the continent's rich biodiversity but also advocates for a shift towards more integrative and sustainable health practices worldwide. By exploring these natural resources, there's potential to significantly impact the global fight against diabetes and obesity, offering hope for more effective management strategies rooted in the natural world.

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Keywords: Antidiabetic properties, Diabetes mellitus (DM), Global health issue, Hyperglycemia, Insulin resistance, Indigenous african plants, Obesity.

#### **INTRODUCTION**

Diabetes mellitus (DM) is characterized by significantly elevated glucose levels resulting from either abnormality in insulin production, insulin resistance, or both. The disease affects approximately 29.1 million individuals annually in the United States, making it the seventh leading cause of death, according to the Centers for Disease Control and Prevention (CDC) [1]. The World Health Organization (WHO) projects that by 2030, diabetes will become a leading cause of mortality worldwide, with its death rate expected to double from the 2005 figure. Diabetes manifests in several forms: Type 1 diabetes mellitus (T1DM), involving an absence of insulin production; Type 2 diabetes mellitus (T2DM), characterized by insulin resistance; and gestational diabetes, which occurs during pregnancy [2]. T1DM accounts for 5-10% of all diabetes cases, while T2DM comprises the majority. Symptoms of diabetes include excessive thirst, frequent urination, blurred vision, and weight loss. If not properly managed, these symptoms can lead to severe complications such as ketoacidosis or a non-ketotic hyperosmolar state, potentially resulting in death. Effective diabetes management underscores the importance of physical activity and a balanced diet. While oral hypoglycemic agents and insulin therapy are effective for many, about 5-10% of patients may experience secondary failure due to various factors, including decreased beta-cell function and poor medication adherence. In many underdeveloped countries, access to pharmaceutical treatments and insulin is limited, increasing the cost of diabetes care and making it unaffordable for many [3, 4]. As a result, phototherapy and the use of natural substances with antidiabetic properties often become primary treatment modalities [5]. Herbal medicines offer a promising alternative to synthetic drugs owing to their availability, lower side effects, and cost-effectiveness. The role of bioactive compounds in these plants, such as tannins, flavonoids, catechins, and gallic acids, has been recognized for their potential to inhibit enzymes like  $\alpha$ -amylase and  $\alpha$ -glucosidase, thus helping to regulate blood glucose levels and maintain pancreatic cell function. Additionally, these natural compounds may counteract oxidative stress, a significant factor in diabetes pathology, suggesting that antioxidant therapy could be beneficial in diabetes management. With the prevalence of T2DM increasing globally, the exploration of natural plants for antidiabetic compounds remains a critical area of research [6]. Despite over 400 plant species being documented for their hypoglycemic effects, the quest for new antidiabetic agents continues, highlighting the potential of these plants in developing effective diabetes treatments. This study aims to explore the active compounds in natural plants with antidiabetic properties, proposing them as viable alternatives for diabetes

#### Exploring Obesity

management [7]. This comprehensive review has systematically assessed the antidiabetic potential of indigenous African plants, particularly about obesitylinked diabetes mellitus. Through a detailed examination of available scientific literature, the review has identified several key bioactive compounds present in these plants that exhibit significant antidiabetic and anti-obesity effects [8, 9]. The findings underscore the potential of these indigenous plants in contributing to the management of diabetes mellitus, especially Type 2 diabetes, which is closely associated with obesity. The mechanisms through which these plants exert their effects include enhancing insulin sensitivity, promoting glucose uptake, inhibiting digestive enzymes linked to carbohydrate digestion, and modulating lipid metabolism. These actions collectively contribute to glycemic control and weight management, addressing two critical aspects of diabetes care [10, 11]. Future research should focus on conducting rigorous clinical trials to validate the efficacy and safety of these bioactive compounds, with an emphasis on understanding their pharmacodynamics, pharmacokinetics. and potential interactions with conventional diabetes medications. Additionally, there is a need for more extensive ethnobotanical studies to document the traditional use of these plants, which could provide insights into their potential therapeutic applications [12, 13]. The integration of traditional knowledge with modern scientific research could lead to the development of novel therapeutic agents derived from indigenous African plants. Such an approach not only supports the conservation of biodiversity and cultural heritage but also contributes to the global effort to find sustainable and accessible treatments for diabetes mellitus. The promising outcomes of this review highlight the importance of indigenous African plants as a valuable resource for antidiabetic compounds, warranting further investigation and development within the scientific community [14].

#### PATHOPHYSIOLOGY OF OBESITY-ASSOCIATED DIABETES

Obesity is the primary risk factor for diabetes, with over one-third of obese individuals developing T2DM [15, 16]. Obesity increases the development of T2DM through factors such as insulin resistance [17], pancreatic  $\beta$ -cell dysfunction [18], systemic inflammation [19], and the microbiome-gut-brain axis [20].

#### Insulin Resistance

Insulin resistance often refers to the body's reduced responsiveness to insulin in terms of glucose absorption, metabolism, or storage. In obesity and type 2 diabetes, insulin resistance is marked by diminished insulin-induced glucose transportation and utilization in adipocytes and skeletal muscle, as well as poor inhibition of hepatic glucose production [17, 21]. Obesity exacerbates the

#### **CHAPTER 6**

## The Contribution of Traditionally Used Medicinal Plants to Modern Medicine: An Update on the Successful Journey of Medicinal Plants of North East Africa

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Abstract: Traditional herbal treatments have a long history and are highly valued in South Africa. Many North-East African medicinal plants have been found to have a broad range of pharmacological characteristics by using ethnobotanical knowledge as a guide. In this chapter, some successful bioprospecting of phytochemicals formulation & compounds from medicinal plants of North-East African medicinal plantsis highlighted by following the advantages of the medicinal application, status of preclinical & clinical study, and development as a commercial drug. Drugs like Artemisinin, resveratrol, Berberine, Quassin, Cathinone, Colchicine, Glaucine, Ouabain, Salicin, Scopolamine, Silymarin, Vinblastine, Vincristine, Allicin, Capsaicin, Silymarin, Kaempferol, Quercetin, Curcumin, Quinine, THC & CBD has been successfully investigated and developed as drug for various applications with antimalarial, anticancer, cardiotonic, bacillary dysentery, Antitussive, Analgesic, Sedative, Antihepatotoxic activity. Various formulations have been commercialized, like Khat, Aspirin (Acetylsalicylic acid), Quinine, and Quinidine. Recently, proteinbased molecular targets have been developed, which has increased the demand for new chemical diversification in screening. The vast majority of the North East African biodiversity is still uncovered, thus, successful bioprospecting has more potential in the coming days from this North East African region. It requires multidisciplinary, national, and international collaborations in design, synthesis, discovery, and drug development methodologies to investigate these natural resources. More investigation is warranted into the possible chemical variety of traditional medicinal plants and their potential therapeutic utility.

