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Inferences Regarding the Usage Areas and Climate Effects of Similar Medicinal Plant Species in Nairobi and Sivas Museums

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Abstract: From ancient times to the present day, many cultures worldwide have long used medicinal plants for their therapeutic benefits. Members of Lamiaceae and Fabaceae are among the most popular therapeutic plants because they contain a wide range of secondary components, especially essential oils. However, they are in danger of extinction due to recent climate changes, global warming, and the uncontrolled consumption of these plants. Understanding how climate change affects medicinal plants can help us create plans to preserve them for future generations. This study discusses climate change impacts on similar medicinal plants in Sivas (Türkiye) and Nairobi (Kenya), regions known for their great biodiversity and long history of medicinal plant use. Both cities host a rich biodiversity of medicinal plants integral to their respective regions' culture and history. The study covers several plant families, such as Lamiaceae and Fabaceae, common to both regions. These plants are used for their healing properties, particularly for treating bacterial infections in Kenya and as part of traditional cuisine in Sivas. This study highlights the need for further research on the sustainable use of medicinal plants and their potential role in the effects of climate change.

Keywords: Climatic conditions, Nairobi National Museum, SCU Natural History Museum, Fabaceae, Lamiaceae

Nairobi ve Sivas Müzelerindeki Benzer Tıbbi Bitki Türlerinin Kullanım Alanları ve İklim Etkilerine İlişkin Çıkarımlar

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Öz: Antik çağlardan günümüze kadar dünya çapında birçok kültür, şifalı bitkileri tedavi edici faydaları için uzun süredir kullanmaktadır. Lamiaceae ve Fabaceae üyeleri, başta uçucu yağlar olmak üzere çok çeşitli ikincil bileşenler içerdikleri için en popüler tedavi edici bitkiler arasındadır. Ancak, son iklim değişiklikleri, küresel ısınma ve bu bitkilerin kontrolsüz tüketimi nedeniyle yok olma tehlikesiyle karşı karşıyadırlar. İklim değişikliğinin şifalı bitkileri nasıl etkilediğini anlamak, onları gelecek nesiller için koruma planları oluşturmamıza yardımcı olabilir. Bu çalışma, büyük biyolojik çeşitlilikleri ve uzun tıbbi bitki kullanım geçmişleriyle bilinen Sivas (Türkiye) ve Nairobi'deki (Kenya) benzer tıbbi bitkiler üzerindeki iklim değişikliği etkilerini tartışmaktadır. Her iki şehir de kendi bölgelerinin kültürü ve tarihi ile bütünleşmiş zengin bir tıbbi bitki biyoçeşitliliğine ev sahipliği yapmaktadır. Çalışma, her iki bölgede de yaygın olan Lamiaceae ve Fabaceae gibi çeşitli bitki familyalarını kapsamaktadır. Bu bitkiler, özellikle Kenya'da bakteriyel enfeksiyonların tedavisinde ve Sivas'ta geleneksel mutfağın bir parçası olarak iyileştirici özellikleri için kullanılmaktadır. Bu çalışma, şifalı bitkilerin sürdürülebilir kullanımı ve iklim değişikliğinin etkilerindeki potansiyel rolleri konusunda daha fazla araştırma yapılması gerektiğini vurgulamaktadır.

Anahtar Kelimeler: İklim koşulları, Nairobi Ulusal Müzesi, SCÜ Tabiat Tarihi Müzesi, Fabaceae, Lamiaceae

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Introduction

In recent years, factors such as increasing desertification, melting glaciers, climate changes, and global warming have been associated with an increase in carbon dioxide emissions (Karl and Trenberth, 2003). Consumption of natural resources due to urbanization and industrialization, which are the needs of the global world, poses a threat to living ecosystems and causes a decrease in living spaces. Accordingly, our Earth faces dangers such as the extinction of some living species or a decrease in living diversity. It is very important to protect these species and pass them on to future generations.

Natural history museums play a crucial role in preserving and displaying the Earth's biodiversity. These institutions house specimens representing millions of years of our planet's history (Biodiversity | Natural History Museum, n.d.). These establishments function as knowledge repositories, keeping a variety of collections of plants, animals, fossils, and cultural items.

This study discusses the properties, areas of use, and requirements for protection against climate change of some medicinal plants that have been used in medical treatments throughout human history and are still used today. The existence and well-being of humans depend on medicinal plants (Ghorbanpour et al., 2017). Concerning, extreme weather and climate change are becoming major dangers to the variety and long-term usage of medicinal plants (Robiansyah et al., 2023). For millennia, the utilization of therapeutic plants has been fundamental to human well-being; over 80% of the global populace still depends on conventional plant-based remedies (Izah et al., 2023).

