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Ethnobotanical review of Ethiopian spices and condiments: traditional uses, cultural significance, and applications

Nigussie Amsalu¹, Liyew Birhanu¹ and Ashebir Awoke^{2*}

Abstract

Ethiopia is renowned for its remarkable diversity of spices and condiments, which play essential roles in cuisine, traditional medicine, and cultural rituals. Many of these plants are deeply embedded in local health systems, spiritual practices, and livelihoods, yet their sustainability is challenged by small-scale cultivation, inconsistent quality, and the erosion of indigenous knowledge. This review presents a systematic thematic synthesis of ethnobotanical literature including peer-reviewed articles, books, theses, reports, and surveys across major agro-ecological zones with taxonomic verification of species names. Species were selected based on endemism or long-standing cultural significance, with documented culinary, medicinal, or ritual applications. The analysis highlights key spices such as *Capsicum annuum* L. (mitmita), *Nigella sativa* L. (tikur azmud), *Coriandrum sativum* L. (dimbilal), and *Aframomum corrorima* (A.Braun) P.C.M.Jansen (korarima), which are integral to Ethiopian culture and economy. These plants are widely used to treat respiratory, gastrointestinal, and dermatological conditions, while also holding symbolic value in ceremonies and rituals. Forest-derived spices such as korarima and long pepper show increasing market demand, while homegardens continue to support biodiversity and household income. Despite their cultural and economic significance, spice production remains constrained by agronomic challenges and low genetic diversity. Strengthening indigenous knowledge systems and integrating them with modern conservation and development strategies will be critical for safeguarding biodiversity, cultural heritage, and economic opportunities.

Keywords Ethiopian spices, Ethnobotany, Indigenous knowledge, Spice conservation, Traditional medicine

Introduction

Ethiopia, one of Africa's most botanically diverse countries, hosts a remarkable array of ecosystems, cultures, and culinary traditions. Its diverse agro-ecological zones from arid lowlands to highlands support the growth of numerous plant species traditionally used as spices and condiments [1, 2]. These plant-based ingredients are

not only central to Ethiopian cuisine but are also deeply embedded in cultural identity, health practices, and spiritual rituals [2]. Despite their significance, a comprehensive synthesis of their ethnobotanical uses remains limited [3]. The FAO defines spices as vegetable products used for flavoring, seasoning, and aroma [4]. Condiments, in contrast, may include spices, herbs, sauces, and other flavor-enhancing substances, often added to food after preparation [4, 5]. Ethiopian spices often serve both culinary and medicinal roles, reflecting their integrative role in everyday life.

Spices and condiments in Ethiopia transcend culinary function; they play vital roles in traditional medicine, rituals, and social customs [4]. Cultural dishes such as

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Doro wot, *Shiro*, and *Kitfo* rely on complex spice blends like *Berberis*, *Mitmita*, *Awaze*, and *Mekelesha*, which vary across regions and reflect Ethiopia's rich cultural mosaic [5]. These blends often include indigenous and naturalized species such as *Aframomum corrorima* (Ethiopian cardamom), *Thymus schimperi* (tosign), *Capsicum* spp., *Zingiber officinale* (ginger), *Piper capense* (Ethiopian black pepper), and *Lippia adoensis* (koseret) [6, 7]. Their preparation and use are passed down orally, forming intricate systems of traditional knowledge that are increasingly under threat due to environmental degradation, globalization, and changing dietary patterns [8, 9].

Ethnobotanical research provides critical insights into the sociocultural, medicinal, and ecological value of these plant resources [10]. In Ethiopia, localized studies have documented the use of spices for managing gastrointestinal and respiratory ailments, as well as for their preservative and antimicrobial properties [11, 12]. However, existing literature remains fragmented, often focused on specific regions or communities, lacking a cohesive national perspective [12].

Ethiopia's participation in ancient trade networks via the Red Sea and Indian Ocean underscores its longstanding relationship with spices not only as a consumer but also as a cultivator and trader [12–14]. Today, spices continue to contribute to local livelihoods and international exports [15]. Yet, rising global interest in Ethiopian food and herbal products has not been matched by academic research or policy support to ensure their sustainable use and conservation [9].

The biological and cultural heritage of Ethiopia's spice plants faces multiple threats, including deforestation, land-use change, climate variability, and erosion of indigenous knowledge [6–8]. Many of the species used in spice mixtures are wild-harvested and under pressure, yet their conservation status is often not assessed. Furthermore, the decline in traditional knowledge due to generational shifts and limited integration into formal education exacerbates the issue [11].

Against this backdrop, a comprehensive review of Ethiopian spices and condiments is both timely and necessary. Such a synthesis can consolidate existing data, identify key species and under-documented taxa, and reveal gaps in research. It can also support biodiversity conservation, inform sustainable utilization, and create opportunities for economic development. Importantly, it bridges disciplines ethnobotany, food science, pharmacology, and anthropology to provide a holistic understanding of how spices shape and are shaped by Ethiopian life [2].