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The Contribution of Traditionally

**Keywords:** Bioprospecting, Commercial drugs, Drug discovery and development, Ethnobotanical knowledge, North east medicinal plants, Phytochemicals, Scientific validation.

#### **INTRODUCTION**

It has been reported that approximately 2.5 lakh plant species are estimated to exist on Earth, of which more than 70,000 have been identified as having medicinal properties used in folk medicine worldwide. Around 25% of medications prescribed for health benefits are derived from plants and more than 5,000 plant species are used for medicinal application in Africa [1].

Plants have been utilized in traditional medicine for centuries, long before the emergence of so-called modern or allopathic medicine, to treat a wide range of health issues [2]. Therefore, traditional knowledge of medicinal plants must also be studied to identify novel lead compounds for the development of new modern allopathic medications [3]. Any local, specialized medicinal plant use results from a complex interplay of cultural origins, beliefs, and attitudes about specific plant resources [4].

Northeast Africa is renowned for its exceptional biodiversity and cultural heritage. particularly concerning the utilization of medicinal plants. Northeast Africa, refers to the countries of Africa situated in and around the Red Sea, intermediate between North Africa and East Africa, and includes Diibouti, Eritrea, Ethiopia, and Somalia (Horn of Africa), as well as Egypt, Libya, and Sudan [5]. The region has an extensive history of colonization, with fossils dating back to the early hominids and humans of today [6]. It is one of the world's most culturally and linguistically varied regions, with several civilizations and a vital commerce route connecting various continents [7]. A recent survey by the World Conservation Union (IUCN) reported that 72,000 species of higher plants are used for the production of medicines worldwide, along with 17% of the higher plants in the world [8]. Around 85% of the world's population depends upon medicinal plants for the treatment of various human and animal ailments. Furthermore, due to a lack of funds or physical accessibility to allopathic treatments, nearly 80% of people in developing countries rely on medicinal plants as their primary source of medicine, including African countries. Traditional medicinal plants have become an integral element of African society, even though they are not as well organized as they are in India and China [9].

Countries like Ethiopia are a land of diversity, with diversified flora and ethnic groupings, each with its unique methods of utilizing therapeutic herbs [10]. They make efficient use of a vast number of medicinal plants, even though the plants employed and the techniques of preparation are sometimes kept secret. Many

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misconceptions regarding the efficacy of medicinal herbs arose due to a lack of interest in modern society and how elders passed on their expertise. Several ethnomedicinal and ethnobotanical investigations have been carried out in recent years to highlight the benefits of traditional medicine in promoting healthcare services, and the findings of these studies are playing a significant role in moral changes. However, considering the country's biodiversity, the number of these studies is quite minimal [9].

Other Northeastern nations such as Sudan, where people rely on traditional medicine to cure a wide range of problems because of limited access to professional healthcare, expensive drug costs as well as spiritual beliefs, also utilize medicinal plants and their derivatives extensively (Fig. 1). Only 11% of the population is thought to have access to formal healthcare. Sudan's geographic location fosters a diversity of traditional knowledge across continents, making it easier to share knowledge about medicinal plants with nations in Africa, the Middle East, and Asia. However, there is a notable lack of written documentation on the traditional usage of medicinal plants despite the highly diverse flora in Sudan [11]. It has already been reported that Sudanese medicinal herbs have been shown to exhibit many biological activities, including antibacterial, anthelmintic, antiparasitic, antiplasmodial, anticancer, and antidiabetic properties [12].

In this book chapter, we are focusing on some successful bioprospecting of phytochemicals formulation and compounds from medicinal plants.North-East African medicinal plants are highlighted by following the advantages of the medicinal application, status of preclinical and clinical study and development as commercial drugs.

## ETHNOBOTANICAL KNOWLEDGE OF NORTH EAST AFRICAN PLANTS

Historically, medicinal plants have been used by indigenous populations in Northeast Africa to treat a variety of health issues and enhance well-being. Notably, *Artemisia annua*, or sweet wormwood, has been utilized for years to treat fevers and malaria in traditional medicine [13]. In Sudan, fruits of *Balanites aegyptiaca* are effective against skin infections and digestive ailments [14, 15], and *Ruta chalepensis* (Ethiopian Rue) is used for stomach disorders in Ethiopia [16]. Cultural beliefs also influence the utilization of medicinal plants, such as Frankincense resin produced from *Boswellia* trees, which have cultural and economic importance in Egypt [17].

## Exploring the Therapeutic Potential of *Viburnum Opulus* L.: A Comprehensive Review of its Medicinal Properties and Health Benefits

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Abstract: Viburnum opulus L., often called European dogwood shrub, golden rose, or viburnum tree, belongs to the Adoxaceae family and is a species of tall shrub native to Europe, Central Asia, and North Africa. This plant is valued as an ornamental, medicinal, and food plant. It is particularly popular as an ornamental plant but also has health benefits. The fruits of Viburnum opulus L. have a high content of phenolic compounds, including phenolic acids and flavonoids such as chlorogenic acid, catechins, quercetin glycosides, tannins, and anthocyanins. Fruits, juices, flowers, leaves, twigs, and twig extracts of Viburnum opulus L. contain biologically active substances that are known for their antioxidant properties and are used in traditional medicine. The red berries of the European dogwood are not normally consumed directly because of their unpleasant odor and bitter, astringent taste. In traditional folk medicine, however, they are used to treat numerous diseases and disorders such as coughs, colds, ulcers, kidney stones, dysmenorrhea, and high blood pressure, including bleeding, heart disease, neuroses, and diabetes. The plant has been shown to have pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial, antiobesity, antidiabetic, osteogenic, cardioprotective, and cytoprotective effects. In vitro studies have shown that extracts from Viburnum opulus L. can influence cellular glucose and lipid metabolism, stimulate glucose uptake, reduce lipid accumulation, and reduce the secretion of inflammatory cytokines. In conclusion, Viburnum Opulus L. is a testament to the rich botanical heritage of Northeast Africa and a promising avenue for further research and exploration in the field of traditional medicine.