In the study, similar plant species exhibited at the Nairobi National Museum in Kenya and Sivas Cumhuriyet University Natural History Museums in Türkiye were preferred (Figure 1). We shall pay particular attention to the genera of two families the Fabaceae and Lamiaceae that are well-known for their therapeutic qualities. These plants are vital to ecosystems because they support pollinators, provide food, and maintain healthy soil (Odongo et al., 2022). In Sivas, the genera of Lamiaceae most commonly used for medicinal purposes are Salvia, Sideritis, Stachys, Thymus, and Origanum. The correlation between these two museums transcends geographical boundaries. As stewards of our planet’s natural heritage, they inspire us to appreciate the interconnectedness of ecosystems and their role in shaping climate patterns.

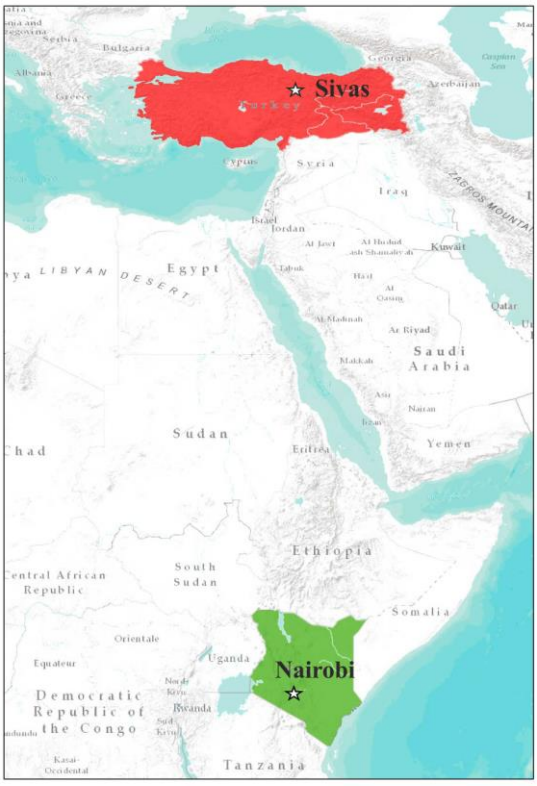

Figure 1. Location map of the museums.

Museums

The Nairobi National Museum (Kenya)

In Kenya, the management of museums, landmarks, and state corporations is under the purview of the Nairobi National Museum, a state corporation. It was established in 1910 by the East Africa Natural History Society, primarily to conduct scientific research on the natural characteristics of the East African environment (Nairobi National Museum – National Museums of Kenya, n.d.). The Nairobi National Museums serve as sites for exploration, reflection, and education (Figure 2). The four pillars that support the Institution of National Museums of Kenya are culture, history, the arts, and nature(Nairobi National Museum – National Museums of Kenya, n.d.). The competence of the museum is broad and includes studies on biodiversity, archeology, paleontology, and ethnography. There is a sizable collection of specimens in the museum, both transient and permanent (Nairobi National Museum Kenya, n.d.). The museum offers tourists and researchers the opportunity to view and investigate exhibits highlighting the region's diverse ecosystems, fauna, and geological history (Nairobi National Museum Kenya, n.d.).

The Nairobi National Museum advances knowledge on climate change by examining the relationships among ecosystems, climate, and human activity. It clarifies how local and global temperatures are impacted by changes in habitats, deforestation, and species extinction. Since healthy ecosystems are essential for carbon sequestration and climate management, conservation actions started by the museum can have a direct impact on climate resilience (Nairobi National Museum Kenya, n.d.) (Nairobi National Museum: Tours and Tickets - Tripadvisor, n.d.). Due to its vast geographic disperse, varied climatic conditions, and various soil types, Kenya, an African nation with significantly higher plant variety, also has a matching diversity of plant relationships and circumstances.

Figure 2. Views of the Nairobi National Museum. (a) Entrance of the museum, (b) Herbal Garden at Nairobi National Museum, (c-d) Learning about medicinal plants with the TICAH (Trust for Indigenous Culture and Health) herbalist at the Medicine Shield Garden at NMK

Sivas Cumhuriyet University Natural History Museum

Its significant geographic location in the Central Anatolian, Eastern Black Sea, and Eastern Anatolian regions, along with its diverse cultures, climates, and values, make it an important place. Sivas, a city of science and culture with its renowned madrasas, ruins, and historic buildings, is situated on the shore of Kızılırmak in

eastern Central Anatolia (Türkiye: Madrasas of Sivas National Geographic, n.d.). Sivas has hosted significant civilizations.