Globally, spices have influenced human history, trade, and culinary for millennia. While European explorers like Columbus and Vasco da Gama are often credited

with expanding the spice trade, ancient civilizations in India, Egypt, and Ethiopia had already established rich traditions of spice use [16, 17]. Archaeological records show spice use as early as 2000 BC in India and 1500 BC in Egypt [18]. Documenting localized traditions such as Ethiopia's, independent of the Eurocentric narrative, offers a more inclusive understanding of the global role of spices [4].

The dissemination of spices via extensive land and sea routes shaped culinary cultures across Asia, Africa, and Europe [19]. Arab intermediaries facilitated the spice trade from India, Southeast Asia, and Africa to the Mediterranean and beyond. Ethiopia's location along these historic trade routes positioned it as both a recipient and contributor to this exchange [20]. Spices remain culturally and economically significant in Ethiopia today.

Ethiopian spices and condiments derived from roots, fruits, bark, seeds, and other plant parts are essential not only for flavor and aroma, but also for their health benefits and preservative qualities [4, 5].

Ethiopia's underutilized herbs and spices present valuable opportunities for poverty alleviation, women's empowerment, and climate resilience [6]. However, sociocultural, informational, and research barriers hinder this potential [7]. Traditional knowledge on the culinary, medicinal, and ritual uses of spices persists in local communities, yet remains under-documented.

To address these gaps, this review systematically compiles and analyzes ethnobotanical data on Ethiopian spices and condiments. It explores their cultural, medicinal, and ecological significance; outlines traditional processing techniques; assesses conservation challenges; and identifies opportunities for sustainable cultivation and commercialization. This work aims to support efforts toward preserving Ethiopia's botanical heritage and leveraging its plant resources for future development.

Methods and materials

Study design

This study employs a systematic thematic ethnobotanical literature synthesis. The objective was to document and analyze the traditional knowledge systems and diverse applications of spices and condiments indigenous to, or widely utilized in, Ethiopia. Emphasis was placed on culinary, medicinal, and cultural contexts, while ensuring taxonomic accuracy and thematic organization of data.

Data collection methods

Data were collected using a multi-source approach that combined systematic literature analysis, ethnobotanical survey reports, and taxonomic verification. A comprehensive search of peer-reviewed journals (e.g., *Journal of Ethnopharmacology*, *Economic Botany*, *Journal of*

Ethnobiology and Ethnomedicine, Ethnic foods and Ethnomedicine), books, and monographs on Ethiopian flora and cultural practices was conducted. Sources from governmental and non-governmental organizations working on agriculture, biodiversity, and cultural heritage were also included, together with graduate theses and dissertations.

Electronic database searches (Google Scholar, PubMed, Scopus, JSTOR, ScienceDirect, and AGRIS) were performed using combinations of keywords such as “Ethiopian spices,” “traditional medicine Ethiopia,” “ethnobotany Ethiopia,” “indigenous knowledge spices,” and specific plant names (e.g., tenadam, koseret, korarima).

Existing ethnobotanical surveys from major agro-ecological regions (Oromia, Amhara, Tigray, Central Ethiopia, South Ethiopia and Southwest Ethiopia) were reviewed. These often included field interviews with local healers, elders, farmers, and herbalists, whose oral knowledge offered critical insights into plant use. Where possible, traditional knowledge claims were validated or cross-referenced against multiple independent

ethnobotanical surveys, pharmacological studies, or official flora databases.

To ensure botanical accuracy, plant names were verified and harmonized using The Plant List, Kew’s Plants of the World Online, Flora of Ethiopia and Eritrea, Tropicos, and the International Plant Names Index (IPNI). Synonyms were consolidated to avoid duplication.

Inclusion and exclusion criteria

The study selection process, summarized in the flow diagram (Fig. 1), began with 100 database records and 8 local sources (total 108). After removing duplicates, 92 records were screened by title/abstract, of which 35 were excluded. Fifty-seven articles underwent full-text review, and 25 were excluded due to lack of relevance or insufficient data. Ultimately, 32 studies met the eligibility criteria.

Inclusion criteria required that species were endemic to Ethiopia or held long-standing cultural integration in food or medicine. Only studies published in English or Amharic between 1980 and 2024 were considered. Eligible works documented clear ethnobotanical significance