**Keywords:** European cranberry bush, Guelder rose, Health benefits, Medicinal properties, Phytochemical composition, Pharmacological applications, *Viburnum opulus* L.

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#### **INTRODUCTION**

Natural wild berries are full of biologically active ingredients that offer the body's numerous health benefits. Known for their anti-inflammatory properties, these berries reduce inflammation while protecting the liver and promoting heart health. With the addition of wild berries, many food products can gain value, from smoothies and salads to desserts and sauces. In addition, wild berries can be consumed directly in dried form and products such as jam and jelly. They can also produce functional foods with specific benefits for human health. In this way, wild berries are becoming a vital resource that offers valuable contributions to health and allows the creation of flavourful food products [1].

*Viburnum opulus* L., commonly known as guelder rose or European dogwood, is a deciduous shrub from the Caprifoliaceae family. It is native to Europe, North Africa, and North Asia. The plant typically grows in moist forests, hedgerows, and bogs and is characterized by its distinctive white flowers and bright red berries [2].

Northeast Africa has a rich diversity of flora, many of which are traditionally used for therapeutic purposes by indigenous communities. Studying traditional medicinal plants in this region is essential for several reasons. Firstly, it contributes to preserving and documenting indigenous knowledge systems, which are often transmitted orally over generations. Secondly, studying traditional medicinal plants can lead to discovering new bioactive compounds with potential pharmacological applications. Finally, given the cultural and economic importance of traditional medicine in North East Africa, understanding the medicinal properties of local plants can facilitate the development of sustainable health practices and promote community-based health initiatives [3].

The study of traditional medicinal plants in Northeast Africa is of great importance due to the region's rich biodiversity and the deeply rooted cultural practices surrounding herbal medicine. For centuries, traditional healers and herbalists in Northeast Africa have relied on indigenous plant species such as *Viburnum opulus* to treat various ailments and promote general well-being. Understanding the therapeutic potential of these plants not only preserves cultural heritage but can also contribute to the development of modern medicines and health practices.

Studies have shown that traditional medicinal plants serve as a valuable reservoir of bioactive compounds with diverse pharmacological properties. By systematically documenting and studying these plants, researchers can uncover novel therapeutic agents and formulate evidence-based treatments for common health conditions [4].

#### Health Benefits

The main objective of this chapter is to present a comprehensive review of the medicinal properties and health benefits of *Viburnum opulus*. This review first aims to explore the historical and cultural significance of *Viburnum opulus* in traditional medical practices, then investigate the plant's phytochemical composition and pharmacological effects. Furthermore, by reviewing the scientific evidence supporting the traditional uses of *Viburnum opulus* for various health conditions, it will be able to discuss its potential therapeutic applications in modern medicine. focusing on its cardiovascular. gastrointestinal. neuroprotective, and immunomodulatory effects. Furthermore, it will highlight the safety profile and toxicological considerations associated with using Viburnum opulus preparations. It aims to promote integrating traditional knowledge with modern pharmacological approaches by identifying future research directions and opportunities. Thus, this chapter aims to contribute to the growing literature on traditional medicine in Northeast Africa and to encourage further research and exploration of medicinal plants in the region.

#### Viburnum opulus L. Nomenclature

*Viburnum opulus*, often called European dogwood bush, guelder rose, or viburnum tree, belongs to the Adoxaceae family and is a tall shrub native to Europe, Central Asia, and North Africa. The common name "Guelder rose" is supposedly related to the Dutch province of Gelderland, but in Slavic cultures, this plant is called Kalyna. Once Kalyna, the birth of the Universe, the fiery trinity: Sun, Moon, and Star. Its red berries symbolize homeland, blood, immortality, and the beauty of a virgin. In Slavic mythology, the Kalyna Bridge connects the world of the living with the world of the dead. Kalyna is the national symbol of Ukraine, where the image of Kalyna has been revered since ancient times [5]. *Viburnum opulus* L. belongs to the kingdom Plantae, phylum Angiosperms, class Eudicots, order Dipsacales, family Adoxaceae, and genus Viburnum [6].

The scientific name of *Viburnum opulus* L. adheres to the binomial nomenclature system, where the genus name (Viburnum) precedes the specific epithet (opulus), and the author abbreviation (L.) denotes the taxonomist Linnaeus, who first classified the species. The genus "Viburnum " derives from the Latin term "viburnum," which refers to a shrub or tree. The epithet "opulus" originates from the Latin word "opulus," used by Pliny the Elder to describe a shrub or tree bearing red berries. The abbreviation "L." refers to the Swedish botanist Carl Linnaeus, who formally documented *Viburnum opulus* L. in his essential publication "Species Plantarum" in 1753 [7].