Located in Sivas, Türkiye, the Cumhuriyet University Natural History Museum was established in 2022 to serve as a hub for scientific research, education, and public engagement (Figure 3). Its mission includes preserving and showcasing Türkiye's natural heritage, emphasizing the importance of biodiversity conservation (Özgen Erdem and Canbaz, 2023) (Pehlivan, 2023) (Sivas Cumhuriyet University, n.d.). The museum houses an array of specimens, from fossils and minerals to botanical samples. These collections provide valuable insights into the region's geological history and ecological dynamics. Researchers at the museum contribute to studies on climate change adaptation, habitat restoration, and sustainable land use practices. The museum actively plans to collaborate with local communities, policymakers, and scientists to address climate-related challenges. By promoting awareness and advocating for conservation, the museum aims to build climate-resilient ecosystems in the Sivas region.

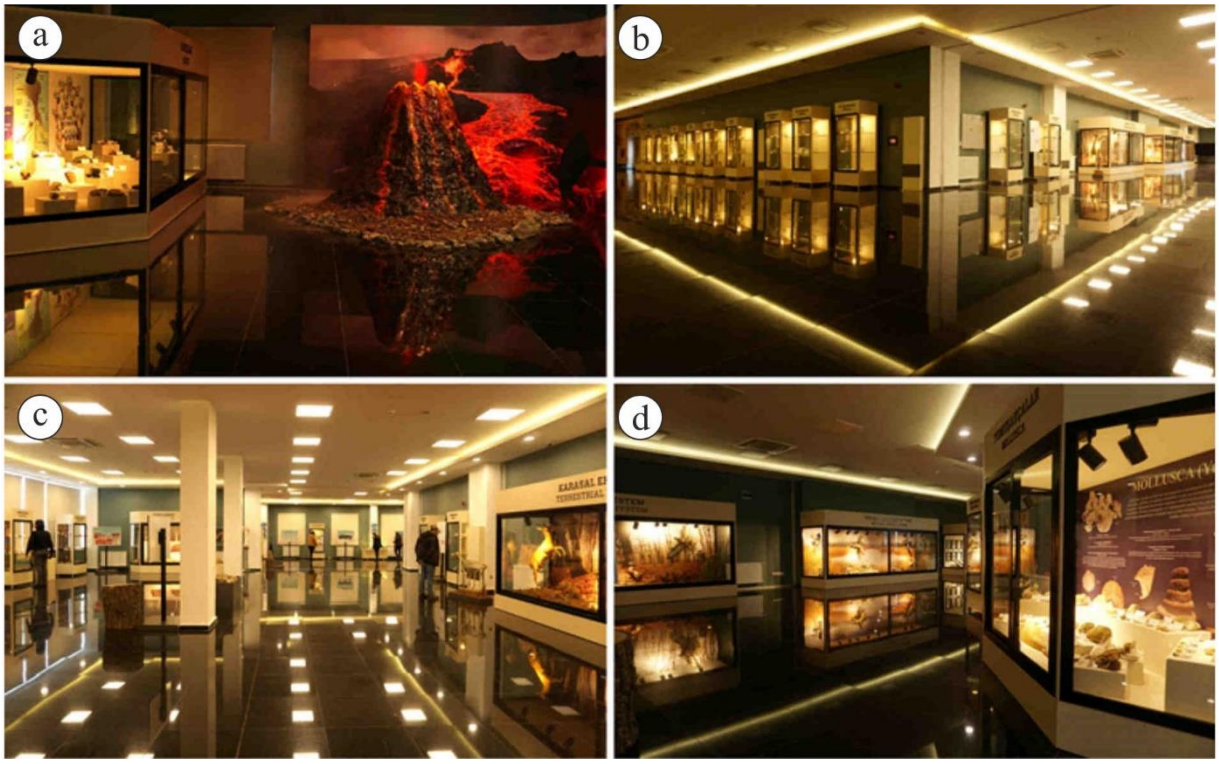

Figure 3. Views of the Sivas Cumhuriyet University Natural History Museum. (a) a volcanic model, (b-d) general views.

Material and Methods

The data for the Sivas Cumhuriyet University Natural Museum was directly collected from the Museum while the Nairobi National Museum data on fauna was obtained from the relevant museum website. The Sivas Cumhuriyet University Natural History Museum houses a total of 127 species which are divided into 36 families. Kenya has a wide variety of 105 plant species which are divided into 43 families.