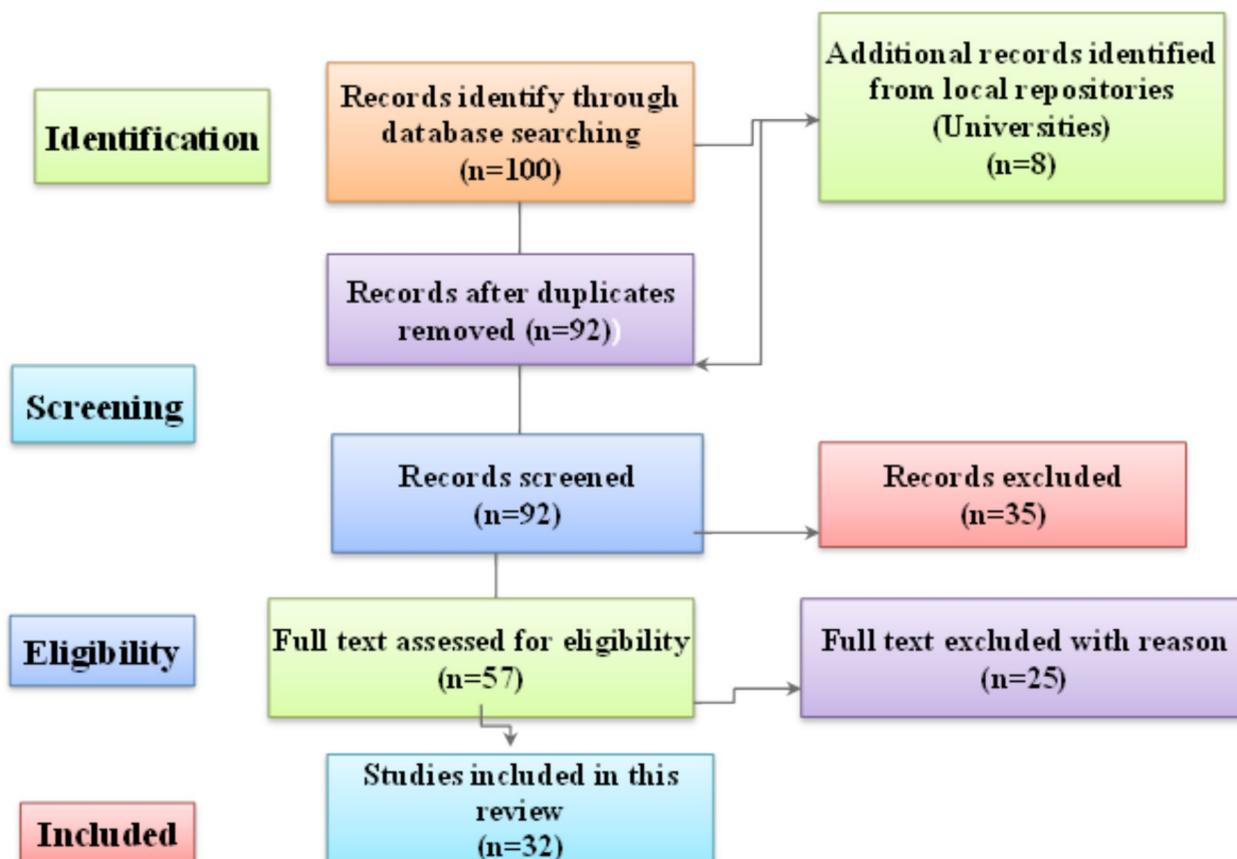


Fig. 1 Flow diagram illustrating the process of literature identification, screening, eligibility assessment, and inclusion in the systematic review

(culinary, medicinal, ritual, or symbolic). Excluded materials comprised ornamental/industrial plants, imported species without cultural assimilation, and studies lacking sufficient taxonomic or ethnographic detail.

Data analysis

Extracted data were systematically organized into thematic categories, including botanical information (family, genus, species, and local/common names), culinary roles (such as dishes, preparation methods, and preservation uses), medicinal applications (ailments treated, preparation techniques, and dosage forms), cultural significance (ceremonies, taboos, and symbolic practices), and economic and conservation aspects (market values, IUCN status, and local conservation notes where available). Data were cataloged using Microsoft Excel, and descriptive statistical analysis was performed with R software version 4.4.3.

Limitations of the methodology

This synthesis is subject to limitations. Reliance on published secondary sources introduces potential bias, and the predominance of English and Amharic literature may exclude knowledge documented in other Ethiopian languages. Much traditional knowledge remains orally transmitted and under-documented, creating risk of omission. The geographic distribution of available studies is uneven, with underrepresentation from northern, eastern, and central Ethiopia, limiting the comprehensiveness of the national perspective. Furthermore, species-specific conservation assessments were possible only for plants with available IUCN or national status records; for others, data gaps persist. These limitations are acknowledged, and conclusions are framed as a representative synthesis rather than a fully comprehensive national review.

Results and discussion

Ethiopian spices and condiments: an ethnobotanical overview

This review offers a comprehensive ethnobotanical examination of spices and condiments traditionally used in Ethiopia. It explores their taxonomic diversity, culinary significance particularly in the context of traditional spice use medicinal applications, phytochemical composition, and other cultural functions. Drawing from a wide array of scholarly sources, the review synthesizes current knowledge on the rich and multifaceted roles these plant species play in Ethiopian society.

Taxonomic diversity and distribution

Ethiopia is renowned for its exceptional floral biodiversity, home to an estimated 5,757 vascular plant species,

of which approximately 9.4% (544 species) are endemic [21]. Ongoing botanical investigations, especially in underexplored regions, continue to reveal new species, further contributing to the country's remarkable taxonomic wealth [21]. Globally recognized as a major center of crop genetic resources, Ethiopia's botanical richness is closely linked to its varied agro-ecological zones, diverse agricultural practices, and complex sociocultural landscapes [22]. This broad ecological and climatic variability [21–24] provides ideal conditions for the cultivation of numerous spice-producing plant species.