#### **CHAPTER 8**

## *Citrullus colocynth (L.) Schrad:* A Promising Medicinal Plant with Health Benefits and Safety Considerations "A Comprehensive Review"

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Abstract: Citrullus colocynths (L.) Schrad is an important cucurbitaceous plant that is widespread in sandy regions of the world. Citrullus colocynth (L.) Schrad. It is widespread in Africa, the Middle East, and South Asia. Citrullus colocynth (L.) Schrad is widely used in African and Asian folk medicine and is known as a fascinating plant for ethnopharmacological purposes. It is used in the treatment of numerous diseases, including dermatological, gynecological, pulmonary infections, inflammation, cardiovascular diseases, asthma, diabetes, joint pain, constipation, jaundice, colds, leprosy, and gastrointestinal diseases. The plant Citrulluscolocynth (L.) Schrad contains active secondary metabolites such as phenols, flavonoids, glycosides, alkaloids, and essential oils that exhibit properties for a wide range of pharmacological activities such as anticancer, antidiabetic, antioxidant, cytotoxic, antimicrobial, antiinflammatory, antilipidemic and insecticidal. However, high doses and prolonged oral administration of Citrulluscolocynth (L.) Schrad has been associated with decreased body weight, increased white blood cell counts, and destruction of the gastric mucosa. Histological changes such as superficial loss of the protective epithelium of the gastric mucosa, atrophy of the gastric mucosal cells, and thickening of the connective tissue of the mucosa were also observed. Citrulluscolocynth (L.) Schrad has numerous pharmacological and physiological functions. It has very useful applications in the treatment of various human ailments. Therefore, the main objective of this comprehensive study is to provide an overview of the findings on the beneficial effects and risks of Citrulluscolocynth (L.) Schrad consumption on human health.

**Keywords:** Advantages, *Citrullus colocynth (L.) Schrad*, Cucurbitaceae plant, Ethnopharmacological, Gastric mucosa, Histologic changes, Human diseases, Insecticide, Pharmacological activities, Pharmacological functions, Risks, Secondary metabolites, Toxicity.

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#### **INTRODUCTION**

*Citrullus colocynths* (L.) Schrad is a medicinal plant belonging to the Cucurbitaceae family (Fig. 1). The Cucurbitaceae family encompasses many plants, including about 123 genera and more than 800 species. This family is usually found in tropical or subtropical regions, while it rarely occurs in temperate regions. It includes plants generally sensitive to frost, intolerant of wet and poorly drained soils, and drought-tolerant [1], such as bitter apple, cucumber, gourd, pumpkin, and melon. These plants have gained popularity over time due to the increasing awareness of their numerous health benefits, leading to a significant increase in production. Some of the most popular members of this plant family include bitter apple, cucumber, gourd, pumpkin, and melon. These plants have gained popularity over time due to the increasing awareness of their numerous health benefits, leading to a significant family include bitter apple, cucumber, gourd, pumpkin, and melon. These plants have gained popularity over time due to the increasing awareness of their health benefits, leading to increased production. This plant family includes well-known members such as bitter apple, cucumber, gourd, pumpkin, and melon. Due to the growing recognition of their health benefits, the production of these plants has increased over time.

Citrullus colocynths, which is also called Citrullus colocynth (L.) Schrad. is a plant that belongs to the cucurbitaceous family. It is commonly found in arid regions worldwide, especially in deserts such as those in Arabia, the Sahara, and southern Asia, including India, Pakistan, and the southern islands [2]. The fruit of *Citrullus colocynth* is known by various names such as bitter cucumber, bitter melon, Citrullus colocynth (L.) Schrad. melon, Citrullus colocynth (L.) Schrad. Landaus and the bitter vine of Sodom. It grows naturally in dry regions worldwide and has potential therapeutic, nutraceutical, and culinary applications [3]. Many traditional medicines incorporate various parts of plants to treat different ailments. One such plant is Citrullus colocynth (L.) Schrad, which is known for its effectiveness in treating jaundice, diabetes, and asthma. The fruit of this plant is spherical, has a bitter taste, and has a smooth and delicate texture. It is enclosed in a hard shell with a gourd head that contains up to 200-300 seeds [4]. Citrullus *colocynth* is a type of perennial vine that bears small-sized aromatic flowers. The plant's physical characteristics include mesocarp thickness, density, and seed-tofruit ratio. As for the fruit, it has an average mass of 506 grams and is composed of seeds, pulp, and epicarp. The extract from the fruit accounts for about half of its mass, while the seeds comprise 75.1 grams of the fruit's weight. The ripe fruit has compact and oval shapes, is approximately 6mm long, and has a soft texture. Additionally, it has tiny brownish seeds [5].

#### **Botanical Characteristics**

*Citrullus colocynths* (L.) Schrad belongs to the family Cucurbitaceae, which has a wide genetic diversity. It grows successfully in alkaline soils, especially in desert regions, and is highly resistant to water stress and salinity [5]. This perennial plant has leafy and thorny hairy stems like watermelon. It also has alternate leaves (scattered, variously indented, hairy, triangular, and broad) on long petioles. The upper surface of the plant is delicate green, while the lower surface is pale and irregular. Its yellow flowers also grow singly in the leaf axils [6].

#### **Geographical Distribution**

*Citrullus colocynths (L.) Schrad. (L.)* Schrad, an essential plant commonly known as Colocynth, is a member of the Cucurbitaceae family and has been reported in all arid regions worldwide (Fig. 1). However, its homeland is the Mediterranean region and Asia [7]. Geographically, it is distributed throughout North Africa, Southern Europe, Asia, and deserts as far as Egypt [5].*Citrullus colocynth(L.) Schrad.* It is found in various countries, especially in desert regions. Some of the countries where *Citrulluscolocynth (L.) Schrad. (L.) Schrad.* is distributed are Algeria, Egypt, Sudan, Somalia, Chad, Niger, Mali, Mauritania, Libya, Tunisia, Morocco, Saudi Arabia, Iran, Iraq, Jordan, Lebanon, Syria, Turkey, Afghanistan, Pakistan, India, Oman, Yemen, United Arab Emirates, Kuwait, Spain, Australia, Western Sahara, Qatar, Italy, and Kenya (Fig. 1).

#### **Taxonomic Classification and Nomenclature**

The family consists of about 118 genera and 825 species, including both cultivated and wild members, and is divided into two subfamilies: Zanonioideae (19 genera and 60 species) and Cucurbitoideae (111 genera and 740 species) [9] (Table 1).

*Citrullus colocynths* is a wild, perennial, herbaceous, non-hardy, angular vine with stiff, lobular branches. It is well adapted to arid climatic conditions. Leaves are alternate, rough, hairy, green on the upper surface, pale-colored on the lower surface, long-petioled, 5-10 cm long, and 3-7 deeply lobed.