Rich medicinal plant biodiversity is ingrained in the history and culture of both organizations' respective locations. Both locations have large populations of the Lamiaceae family, often known as the mint family, and the Fabaceae family, commonly known as the bean family. These families are well-known for their wide range of therapeutic qualities, which include antioxidant, anti-inflammatory, and antibacterial effects (Rao and Rao, 2015; Maroyi, 2023).

These therapeutic plants are essential for regulating climate variation (Cammarano et al., 2023). They improve soil health, aid in the sequestration of carbon, and serve as a habitat for a variety of creatures, all of which support biodiversity. The necessity for their conservation and sustainable use is highlighted by the way that their sustainable use can support policies aimed at mitigating climate change (Alahmad et al., 2023). Additionally,

these areas have a long history of transferring information about the uses of these plants from one generation to the next, underscoring the significance of these plants in the cultures in which they are found (Hardy, 2020; El Sheikha, 2017).

Results

Within the Nairobi National Museum, there is a significant representation of Lamiaceae (*mint family)* and Fabaceae (*legume family*) plants. These families are vital for ecosystems due to their roles in supporting pollinators, providing food, maintaining healthy soil, and also used in healing practices. Aloe secundiflora is a drought-tolerant plant mostly found in the arid and semi-arid areas of Kenya. The species is locally used as a medicine for humans and livestock, a fermenting agent in local beers, and a border plant (Kokwaro, 1976). The Aloe is famous for its medicinal and cosmetic properties and has a long history of use in Kenya. Many species of aloes are threatened with extinction, especially in the current climate change scenario, and thus the a need to keep knowledge about their use for sound conservation strategies (Bjora, et al, 2015).

Fuerstia africana is a genus of plants in the family Lamiaceae, first described in 1929 and it is native to Eastern and Southern Africa. An infusion of the leaves of Fuerstia africana T.C.E. Fr (Lamiaceae) is used to treat genital and oral thrush (Matu, et al., 2008) while Sericocomposis hildebrandtii Schinz (Amaranthaceae) roots juice is drunk for purgative effect and to treat dysmenorrhea (Kokwaro, 1993; Kipkore, et al., 2014)).

Olea africana is a small to medium-sized hardy tree with a rounded dense spread. It has narrow glossy grey-green leaves with silvery undersides and its fragrant flowers are greenish-white or cream which develop into fruits that ripen to purple-black (Bussmann, et al., 2020). Traditional remedies prepared from this plant serve as eye lotions and tonics, lower blood pressure, improve kidney function, and deal with sore throats. The early Cape settlers in South Africa used the fruits to treat diarrhoea. Frost-, drought- and wind-resistant, the wild olive has beautiful wood for furniture, and is regarded as a small-fruited subspecies of the commercial olive. This tree occurs throughout South Africa in various habitats and displays some growth forms from multi-stemmed shrubs to stately trees up to 18m tall (Orwa, et al., 2009)

On the other hand, Sivas province, located in central Türkiye has a rich history of traditional medicine. Indigenous knowledge about medicinal plants has been passed down through generations. The Lamiaceae family is particularly relevant for medicinal purposes in Sivas. Genera such as *Salvia*, *Sideritis*, *Stachys*, *Thymus*, and *Origanum* are commonly used. These plants have diverse therapeutic properties and are integral to local healing practices (Table 1).

Efforts to conserve these valuable plant resources are essential. Sustainable practices, including cultivation and responsible harvesting, can ensure their availability for future generations. In summary, both Nairobi and Sivas museums recognize the importance of preserving medicinal plant diversity. By understanding their unique contexts and leveraging traditional knowledge, we can promote sustainable use and protect these valuable natural assets.

Table 1. Similar Plants remedies in Sivas (Türkiye) and Nairobi (Kenya)

No.	Family and species name	Parts used	Use and administration
1	*Thymus/Thyme* **Lamiaceae**	Leaves	- It boosts the general immunity of the body as it contains vitamin A and Vitamin B (*Thyme: 12 Health Benefits and More*, n.d.). - It is used in disinfecting as it contains antiseptic properties e.g. mouthwashes, medicated bandages, or fungal creams(*Antiseptics and Disinfectants | MSF Medical Guidelines*, n.d.). - It's also effective against mold, a common indoor pollutant(*Reduce Your Exposure to Mold in Your Home | Mold | CDC*, n.d.) - It also impacts the mood positively hence referred to as aromatherapy to boost spirits and create a pleasant environment(*Everyday Aromatherapy for Enhancing Calm and Well-Being | Psychology Today*, n.d.)