The country is also considered a center of origin and domestication for several key spices, including *A. corrorima* (Ethiopian cardamom), *Nigella sativa* (black cumin), *Trachyspermum ammi* (Ethiopian caraway), *Coriandrum sativum* (coriander), *Thymus schimperi* (thyme), *Trigonella foenum-graecum* (fenugreek), and *Lippia adoensis* var. *koseret* (koseret) [24–27]. The International Organization for Standardization (ISO) has formally recognized many of these spices as uniquely Ethiopian in origin and composition, affirming their botanical and cultural importance [4]. The enduring legacy of spice use is vividly reflected in the country's diverse culinary traditions, which vary considerably among Ethiopia's numerous ethnic groups [28].

In total, this review documents 63 plant species used as spices and condiments across Ethiopia, representing 46 genera and 25 botanical families (Table 1, 2, Table S1). The Lamiaceae family emerges as the most dominant, contributing 14 species (22%) to the national spice flora. This is followed by Apiaceae with six species (9.5%) and Asteraceae with five species (8%). Both Solanaceae and Zingiberaceae are represented by four species each, while many other families contribute one or two species. Notably, Fabaceae and Poaceae also play significant roles in Ethiopia's spice biodiversity [21].

These findings highlight the country's impressive array of spice and condiment-producing plants, emphasizing their value not only for culinary purposes, but also for traditional medicine, cultural identity, and potential economic development. The wide range of taxa involved points to the deep ethnobotanical knowledge embedded in local communities and underscores Ethiopia's significance as a reservoir of both biological and cultural diversity.

Taxonomic significance and utilized plant parts of Ethiopian spices and condiments

This review data revealed that the Lamiaceae family emerges as the most dominant, accounting for 14 species representing 22% of all documented taxa (Table 2, Table S1). This underlines the pivotal role of aromatic herbs from this family, including mints and thymes, in

Table 1 Ethiopian local cuisines with illustrations

Picture	Name of Cuisine	Description
	Beyaynetu (Vegetarian Platter)	Mixed vegetarian platter of stews and salads served on injera, commonly eaten during fasting
	Beyaynetu (Variant)	Variation of vegetarian platter with lentils, greens, and spicy sauces on injera
	Kitfo with accompaniments	Minced raw beef seasoned with mitmita and niter kibbeh, served with ayib (cottage cheese) and gomen
	Shiro Wat	Chickpea flour stew cooked with berbere and spices, served with injera
	Beyaynetu Sampler	Combination of lentils, peas, greens, and flatbread pieces arranged on injera
	Vegetarian Feast	Large festive serving of multiple colorful vegetarian dishes on injera
	Kitfo Special	Raw minced beef dish with gomen (greens) and ayib, a national delicacy
	Doro Wat with Injera	Spicy chicken stew prepared with berbere, onion, garlic, and boiled egg, served on injera
	Tibs with spices	Fried or sautéed meat cubes (beef/lamb) with vegetables, served with injera and spice condiments

Ethiopia’s culinary and medicinal traditions. Following Lamiaceae, the Apiaceae (Umbelliferae) and Asteraceae families contribute 6 (9.5%) and 5 (8%) species,

respectively, featuring well-known plants such as parsley, carrots, and daisy-like species.

Interestingly, 12 of the plant families are each represented by only a single species, accounting for 1.6%

Table 2 Representative culinary uses of Ethiopian spices and condiments documented in the review

Taxa (Family)	Local/common names	Plant part used	Culinary uses/preparation	Selected references
<i>Aframomum corrorima</i> (Zingiberaceae)	Ethiopian cardamom (Korarima)	Seeds	Flavoring berbere, coffee, tea, stews, breads	[11, 28, 30]
<i>Allium cepa</i> ; <i>Allium sativum</i> (Alliaceae)	Onion (Shinkurt); Garlic (Netch shinkurt)	Bulbs	Essential base for sauces, stews, berbere, shiro, butter refinement	[11, 28, 31]
<i>Capsicum annuum</i> ; <i>C. frutescens</i> (Solanaceae)	Chili pepper (Berbere, Mitmita)	Fruits	Spice blends (berbere, mitmita), raw and cooked dishes, flavoring coffee	[11, 30, 44]
<i>Zingiber officinale</i> (Zingiberaceae)	Ginger (Zinjibil)	Rhizomes	Spice for wot, berbere mix, tea flavoring	[11, 28, 30]
<i>Curcuma domestica</i> (Zingiberaceae)	Turmeric (Erid)	Rhizomes	Coloring and flavoring stews and breads	[28, 31, 42]
<i>Coriandrum sativum</i> (Apiaceae)	Coriander (Dimblal)	Fruits	Berberere preparation, flavoring sauces, injera, bread	[11, 24, 55]
<i>Cuminum cyminum</i> (Apiaceae)	Cumin (Kemun)	Fruits	Foundation spice for berbere, savory dishes	[11, 34, 43]
<i>Trigonella foenum-graecum</i> (Fabaceae)	Fenugreek (Abish)	Seeds	Berberere, baking, local drink (shamet)	[24, 28, 39]
<i>Ruta chalepensis</i> (Rutaceae)	Rue (Tena Adam)	Fruits, aerial parts	Berberere blend, flavoring milk, cheese, coffee, tea	[11, 28, 45]
<i>Ocimum basilicum</i> & relatives (Lamiaceae)	Basil (Besobila, Awot)	Aerial parts	Ingredient in berbere and sauces	[11, 24, 39]
<i>Lippia adoensis</i> & <i>L. koseret</i> (Verbenaceae)	Koseret, Kesie	Leaves	Spicing butter, flavoring meat, cleaning milk pots	[19, 28, 40]
<i>Thymus</i> spp. (Lamiaceae)	Thyme (Tosign)	Leaves	Flavoring berbere, shiro, tea	[9, 30, 34]
<i>Rosmarinus officinalis</i> (Lamiaceae)	Rosemary (Siga metibesha)	Leaves, shoots	Tea, meat seasoning, stews	[28, 32, 39]
<i>Nigella sativa</i> (Ranunculaceae)	Black cumin (Tikur Azmud)	Seeds	Sprinkled on bread, flavoring sauces	[11, 28, 55]