The flowers are monoecious (five-lobed, with a corolla and five-parted calyx), solitary, and yellow. The calyx of the female flower is more significant than that of the male flower. Each plant bears 15 to 30 smooth-surfaced, unshelled, globose fruits ranging from 5 to 7.5 cm in diameter, variegated with green and yellow stripes and yellowing as they ripen.

### **CHAPTER 9**

### Healing from Salvadora persica L. Plant

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Abstract: Salvadora persica L., a member of the Salvadoraceae family, is an evergreen tree standing at 4- 6 measures altitudinous, characterized by a short box, white dinghy, and smooth green leaves. It's generally set up across colorful Asian, African, and Middle Eastern countries. In Ayurveda, Salvadora persica L. has been noted for its remedial eventuality in treating dental conditions. Its fresh leaves are consumable and are employed in traditional drugs to address conditions similar to coughs, asthma, scurvy, rheumatism, hemorrhoids, and other affections. The branches of S. persica, also known as the miswak tree, have been employed for dental cleaning since ancient times, with its operation in oral hygiene being championed by the World Health Organization. The pharmacological parcels of S. Persica L. are well established, flaunting multitudinous significant natural conditioning including antimicrobial, antitumor, hypoglycemic, anti-osteoporosis, anti-inflammatory, analgesic, antiulcer, antioxidant, enzyme inhibitory, anticonvulsant, and dreamy goods. The antimicrobial and antioxidant goods of S. persica can be attributed to various chemicals present in its extracts, analogous as tri-methylamine, salvadorin, chloride, substantial amounts of fluoride, silica, sulfur, mustard, vitamin C, saponins, tannins, cyanogenic glycoside, and benzyl isothiocyanate likewise; disquisition suggests that certain biologically active chemical factors analogous as sodium chloride, potassium chloride, salvadourea, alkaloids, and oleic and linoleic acids combine with saliva, enhancing the sanctification effectiveness and antifungal parcels of Miswak. Phytochemical netting of S. persica leaves, roots, stems, and branches has revealed the presence of secondary metabolites, including sterols terpenes, flavonoids, flavone aglycone, saponins, and tannins.

Keywords: Hygienic, Medicinal plant, Traditional medicine.

#### **INTRODUCTION**

Salvadora persica L., generally known as Arak (Arabic) and Peelu (Urdu), belongs to the family Salvadoraceae. In 1749, the term Salvadora was chased by

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Dr. Laurent Garcin in honour of the apothecary Juan Salvadory Bosca (1598-1681) of Barcelona. The term *Persica* is used to denote Iran, while the standard author condensation L refers to Carl Linnaeus (1707-1778), the father of modern taxonomy [1]. Our ancient literature, similar to the "Charak Samhita" of Ayurveda (1000- 1600B.C.) and the "Charak Samhita" of Rig Ved (4500- 1600B.C.), contains sufficient literature on this plant species [2]. There are about 182 plant species worldwide that are used as chewing sticks. Salvadora persica is the most generally used plant for this operation [3]. Salvadora persica is the most popular plant used as a natural chewing stick in traditional drugs and may be the first toothbrush known to man(used by the Babylonians as early as 3500 BC) [4]. The family Salvadoraceae consists of 10 species belonging to three rubrics (Azima, Dobera, and Salvadora) living substantially in tropical and tropical regions of Africa and Asia. Lately, a new record, Salvadora alii, was linked to the Sindh fiefdom of Pakistan. The most important species, S. persica, is extensively known worldwide by colorful names similar as Arak, Caday in Somalia, Merge, Miswak in Pakistan, Pilaue in India, Sivak in Saudi Arabia, Omungambu in South Africa, and toothbrush in English [5].

Miswak (*S. persicaL.*), also known as toothbrush tree, belonging to the *Salvadoraceae* family, 4- 6 m altitudinous, short box, white dinghy, smooth green leaves, a life span of 25 times, was used [6]. *Salvadora persica* is a large, well-fanned, evergreen shrub or small tree with soft, whitish,- unheroic wood, dinghy, wrinkled from old caddies, branches multitudinous, drooping, rough, terete, finely banded, candescent, and nearly white [7].

Salvadora persica belongs to the family Salvadoraceae, which has a wide geographical distribution from Rajasthan (India), Nepal, and Malaysia in the East to Pakistan, Iran, Iraq, Saudi Arabia, Egypt, and indeed Mauritania in the West. In Africa, they're set up in North Africa from Sudan, Ethiopia, and Central Africa to Southwest Africa [3]. S. persica is one of the most extensively used medicinal shops for dental cleaning and oral hygiene among the global Muslim community [8]. Colorful corridor of the plant *Salvadora persica* has traditionally been used to treat a wide range of health problems. These uses include diuretics, rheumatism, venereal conditions, serious febrile conditions, and beast conditions. It's also noteworthy that it's used for healing the stomach, adding appetite, adding corrosiveness, and curing effects against venoms, goad, laxatives, numbness, worms, leprosy, gonorrhea, and headaches. It has been used for the treatment of numerous health problems similar as eye infections, dental hygiene, respiratory tract infections, helminthiasis, flu/cold wave, malaria, typhoid, tooth decay, toothache, habitual joint pain, gravidity in women, casket pain, analgesic, urinary retention, scurvy, asthma, diabetes, arthritis, skin conditions, depilatory, mouth spray, hostility, palsy [9]. The World Health Organization (WHO) has also recommended and encouraged the use of these sticks for oral hygiene purposes [10].

#### CHEMICAL CONTENTS OF SALVADORA PERSİCA PLANT

#### Characteristics of Salvadora persica in Terms of Secondary Metabolites

It has been used therapeutically to support & treat various ailments or disease conditions. Plant extracts have been used to control illness in China for more than three thousand years; their oldest written document is the unheroic Emperor's Law of Medicine (Y. Chai), a compendium of their knowledge from 500 BC to 300 BC. The Egyptians also described the use of a medicinal plant, *Ebers papyrus*, more than a thousand years ago and the Indian civilization also proved the medicinal parcels of botanicals in Ayurveda around 900 BC [11].