			- Apart from its medicinal benefits, thyme remains a culinary staple due to its distinctive taste when added to the dishes and potential health perks (*Thyme: 12 Health Benefits and More*, n.d.)
2	*Rosmarinus officinalis* (Rosemary leaf) **Lamiaceae**	Leaves	- It is used to cure headaches, dysmenorrhea, stomachache, epilepsy, rheumatic pain, spasms, and nervous agitation (Rahbardar and Hosseinzadeh, 2020; Vieira et al., 2022). - It also helps in the improvement of memory, hysteria, depression, as well as physical and mental fatigue (Vieira et al., 2022; Rahbardar and Hosseinzadeh, 2020)
3	*Salvia officinalis* (sage herb) **Lamiaceae**	Aerial parts	- Adds vibrant color to landscapes (*27 Vibrant Color Choices for the Fall Landscape | Gardener's Path*, n.d.)**.**
4	*Mentha Spicata* (Mint) **Lamiaceae**	Leaves	- Mint is extensively utilized as a culinary herb in cooking flavor and aroma to dishes such as salads, sauces, and beverages (*Cooking With Mint: The Dos And Don'ts*, n.d.). - It is used in creams, lotions, shampoos, and conditioners to soothe irritated skin, reduce oiliness, and promote scalp health(*How to Improve Your Skin with Mint | HowStuffWorks*, n.d.).
5	*Salvia officinalis* (sage) **Lamiaceae**	Leaves	- Its fragrant leaves are prized for their savory flavor and are often used to season meats, poultry, soups, and stews (*Thyme: Exploring Its History, Flavor, And Culinary Uses*, n.d.). - It is believed to possess various therapeutic properties, including antimicrobial, anti-inflammatory, antioxidant, and cognitive-enhancing effects (Mitropoulou et al., 2023).
6	*Cassia* (sinameki) **Fabaceae**	Leaves and pods	- Used to relieve constipation and promote bowel movements(*Constipation - Symptoms and Causes - Mayo Clinic*, n.d.) (*Fruits for Constipation Relief: 16 Fruits That Can Resolve Your Stomach Issue*, n.d.).
7	*Ceratonia siliqua* (carob) **Fabaceae**	Pods	- They can be consumed fresh or dried, and are often processed into various products such as carob powder, carob syrup, and carob chips (*The 5 Best Things About Carob*, n.d.). - Carob syrup is sometimes used as a natural remedy for digestive issues such as diarrhea and indigestion (*CAROB: Overview, Uses, Side Effects, Precautions, Interactions, Dosing and Reviews*, n.d.)**.**
8	*Glycyrrhiza glabra* (meyan) **Fabaceae**	Roots	- It is primarily known for its sweet-tasting root, which contains bioactive compounds with various pharmacological effects(Kumar et al., 2021).
9	*Lavandula stoechas* (karabash herb) **Lamiaceae**	Flowers and Leaves	- Prized for its aromatic qualities, with fragrant flowers and foliage that are used in potpourris, sachets, and aromatherapy products (*Lavandula x Intermedia SENSATIONAL!® (Lavandin)*, n.d.). - Used in traditional medicine for various therapeutic purposes(*Traditional Medicine Has a Long History of Contributing to Conventional Medicine and Continues to Hold Promise*, n.d.).
10	*Lamiumga leodolon (crantz) Alibaba* **Lamiaceae**	Leaves and Aerial Parts	- Used to treat respiratory ailments such as coughs, colds, and bronchitis (*Mullein: A Powerful Herbal Remedy for Respiratory Health — Medicinal Backyard*, n.d.)**.** - Used to support digestive health and alleviate gastrointestinal discomfort. (*Your Digestive System: 5 Ways to Support Gut Health | Johns Hopkins Medicine*, n.d.)