per family. This pattern illustrates the extensive taxonomic breadth of Ethiopian spice and condiment use, demonstrating that numerous unique species from diverse botanical families contribute to the country's culinary, medicinal, and cultural heritage. The percentage breakdown provided in the table allows for a clear comparison of each family's relative contribution and underscores the importance of preserving traditional knowledge systems. Such preservation is particularly vital, given that many of these families have only a single representative species in Ethiopian ethnobotanical records, yet still hold significant cultural and utilitarian value.

Although Ethiopia possesses an abundant array of indigenous spice and condiment species, several "classical" spices such as *Syzygium aromaticum* (cloves), *Myristica fragrans* (nutmeg), *Piper longum* (long pepper), and *Curcuma longa* (turmeric) were historically imported from India [11]. Nevertheless, Ethiopian cuisine has fully integrated these imports into traditional practices alongside its native flora.

Spices and condiments in Ethiopia are derived from a variety of plant parts. These include bark (*Cinnamomum* species), bulbs and rhizomes (*Zingiber officinale*,

Curcuma longa, onion, garlic), floral buds (cloves, saffron), seeds (*N. sativa*, mustard, poppy, sesame, fenugreek, Ethiopian cardamom), leaves (parsley, thyme, basil, rosemary, marjoram, savory, sage, celery leaves), and fruits (*Capsicum* species, coriander, *Trachyspermum ammi*, cress, and peppercorns). As noted by Lulekal [29], fruits, seeds, leaves, rhizomes, and bulbs are the most commonly harvested parts for use in cooking, beverages, and spice preparation. These are utilized in various forms dried, ground, or fresh and serve multiple functions as pot herbs, flavor enhancers, coffee additives, and vegetables.

For instance, *Capsicum annuum* and *C. frutescens* are commonly used as fresh or dried vegetables, while the pungent rhizome of *Zingiber officinale* is highly valued in both culinary and medicinal contexts [30]. Moreover, in several Ethiopian cultural groups, fresh leaves of *Thymus schimperi* and *Ruta chalepensis* are traditionally infused into milk products, coffee, and herbal beverages to enhance aroma and taste [28].

Ethnobotanical studies have documented the wide-ranging uses of spices and condiments across Ethiopia's diverse ecological and cultural landscapes [11, 19, 20, 26–39]. Valuable sources of information on these species

include the *Flora of Ethiopia* volumes 1 through 7 [40–54], the *Honeybee Flora of Ethiopia* [55], and numerous reports by the Ethiopian Biodiversity Institute (EBI) [22]. Despite the availability of these rich resources, a consolidated national overview of spice and condiment usage remains lacking. For example, ethnobotanical studies in two communities in southern Ethiopia documented as many as 33 spice species, pointing to the region's rich cultural plant knowledge. However, such findings also highlight the need for expanded ethnobotanical surveys in underrepresented regions, especially in the northern, eastern, and central parts of the country, to provide a more complete and inclusive understanding of Ethiopia's spice diversity.

Culinary uses of selected spice and condiment yielding taxa in Ethiopia

Plant-derived spices and condiments are widely used in Ethiopia to enhance the flavor of foods, traditional dishes, and beverages, both during cooking and at the time of consumption (Table 1). Ethiopian communities incorporate these spice products into a broad array of culinary preparations, including breads, butters, meats, soups, and vegetable-based dishes [24]. However, the specific culinary applications of these spices vary considerably among communities, and even within individual communities. These differences are likely influenced by sociocultural factors and disparities in traditional knowledge concerning the uses of spice-producing species.