In numerous scientific literatures, it's emphasized that the places of living cells in normal growth, development, and reduplication processes are generally limited, but implants develop defense mechanisms for protection from possible damages in their ecological terrain and for other inter-specific protection purposes. Thus, primary metabolites, which are generally produced in plants for specific requirements, serve common natural purposes among all species, while secondary metabolites can frequently be formed by synthetic means deduced from primary metabolites or by participating substrates of the same origin. Plants evolve by genetically garbling colorful mixtures of secondary metabolites to acclimatize to the terrain. These composites, especially essential canvases, are used in mortal life as medicines, flavorings, or relaxing agents.

In the literature, it's stated that secondary metabolites of plants are generally divided into three main classes: terpenoids, alkaloids, and phenolics [12]. Secondary metabolites are an extremely different group of natural products synthesised by plants, fungi, bacteria and algae. Utmost secondary metabolites are similar to terpenes and phenolic composites. Alkaloids are classified according to their biosynthetic origin. Different classes of these composites are generally associated with a narrow group of species within a phylogenetic group and constitute the bioactive emulsion in colorful medicinal, sweet, colouring, and spice shops and/ or functional foods [13].

The chemical composition of the essential oil painting of the stem of *Salvadora persica* L. grown in Jordan was determined by gas chromatography-mass spectrometry (GC- MS). The oil painting attained by hydro distillation (yield % 0.6 w/ v) was set up to be an admixture of monoterpene hydrocarbons [11], oxygenated monoterpenes and sesquiterpenehydrocarbons [21]. The major

## **Role of Medicinal, Aromatic Plants, Spices and Condiments in Food Industry**

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Abstract: In current years, due to awareness regarding numerous health hazards associated with synthetic food additives, consumers are changing their food habits towards food products that contain natural food additives, are less processed, safer and healthier, and have a longer shelf life. Therefore, the food industries are now focusing on finding natural compounds as an alternative to synthetic food additives to fulfill consumer appeal. Due to these natural pursuits, medicinal and aromatic plants have found an increasingly widespread use in making a variety of food products. The rich nutritional content of medicinal and aromatic plants, high antioxidant value, and functional properties such as antimicrobial properties enable these plants to be widely used in the food industry for their natural additive and protective effect. Therefore, the production of medicinal and aromatic plants and products obtained from these plants is constantly increasing throughout the world. Spices are used for flavor, color, aroma, and preservation of food or beverages. Spices are derived from many parts of the plant: bark, buds, flowers, fruits, leaves, rhizomes, roots, seeds, stigmas, and styles or the entire plant tops. It has long been known that a wide range of active chemicals found in spices and condiments have antibacterial, antifungal, and antiviral properties. Spices, herbal tea, food supplements, and food additives are the most common forms of plant products used in the food industry. Thus, the Industrial application of traditional medicinal plants is being increased exponentially to make food products more safe, healthy, therapeutic, and durable.

**Keywords:** Medicinal and aromatic plants, Natural food preservatives, Natural food additives.

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#### INTRODUCTION

Many foods with noticeably greater water activity are perishable, which means that they deteriorate with time. To ensure that they have the appropriate shelf life, they must be handled carefully and protected from spoiling during harvest, preparation, storage, and distribution.

Particularly, foods with minimal or no processing are available to consume and may be made quickly. Major obstacles to maintaining the quality and safety of food include fresh food products, the worldwide expansion of the food business, and transportation from centralized manufacturing. Food items are susceptible to bacterial and fungal contamination, which can lead to a decrease in the taste, smell, appearance, texture, and sensory aspects of the food being consumed. Typical decomposition and pathogenic bacteria in food packages are influenced by a range of endogenous parameters like pH and oxygen content, as well as extrinsic ones related to storage conditions, such as temperatures, duration, and relative humidity [1 - 3].

However, numerous chemical-based preservation methods have been applied by the food industry to stop the growth of harmful bacteria and deterioration in food [4]. In addition to this, other approaches, such as combining synthetic and natural preservatives, have also been used. Foods maintained with natural enhancements are now extremely secure due to consumer understanding and concern about synthetic chemical additives. In the food sector, natural preservatives are frequently applied to stop the growth of unwanted microorganisms by adding antimicrobials to product formulations, coating food surfaces, or incorporating packaging materials. However, each of these methods has distinct mechanisms of action [5, 6].

Plants and spices are excellent sources of biologically active compounds with potential antimicrobial activity. Essential oils, secondary metabolites produced by plants, have the valuable capability of suppressing the growth of a wide variety of food-spoilage and food-borne microorganisms, including bacteria, yeasts, and molds. From a chemistry point of view, they consist of aromatic and volatile compounds that play an important role in plant defense and possess antimicrobial properties [7]. They can be extracted from different parts of plants, including flowers, roots, bark, leaves, seeds, peel, fruits, wood, buds, and the entire plant [8]. Besides their medical application, essential oils have been used for centuries in the perfume and cosmetic industries and also in the food industry as flavoring agents and preservatives to extend shelf-life and improve the microbiological quality of dairy products [9 - 12]. Natural plant-based chemicals have applications

in industry as biological food preservatives to regulate the microbial and physicochemical shelf life of primary food groups, including meat, seafood, milk, minimally processed vegetables and fruits, and cereal-based products.

#### **Concept of Herbs and Differences Between Spices and Herbs**

Herbs are leaves of a plant used in cooking which come either in fresh or dried form. Herbs as part of the plant, possess a high quantity of polyphenols. Polyphenols are widely known for their antioxidant properties; however, they exert other biological effects (anti-inflammatory, anti-cancer, and neuroprotective), which may also contribute to their purported benefits, possibly or not, *via* their antioxidant properties, and they are therefore linked to the maintenance of health *via* protection against the development of non-communicable diseases. Other properties include anti-microbial, anti-diabetic (Type II), and anti-asthma activities. There is now a growing amount of literature on how polyphenols confer health benefits *via* their action on gut microbiota. Herbal spices include items like thyme, marjoram, parsley, sage, savory, tarragon, chives, rosemary extract, and mint. Herbs and spices store their aromatic compounds differently. Leaves (in case of herb), seeds, bark, and root (in case of spices) of a plant.