11	*Melissa officinalis* (lemon one) **Lamiaceae**	Leaves	- It is renowned for its calming and soothing properties, making it a popular herb for alleviating stress, anxiety, and insomnia(*Can Herbs Help You Alleviate Stress and Anxiety? | Psychology Today*, n.d.)**.**
12	*Lavandula intermedia* (lavender) **Lamiaceae**		- Contributes to perfumes and skincare products(*Lavandula x Intermedia SENSATIONAL!® (Lavandin)*, n.d.)**.**
13	*Acacia* (Acacia tree Resin) **Fabaceae**		- Useful for covering wounds and cuts, providing a protective barrier against infection, and promoting faster healing (Han, 2023).
14	*Astragalus tragacantha* (kitre Zamki) **Fabaceae**	Roots	- It is often used as a herbal remedy to alleviate symptoms and promote respiratory wellness(*Breathe Easy: Herbs to Improve Respiratory Health Amidst Delhi's Air Pollution | OnlyMyHealth*, n.d.). - Support digestive health and aid in gastrointestinal issues such as indigestion, bloating, and diarrhea (*Foods That Help Digestion: What to Eat and Avoid*, n.d.).
15	*Lavandula steochas* (karabas herb) **Lamiaceae**	Leaves	- Used in traditional medicine for its therapeutic properties (*Who Global Report On Traditional And Complementary Medicine 2019*, 2019). - The plant possesses aromatic qualities and is often used for fragrance or as incense(*A Field Guide To Aromatic Plants: Lavender, Rose, Jasmine*, n.d.).
16	*Salviamulticaulis vahl* **Lamiaceae**	Leaves	- The leaves contain bioactive compounds such as phenolic acids, flavonoids, and terpenoids, which contribute to their pharmacological activities (Kumar et al., 2021).
17	*Sileneruscifolia(Hub.-Mor.and Reese)* **Lamiaceae**	Leaves and Roots	- The plant may be used to alleviate symptoms of respiratory disorders such as coughs and bronchitis (Mailu et al., 2020). - To aid digestion and alleviate gastrointestinal discomfort(*7 Foods To Alleviate Digestive Discomfort*, n.d.).
18	*Nepeta betonifolia C.A.Mey* **Lamiaceae**	Aerial parts	- It is used to alleviate symptoms of conditions such as headaches, fever, and gastrointestinal disorders(*Migraine > Fact Sheets > Yale Medicine*, n.d.) (*Headaches > Fact Sheets > Yale Medicine*, n.d.).
19	*Scutelliana orientalis* L. *subsp, bicolor* (*Hochst*) *J.R Edm* **Lamiaceae**		- Beneficial for conditions such as arthritis and other inflammatory diseases.
20	*Thymus pectinatus Fisch and Mey. var. pectinatus* **Lamiaceae**	Leaves	- Used as a culinary herb, imparting a distinctive flavor and aroma to various dishes. It is often used to season meats, soups, stews, and sauces. - It is believed to have antiseptic, antimicrobial, and antioxidant properties, making it useful for treating respiratory ailments, digestive issues, and minor skin infections.
21	*Salviacryptantha Montbret* and *Aucher ex Benth* **Lamiaceae**	Leaves and Aerial parts	- Used in traditional herbal remedies to treat various ailments, including digestive disorders, respiratory conditions, and skin ailments (Chaachouay et al., 2024).

22	*Ebenus laguroides Boiss. var. laguroids* **Fabaceae**		- It is often utilized for its medicinal properties in treating various ailments such as gastrointestinal disorders, respiratory problems, and skin conditions, - The plant's antimicrobial properties may also contribute to its efficacy in wound management.
23	*Salvia hypargeia Fisch Mey* **Lamiaceae**	Leaves	- Some cultures incorporate Salvia hypalgesia leaves into culinary dishes for flavoring and aroma, particularly in traditional cuisines of regions where the plant is native (*A Guide to Common Medicinal Herbs - Stanford Medicine Children's Health*, n.d.). - Treating various ailments, such as respiratory infections, gastrointestinal disorders, and skin conditions (*A Guide to Common Medicinal Herbs - Stanford Medicine Children's Health*, n.d.).
24	*Astragalus microcephalus will* **Fabaceae**	Roots	- To boost the immune system and enhance overall health and vitality(*6 Ayurvedic Herbs To Enhance Your Immunity - Tata 1mg Capsules*, n.d.)**.** - Treating conditions such as colds, flu, allergies, and respiratory infections(*A Guide to Common Medicinal Herbs - Stanford Medicine Children's Health*, n.d.).
25	*Teucrium chamaedrys* L. *subsp. chamaedrys* **Lamiaceae**		- To alleviate skin conditions such as wounds, cuts, and insect bites(*The Best Healing Herbs for Skin - Spices and Herbs Guide*, n.d.) - To treat various ailments such as indigestion, liver disorders, and urinary tract infections (Kaushik et al., 2021).
26	*Astragalus xylobasis Freyn* and *Bornm* **Fabaceae**	Roots	- To treat respiratory ailments, such as coughs, bronchitis, and asthma, due to its expectorant and bronchodilator effects(*10 Natural Herbs for Bronchitis Relief and Healing | MedShun*, n.d.).
27	*Astragalus cymbibracteatus Hub.-Mor.* and *Chamb* **Fabaceae**		- Boosting the immune system's function and aiding in the treatment of certain immune-related disorders(Dabas et al., 2023). - Used to treat conditions such as respiratory infections, fatigue, gastrointestinal disorders, and immune system weaknesses(*Herbs for Respiratory Health - CNM College of Naturopathic Medicine*, n.d.)(Dabas et al., 2023).
28	*Hedysarum pestalozzae Boiss* **Fabaceae**		- Potential therapeutic applications, such as antimicrobial, anti-inflammatory, antioxidant, or anti-cancer properties(Jongrungraungchok et al., 2023)(Mashabela et al., 2022).
29	*Nepeta congesta Fisch. Et. Mey* **Lamiaceae**	Leaves	- used to relieve digestive discomforts such as indigestion, bloating, and stomach cramps(*10 Herbs for Healthier Digestion - The Nutrition Insider*, n.d.). - Used to alleviate symptoms of respiratory conditions such as coughs, colds, and bronchitis(*10 Natural Herbs For Bronchitis Relief and Healing | MedShun*, n.d.).
30	*Oregano* [*Origanum vulgare* L.]	Leaves	- Used as a culinary herb, adding flavor to a variety of dishes, including pasta sauces, pizzas, salads, soups, and meat marinades(*Mediterranean Flavors: Herbs and Spices Used in Mediterranean Cuisine.*, n.d.). - It has been used traditionally in herbal medicine to treat respiratory infections, digestive issues, and skin conditions (Chaughule and Barve, 2024).