Woldeyes [28] documented the diverse spice usage among the Basketo and Kafa communities, who flavor a range of foods such as coffee, tea, butter, cheese, cabbage, *Wot* (a spiced stew), *Shiro* (a chickpea-based purée), *Qocho* (a fermented product made from *Enset*), and roasted beef. Spices are also commonly used to enhance the taste of milk, cheese, water, herbal infusions, and local beverages like *Qolo* (roasted cereals). They are further employed to impart color and depth to breads and *Berberé* a quintessential Ethiopian spice blend typically containing *Capsicum* species. Despite being used in relatively small quantities, spices have a significant impact on the sensory properties of food, primarily due to their content of fixed and volatile oils [14, 56].

The culinary roles of major plant families and species, based on reviewed literature, are summarized below:

Lamiaceae is one of the most culturally and culinarily significant families in Ethiopia. It contributes numerous herbs and flavoring plants, such as *Mentha spicata* (spearmint), *M. piperita* (peppermint), *Rosmarinus officinalis* (rosemary), *Thymus* spp. (thymes), *Ocimum basilicum* (sweet basil), and *Salvia officinalis* (sage) [57]. Among these, *Ocimum* species are essential ingredients in traditional stew preparations and form a core

component of *Berberé* spice blends (Table 2). *Thymus* species, especially *T. schimperi*, are highly fragrant and antioxidant-rich herbs used to flavor dairy products like yogurt, butter, and cheese. The entire plant is aromatic and used in culinary preparations such as *Besso* (roasted barley flour) [58]. Additionally, the leaves of *T. serrulatus* are dried, ground, and blended with other spices to produce the complex spice mixtures used in *Berberé* and *Shiro*. *Thymus* leaves are also used to prepare herbal infusions, either directly as tea or by boiling them in water [34, 39]. *Rosmarinus officinalis* leaves are commonly added to roasted meats, including beef, mutton, and goat, adding flavor and aroma (Table 2).

Verbenaceae: *Lippia adoensis* var. *koseret* is a domesticated, aromatic herb endemic to Ethiopia, especially cultivated in home gardens in the Gurage region (Fig. 2). Its fragrant leaves are integral to the preparation of spiced butter by the Gurage and Oromo communities. The distinctive flavor and aroma of Gurage-style *Kitfo* (raw or lightly cooked minced meat with spiced butter) are largely attributed to the volatile oils of *L. adoensis* [41].

Zingiberaceae is a key family for globally important spices. Prominent Ethiopian representatives include *Curcuma longa* (turmeric), *Elettaria cardamomum* (cardamom), *Zingiber officinale* (ginger), and *A. corrorima* (Ethiopian cardamom) [11, 57, 59]. *Z. officinale* is prized for its pungent taste and aromatic compounds, mainly phenolic constituents and essential oils [59]. In Ethiopia, it is used in various dishes and to prepare the popular ginger tea (*Qeshir*). Globally, ginger is incorporated into both savory and sweet preparations, such as curries, cakes, and ginger-based beverages [59]. *A. corrorima* holds a unique place in Ethiopian cuisine; it is used in hot pepper sauces (*Mitmita*, *Awaze*), spice blends, and even as a coffee flavoring agent [60]. *C. longa* is also essential for its yellow color and earthy flavor, particularly in dishes like *Alicha* [61].

Apiaceae (*Umbelliferae*) contributes several vital spices and condiments [57]. Notable taxa include *Anethum graveolens* (dill), *Apium graveolens* (celery), *Coriandrum sativum* (coriander), *Cuminum cyminum* (cumin), *Foeniculum vulgare* (fennel), and *Trachyspermum ammi* (ajwain). *C. sativum* which are widely cultivated and globally appreciated, especially in Asian cuisines, where it is used in pickles and meat preparations [12, 43]. In Ethiopia, coriander seeds are vital components of *Berberé* spice blends and are used to flavor stews and *Injera*. *C. cyminum* is similarly used to season soups, meats, rice, cheeses, and chutneys, and is a critical ingredient in *Berberé* and clarified butter [11, 34, 39, 43]. *T. ammi* contributes a pungent flavor to sauces and breads through its roasted and ground fruits, while *F. vulgare* provides a sweet aroma from its young stems and leaves, used in



Fig. 2 Some Ethiopian spices and condiments picture

stews and traditional drinks like *Areqi* or *Katikala* [11, 30, 31].

Solanaceae, or the nightshade family, includes several important spice and condiment species in Ethiopian cuisine [57]. These include *Capsicum annuum*, *C. frutescens*, *Solanum pseudocapsicum*, and *S. nigrum*. Among them, *C. annuum* is the most significant, cultivated worldwide and used both as a fresh vegetable and a dried spice [17, 57, 62]. In Ethiopia, three distinct forms of *Capsicum* are recognized: *Qarya* (immature green fruit), *Berbere* (mature red fruit), and *Mitmita* (small, hot fruit). *C. annuum* is highly diverse in its cultivars, ranging from sweet to extremely hot varieties [44, 55]. In various regions, *Capsicum* fruits are used fresh, cut, or dried to prepare dishes and fast foods like *Beyaynet*. *Berbere*, a cornerstone of Ethiopian cuisine, is traditionally made at home by grinding dried red peppers with other spices [19, 40]. Processed pepper products like *Berbere* powder, *Dilih*, and *Awazie* are widely available in local markets, particularly in Mareqo and Mesqan districts. The *Capsicum* value chain from fresh produce to processed spice is detailed in Fig. 2, illustrating the stages of value addition.