#### Herbs and Their Uses

#### Thyme: A Typical Herb

Thyme is an aromatic plant and is widely distributed over the Mediterranean area (Europe, Asia, and North Africa). Thyme is one of the medicinal aromatic plants found in the Iberian Peninsula, and its essential oil has become one of the most widely used in the food industry. Thyme has been used since ancient times for its wide use in the food industry. Thyme has been used since ancient times for its components. Its economic importance is associated with its essential oils.

In all thyme species and varieties, the main part used commercially is its leaves, with purposes that vary from seasoning to herbalism. Another important use that mainly involves the species [13]. The use of thyme in food is limited almost entirely to meat products, where it is used for technological purposes, mainly as an antioxidant and preservative.

#### Mint (Menthapiperita L.)

Some of the most aromatic plant species in the world, growing in a variety of habitats, are found in the genus *Mentha* (*Lamiaceae* family). Mint leaves are straightforward, distinctive, and have a lovely aroma. Mint is a perennial, hardy, branching plant with brilliant green, lance-shaped, highly serrated leaves,

### **CHAPTER 11**

## The Multipurpose Wonder: *Adansonia digitata L. –* A Botanical Treasure Trove

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Abstract: Adansonia digitata L., which belongs to the mallow family (Malvaceae), has a very wide distribution area and is found in most semi-arid and semi-humid regions of Africa south of the Sahara and in western Madagascar and is widespread in many countries. Adansonia digitata L. is a perennial tree with numerous uses. The various parts of the tree are often used as food and medicine, and the bark fibers are also used. The tree is used as a source of food, shelter, clothing, and medicine, as well as material for hunting and fishing. Traditionally, its various parts are used to treat diseases such as bronchial asthma, dermatitis, sickle cell anemia, diuretic, antidiabetic, diarrhea, dysentery, laxative, hiccups, malaria, and other infections. Adansonia digitata L. is known for its exceptional antioxidant properties due to its extremely high vitamin C content, which is reportedly ten times higher than oranges, and it offers numerous biological benefits, including significant antimicrobial, antiviral, antioxidant, and antiinflammatory properties. Among its components, phytochemical analyses have identified flavonoids, phytosterols, amino acids, fatty acids, vitamins, and minerals. The seeds of Adansonia digitata L. are a rich source of elements such as calcium and iron. In recent years, the commercial importance of the plant has increased as the food and beverage, nutraceutical, pharmaceutical, and cosmetic industries have shown a growing interest in its medicinal use. The demand for the seed oil of Adansonia *digitata L*. in cosmetic formulations has increased due to its rich fatty acid compounds.

Keywords: Adansonia Digitata, Biological activity, Baobab tree, Medicine, Traditional uses.

#### **INTRODUCTION**

*Adansonia digitata* is a member of the Bombacaceae family, the Bombax or Kapok family. There are eight different species of the genus *Adansonia*, also known as the dead mouse tree, Ethiopian sour gourd, Judas' bag, monkey bread

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#### The Multipurpose Wonder

tree, lemonade tree, Senegalese gourd, monkey tamarind, and African baobab, also known as the upside-down tree [1 - 3].

In the last ten years, it has attracted the interest of several pharmaceutical and research companies and scientists due to its various traditional uses (medicinal, nutritional, and cosmetic). In 2009, the European Commission authorized the importation of baobab fruit extract as a new food, which the European Commission approved. In the United States, it has been approved as a food ingredient by the United States Food and Drug Administration [4 - 6].

The plant is a humongous tree with an extensive stem (up to 10 m in diameter) that grows up to 25 m in length and is capable of living for hundreds of years (Fig. 1) [7]. The bark is smooth, reddish brown to gray in color, soft, and has elongated fibers [8]. The plant is widespread in tropical Africa's hot and dry regions [7].



Fig. (1). Adansonia digatata tree, fruits, and seeds [11].

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The tree supplies material for food, shelter, clothes, and medicine, as well as for fishing and hunting. The tubers, branches, fruits, seeds, leaves, and flowers of this plant are identified as common ingredients of traditional dishes in rural and urban areas [8].

Adansonia digitata is a glorious tree revered in Africa for its medical and nutritional value. Plant parts are used in various illnesses, such as diarrhea, malaria, and various microbial infections. Some plant parts have antioxidant and anti-inflammatory effects, and baobab has been widely used in traditional medicine since ancient times [9, 10].

#### **ECOLOGY AND DISTRIBUTION**

Adansonia digitata L. is widespread throughout sub-Saharan Africa and is mainly found in the dry plant communities of the Sudan-Zambia lowlands in western, eastern, and southern Africa, where annual rainfall is 200-800 mm [11, 12]. In the natural landscapes, baobab distributions of densities and size classes varied considerably among different vegetation types and soil types [13].

They grow on sandy and stony soils, from short-grass savannas to deciduous savanna forests [11]. They are usually observed as widely spaced individuals or small groups of individuals distributed over large areas [14].

#### TRADITIONAL INFORMATION

The crops of the baobab plant (*e.g.*, fruits, seeds, leaves, bark) provide food, fiber, and medicine, contributing to the livelihoods of many communities in Africa. Over three hundred traditional usages have been collectively documented in Benin, Mali, Zimbabwe, Cameroon, Central African Republic, Kenya, Malawi, South Africa, and Senegal. In many African countries, various plant parts (*e.g.*, leaves, bark, fruit pulp) have been traditionally used in the treatment of diarrhea and dysentery for their properties as immunostimulants, anti-inflammatories, analgesics, insect repellents, and pesticides and have been accepted as substitutes for western imported medicines [4, 15, 16].

Baobab is used in various ways, including fruit for food, oil extracted from the seeds, rope, cordage, and cloth from the bark fiber, phenolic tannin to improve leather from the bark, pollen grain glue extracted from the pollen of the flowers, and pulp to manufacture paper from the wood harvested, used as a spice and as an appetizer [17, 18].