Discussion

Climate Change Mitigation and Medicinal Plants

Medicinal plants, especially those from the Fabaceae and Lamiaceae families, have enormous potential to contribute to climate change mitigation (Bussmann and Sharon, 2007). Beyond their traditional uses in health and livelihoods, they play a crucial role in carbon sequestration, biodiversity conservation, and ecosystem resilience. Below, we discuss their multidimensional roles in responding to climate change and highlight regional insights from Sivas and Nairobi.

Carbon Sequestration

Carbon sequestration, the process by which plants absorb atmospheric carbon dioxide during photosynthesis (Kumar et al 2014), and it is pivotal in mitigating global warming. Medicinal plants, like other plants, store carbon within their tissues and release oxygen back into the atmosphere. Over time, this sequestered carbon can contribute to soil organic carbon (SOC) through the decomposition of plant matter, enhancing the soil's carbon-holding capacity (Sanderman et al., 2017).

Medicinal plants have been shown to act as carbon sinks. The rate of sequestration by various species, suc h as Amla, Bahera, and Harar, has been found to be 1, 2.64, and 1.42 tC ha^{-1} yr^{-1}, respectively, in Sikkim, India (Lis-Balchin et al., 1998). Such observations suggest that medicinal plants, if integrated into carbon forestry initiatives, could yield economic dividends through carbon credits under plausible scenarios of \$5/tCO_2 (Aggarwal and Chauhan, 2014).

However, carbon storage is not permanent, as the decay of plants releases stored carbon into the soil and atmosphere. Therefore, such sustainable practices and conservation efforts are important in maintaining such benefits herein (Baltes and Voytas, 2015).

Biodiversity Conservation

Medicinal plants are important in the conservation of biodiversity in that they provide food, habitat, and ecosystem services.

Food Source

Many medicinal plants provide necessary inputs in terms of nectar, pollen, seeds, and leaves that provide various organisms such as insects, birds, and mammals with shelter (Tohidi et al., 2019).

Habitat

Medicinal plants are complexly structured; hence, the form in which they exist provides shelter to the microorganisms, insects, and sometimes the bigger animals. The root structure, stem, and the leaves will give a niche environment for the micro-ecosystem (Oremland, 2003).

Ecosystem Services

Medicinal plants contribute to provisioning (e.g., food, medicine), regulating (e.g., climate regulation), supporting (e.g., nutrient cycling), and cultural services (e.g., spiritual, recreational) (Soliveres et al., 2016). These ecosystem services improve overall health and resilience in ecosystems, which are key factors for adapting to climate change.

Resilience to Climate Change

Medicinal plants are part of healthy ecosystems that are more resistant to climatic changes. Plants stabilize soils, prevent erosion, sequester carbon, and act as a buffer for extreme weather events. However, Aggarwal and Chauhan, 2014; Yu et al., 2023, present the challenges of conservation: habitat loss, overharvesting, and climate chance. For medicinal plants, strategies need to be implemented to preserve the biodiversity and ensure sustainability (Applequist et al., 2020; Xia et al., 2022).