The figure illustrates the different stages and uses of *C. annuum* (long chili, hot pepper) in Ethiopian

culinary practices. The images depict the fresh green and mature red fruits, which are harvested and dried under the sun. The dried pods are displayed in bulk at markets and are then ground into coarse or fine chili powder. This powder is sold in both unpackaged and packaged forms, often blended with other traditional Ethiopian spices such as black cumin (*N. sativa*), basil (*Ocimum basilicum*), korarima (*A. corrorima*), thyme (*Thymus schimperi*), and black pepper (*Piper nigrum*). These spice mixtures form the base of *berbere*, a quintessential Ethiopian spice blend widely used for flavoring stews, sauces, and traditional dishes.

The image (Fig. 3) provides a visual narrative of the processing and presentation of *C. annuum*, particularly a long, hot chili pepper variety, within the Ethiopian context. It begins with the depiction of fresh, dark red chili peppers both in close-up and in slightly varied forms suggesting differences in lighting or stages of ripeness. Subsequent stages highlight the transformation of these peppers: a large heap of dried and crushed chilies is followed by a close-up of the crushed form, likely representing an intermediary stage before fine grinding. The process culminates in a display of the final products, which include a cone-shaped arrangement of dried chilies for market sale, a bowl of finely



Fig. 3 Traditional preparation process of spicy *Capsicum annum* L. (Berbere) powder in Ethiopia [5]

ground chili powder (*Berbere*), and packaged chili powder, potentially labeled in Amharic.

The image also features a mixture of ground spices including chili powder combined with ingredients such as garlic and herbs, indicating the preparation of a complex spice blend, most likely *Berbere*. Altogether, the composition effectively visualizes the value chain of *C. annum* in Ethiopia, from raw peppers to finished products, underscoring its central role in both local cuisine and the spice trade. The vivid red hues, multiple forms of presentation, and the presence of Amharic script emphasize the deep cultural significance of chili peppers in Ethiopian foodways.

In addition to *C. annum*, *C. frutescens* another species known for its pungent chili peppers is widely cultivated in Ethiopia and Eritrea. It is categorized locally into green (*Qarya*), red-green (*Gwamiya*), and red (*Berbere*) types and is a staple in traditional cooking across regions such as the Flora area. The dried and powdered fruits of *C. frutescens* are essential ingredients in the preparation of the spice blend *Mitmita* and the spicy sauce *Awazie* [44]. *Mitmita* is a highly versatile condiment, typically used to season raw meat, *Injera*, bread, and cooked roots or tubers. It is generally sprinkled over food just before consumption, enhancing flavor and heat [19].

Rutaceae: The Rutaceae family includes a range of species cultivated for their use as spices, herbs, condiments, and aromatic fruits. Notable members include *Casimiroa* and various citrus species, valued for their juicy fruits and high vitamin C content [55]. Among the

culinary herbs in this family, *Ruta chalepensis* stands out for its pungent, spicy aroma. It is traditionally used to flavor dairy products such as milk, *ergo* (fermented milk/yogurt), and cheese, as well as beverages like coffee, tea, and *Kuti* a local herbal drink [45]. Furthermore, *R. chalepensis* is occasionally incorporated into *Berbere* spice mixtures (Table 2, Table S1), adding a distinct aromatic profile.

Fabaceae (Leguminosae): Within this family, *Trigonella foenum-graecum* (fenugreek) is an important spice plant in Ethiopian cuisine. Its edible seeds are primarily used for culinary purposes, particularly as a spice or condiment in baking and beverage preparation. In Ethiopia, fenugreek seeds are used to make unfermented drinks and are crucial in enhancing the flavor of various dishes. Most notably, *T. foenum-graecum* plays a supporting role in the preparation of *Injera*, the spongy fermented flatbread that accompanies the national dish, *Wot* (a spicy stew). Although used in small amounts, fenugreek improves the palatability of *Injera*, which is a staple food throughout the country, especially in the highland regions.

Key: Only representative and widely used species are listed here. Full dataset with >60 species is provided in Supplementary Table S1.

Growth form: Most spices used in Ethiopia are herbaceous in nature. However, several shrub species are also important, including *Satureja punctata* subsp. *ovata*, *Satureja paradoxa*, *Lippia adoensis* var. *koseret*, *Ruta chalepensis*, *Punica granatum*, and *Rhamnus prinoides*. Tree

species that contribute to the spice repertoire include *Warburgia ugandensis*, *Tamarindus indica*, *Vepris dainellii*, and *Schinus molle*. The above table (Table 2) provides a comprehensive overview of the botanical diversity supporting Ethiopian culinary traditions, highlighting a broad spectrum of plant species valued for their spices, herbs, and condiments. Each species is carefully documented with its scientific and local names, the specific plant parts utilized, their culinary uses, and corresponding literature references. This detailed compilation underscores the sophisticated and strategic incorporation of diverse plant parts including seeds, bulbs, leaves, fruits, roots, and barks into Ethiopian cuisine, resulting in rich and complex flavor profiles.