## **Exploring Moroccan Medicinal Plants: An Ethnobotanical Perspective on Diabetes Management**

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Abstract: Morocco is a country rich in medicinal plants, many of which have been used for centuries in traditional medicine to treat various ailments, including diabetes. Herbal treatment is often used as an alternative to synthetic drugs because they may be more affordable and accessible. Diabetes is a chronic disease characterized by high blood sugar levels, and it is a major public health concern worldwide. Conventional treatments for diabetes can be expensive. This review aimed to document the traditional use of medicinal plants in the prevention and self-treatment of diabetes in Morocco based on ethnobotanical surveys and experimental studies in vitro and in vivo. In Morocco, 263 botanical species belonging to 76 families have been used to treat diabetes, in which leaves represent the most used part. The most recommended plants are Artemisia herba albaAsso. Citrullus colocynthis(L.) Schrad. Trigonella foenumgraecum L. Marrubium vulgare L. Salvia officinalis L. Ajuga iva L. Nigella sativa L. Nerium oleander L. Olea europaea L. Ammi visnaga Lam. Zizyphus lotus (L.) Lamk. and Lupinus albus L. Many medicinal plants are used in Morocco against diabetes, but few pharmacological studies are carried out to determine the mode of action and the compounds responsible for the hypoglycemic effect.

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Atul Kaushik & Jeevan Jyoti Kaushik (Eds.) All rights reserved-© 2025 Bentham Science Publishers **Keywords:** Diabetes, Ethnobotanical, Herbal Medicine, Hypoglycemic effect, Phytotherapy, Traditional medicine.

#### INTRODUCTION

Diabetes is a chronic multifactorial disease characterized by hyperglycemia due to increased blood glucose levels. This affects other biological systems, such as the cardiovascular system [1]. According to the American Diabetes Association, diabetes is classified into three types: type 1 diabetes, which is mainly manifested by the destruction of beta cells in the pancreas and thus the inefficiency of insulin production; Type 2 diabetes, or non-insulin-dependent diabetes mellitus is a metabolic disease characterized by chronic fasting hyperglycemia and resulting in defective insulin action. This pathology is most often linked to food habits and lifestyle. Finally, gestational diabetes, which is characterized by high blood glucose developed during pregnancy [2].

Globally, in 2011, and according to the International Diabetes Federation, the number of diabetic patients reached 366 million [3]. Currently, its incidence is increasing exponentially; estimates expect growth to about 552 million in 2030 and 642 million people by 2040 [3]. In developing countries, the prevalence of diabetes will increase by 69% among young adults [4]. According to the 9th edition of the International Diabetes Federation's Diabetes Report, in 2019, the Middle East and North Africa had the highest age-standardised prevalence of diabetes in the world, at 12.2%. The report also predicts that prevalence in this region will increase further to reach 13.9% by 2045 [5].

Diabetes treatment relies on insulin, diet modification, and oral antidiabetic agents, which are essential for glycemic control in patients with type 2 diabetes, although there is currently a wide range of pharmacological approaches to diabetes management. Biguanides, sulphonylureas, meglitinide, thiazolidinediones, dipeptidyl peptidase-4 (DPP-IV) inhibitors,  $\alpha$ -glucosidase inhibitors, and more recently, sodium-glucose transport protein (SGLT) inhibitors are among the main classes of such drugs [6].

Scientists are currently looking for new, safer, and more effective natural alternatives from sustainable sources due to the usage of conventional medicine and the negative side effects of chemical medications, especially antidiabetic drugs. Nowadays, the search for bioactive compounds from natural sources attracts the attention of many researchers and pharmaceutical industries worldwide. Since the conventional management and treatment of diabetes and its associated complications require a heavy economic impact on healthcare systems worldwide, there has been a growing interest in exploring alternative and complementary treatment options, such as herbal medicine, to alleviate the burden

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of diabetes on individuals and healthcare systems. Throughout history, humans have extensively utilized numerous plants to address diverse health issues. Indeed, various societies have traditionally relied on nature, predominantly plants, as essential sources for medicinal and health-related purposes [7]. In the present day, a significant global population, especially in developing nations, depends on these herbal remedies to fulfill their fundamental medical requirements. It is approximated that approximately 80% of the populace in developing countries resorts to herbal products for self-medication [8].

In developing countries such as Morocco, herbal treatment has been developed as an alternative to the treatment of diabetes because synthetic drugs are expensive [9]. Certainly, the scientific valorization of Moroccan medicinal plants with antihyperglycemic, hypoglycemic and antidiabetic effects will have an extensive positive impact on the environment, quality of life, durable development, and the basic circular economy in both developed and developing countries. From this optic, this study was designed to provide an outlook on the Moroccan medicinal plants and ethnobotanical studies investigating diabetes management, as well as to discuss published data reporting the antidiabetic effect of most cited medicinal plants and provide an overview of possible mechanisms of action.

#### **Geographical Significance**

Morocco's diverse geography, encompassing various regions such as the Rif, the Middle and High Atlas, the Anti-Atlas, and the Saharan desert, supports an impressive variety of medicinal plants traditionally used for diabetes management. This geographical diversity significantly contributes to the distribution of medicinal plants throughout the country. Each region contributes uniquely to a country's botanical wealth.

Rif Mountains (Northern Morocco): The Rif region, known for its temperate climate, is rich in plants like *Salvia officinalis* (sage), *Olea europaea* L. (olive), and *Rosmarinus officinalis* (rosemary).

Middle and High Atlas (Central Morocco): The Atlas Mountains, with their varying altitudes, host a wide array of endemic plants such as *Thymus saturejoides*, *Lavandula dentata* (lavender), and *Origanum compactum* (oregano). These species are traditionally used to manage diabetes because they are hypoglycemic and have anti-inflammatory properties.

Anti-Atlas (Southern Morocco): In the more arid conditions of the Anti-Atlas, plants like *Argania spinosa* (Argan tree) and *Opuntia ficus-indica* (prickly pear) thrive. These plants are highly valued for their potential to improve insulin sensitivity and regulate glucose levels.

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She was also honored with a prestigious research grant under the Women Scientist Scheme (WOS-A) by the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India, New Delhi.