Livelihoods that are Sustainable

Medicinal plants cultivation can provide sustainable livelihoods and reduce dependence on activities like deforestation and fossil fuel use. In addition, communities are able to conserve forest ecosystems and improve their carbon sequestration potential through sustainable cultivation. This is according to Scherr and McNeely, 2007.

Adaptation and Climate Resilience

Some medicinal plants are quite resistant to severe climatic conditions and may contribute to land restoration. For example, several species can be grown in arid or semi-arid regions, which could help in reducing

the heat island effect of cities and store carbon in urban green areas (Howden et al., 2007).

Regional Insights: Sivas and Nairobi

The climates of Sivas and Nairobi represent two extremes in the impact on medicinal plants, considering temperature, precipitation, and seasonal changes.

Sivas has a cold temperate climate, classified as Dsb, with an average annual temperature of 8.1°C. Precipitation is moderate, averaging 467 mm per year, with the highest in April at 67 mm and the lowest in August at 6 mm. The cold winters and unpredictable precipitation make the growth and distribution of medicinal plants difficult and require adaptive conservation methods (Sivas Climate, n.d.). Nairobi has a moderate, warm climate, with the temperature classified as Cfb. The city's average annual temperature is 18.8°C, and it has an annual rainfall of 674 mm. Its relatively stable climate supports various medicinal plants; however, increasing urbanization and changes in land use threaten biodiversity (Climate Nairobi, n.d.).

Effects on Medicinal Plants

Climate change affects the geographical boundaries within which medicinal plants grow. Changes in temperature and rainfall might make certain habitats unfavorable and shift the distribution of the species (Wink, 2015). Changes in climate affect the timing of plant life-cycle events, such as flowering and fruiting, potentially reducing reproductive success and medicinal compound availability (Hedhly et al., 2009). Variations in temperature and rainfall can impact plant growth and the production of medicinal compounds, such as essential oils in Lamiaceae species (Kreuzwieser and Gessler, 2010).

Preservation of the Medicinal Plant Diversity in Sivas and Nairobi

In-situ conservation: Establish reserves and protected areas for native flora.

Ex-situ conservation: Maintain botanical gardens and seed banks to preserve the genetic material.

Sustainable practices: The cultivation of medicinal plants using environmentally friendly methods.

Public awareness: Educate people in all sectors on the importance of biodiversity conservation and sustainable use.

As medicinal plants have a considerable scope to contribute to lessening climate chance, they cannot stand on their own. Dealing with climate change demands an integrated approach to mitigation of emissions, restoration of ecosystems, and sustainable development. Given effective conservation and sustainable use strategies, medicinal plants can contribute significantly to such efforts, playing a diverse ecological role. Cases in Sivas and Nairobi point out that local adaptations and global cooperation are crucial in using medicinal plants in the interest of mitigating climate chance and preserving biodiversity.

Conclusion

Through numerous efforts and programs, Nairobi and Sivas Museums have both significantly contributed to the attainment of the Vision 2030 SDGs. It's crucial to remember that reaching these objectives calls for a coordinated effort from every sphere of society. As SDG 2 (Zero Hunger), SDG 3(Good Health), and SDG 13 (Climate Action) both Nairobi and Sivas museum plays a crucial role as they both provide education and exhibit the importance of sustainable agriculture and food security, promote public health awareness and the well-being and this has led to improve access of quality healthcare services and lastly the two museums has played a major role in raising awareness about the climate change impacts and its resilient adaptive measures through various exhibitions, educational programs and community engagement as shown in Figures 2 and 3.

Lastly, this study demonstrates the similar medicinal plant species in Nairobi and Sivas alongside justifying the use of these plants in traditional medicine. It may serve as a starting point of research geared towards the similar medicinal species of these plants. In conclusion, despite their differences in geography and culture, Kenya and Sivas, Türkiye, use therapeutic herbs in similar ways. There is a long-standing custom in both areas to use the medicinal plants' diverse range of uses for health benefits. This common history emphasizes the value of therapeutic plants everywhere and the necessity to value and conserve this botanical. Also, both Nairobi (Kenya) and Sivas (Türkiye) ethnobotanical archives are further encouraging in that, although living in cities for a long time, the people there continue to use the knowledge passed down from their ancestors. Therefore, the results of this ethnobotanical survey were important to find out the present situation of traditional knowledge in the two countries.

Additional Information and Declarations

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