Classification of spices

Table 3 presents a traditional classification of spices and condiments, dividing them into five distinct categories based on their sensory properties and culinary uses: hot spices, mild spices, aromatic spices, herbs, and aromatic vegetables [63]. This classification offers a valuable framework for understanding the varied roles these ingredients play in global cuisines, emphasizing their contributions to flavor and aroma. The hot spices category includes ingredients known for their pungent and fiery qualities, such as chilies, cayenne pepper, black and white peppers, ginger, and mustard. These spices impart intense heat and a stimulating sensation to the palate, often used to add a spicy kick and enhance overall flavor complexity. In contrast, mild spices like paprika and coriander provide subtler flavor profiles, adding depth and nuance without overpowering other ingredients. For example, paprika contributes color and a gentle sweetness, while coriander offers a warm, slightly citrusy note. The aromatic spices category encompasses a broad range of ingredients prized for their distinct and often complex fragrances. This group includes allspice, cardamom, cassia, cinnamon, clove, cumin, dill seeds, fennel, fenugreek, mace, and nutmeg. These spices enhance the

sensory experience of food, frequently used in blends to create layered and nuanced flavor profiles. Herbs consist of leafy green plants or plant parts valued for their fresh and often volatile aromatic compounds, such as basil, bay leaves, dill leaves, marjoram, tarragon, and thyme. Typically, herbs are added toward the end of cooking to preserve their delicate flavors. Finally, aromatic vegetables like onion, garlic, shallot, and celery contribute strong and distinctive aromas that form the flavor base for many culinary preparations. Their pungent or savory qualities are often released through cooking, creating a foundation upon which other flavors can build. While this classification reflects traditional understandings of spice usage, it provides a useful framework for appreciating the diverse roles these ingredients play in shaping the rich and varied flavors of global cuisines. It is important to note that some spices, such as dill and ginger, could fit into multiple categories, illustrating their multifaceted sensory characteristics. Additionally, the table highlights the significance of the allium family within aromatic vegetables, underscoring their foundational role in many dishes.

Functional and bioactive compounds of spices in Ethiopia

Spices and herbs have long been recognized as ancient functional foods [64], providing diverse benefits such as flavor enhancement, nutritional value, and food preservation [28]. Many spices also function as natural preservatives for example, black pepper helps reduce lipid oxidation in pork and contain potent antioxidant bioactive compounds like curcumin and capsaicin [14].

Table 4 highlights the specific bioactive compounds present in these spices that contribute to their distinctive flavors and potential health benefits. This underscores the importance of phytochemical research into their therapeutic applications. Scientific evidence supports the role of antioxidants found in spices in protecting against cardiovascular diseases, certain types of cancer, and inflammatory conditions such as arthritis. Flavonoids, present in spices like black pepper and oregano, have

Table 3 Indigenous classification systems of Ethiopian spices

Classes	Species name (spices and condiments)
Hot spices	<i>Capsicum frutescence</i> (chilies), Cayenne pepper, <i>Piper nigrum</i> (black and white peppers), <i>Zingiber officinale</i> (ginger), <i>Brassica nigra</i> (mustard) [63]
Mild spices	<i>Capsicum annum</i> (paprika), <i>Coriandrum sativum</i> (coriander)
Aromatic spices	<i>Pimenta dioica</i> (allspice/pimento), <i>Aframomum corrorima</i> (cardamom), <i>Cinnamomum aromaticum</i> (cassia), <i>Cinnamomum verum</i> (cinnamon), <i>Syzygium aromaticum</i> (clove), <i>Cuminum cyminum</i> (cumin), <i>Anethum graveolens</i> (dill), <i>Foeniculum vulgare</i> (fennel), <i>Trigonella foenum-graecum</i> (fenugreek), <i>Myristica fragrans</i> (mace and nutmeg) [63]
Herbs	<i>Ocimum basilicum</i> (basil), <i>Pimenta racemosa</i> (bay), <i>Anethum graveolens</i> (dill leaves), <i>Origanum majorana</i> (marjoram), <i>Artemisia dracuncululus</i> (tarragon), <i>Thymus spp</i> (thyme) [63]
Aromatic vegetables	<i>Allium cepa</i> (onion), <i>A. sativum</i> (garlic), <i>A. ascalonicum</i> (shallot), <i>Apium graveolens</i> (celery) [63]

Table 4 Antioxidant properties of selected Ethiopian spices

Scientific names	English names	Types of compounds/substances
<i>Allium sativum</i>	Garlic	Allicin, ajoene, diallyl disulfide, senevols[14, 57, 63, 65, 66]
<i>Capsicum annum</i>	Red pepper	Capsaicin (phenolic cpd), steroidal saponin[14, 57, 63, 65, 66]
<i>Capsicum frutescence</i>	Chili pepper	Capsaicin, capsaicinol[14, 57, 63, 65, 66]
<i>Coriandrum sativum</i>	Coriander	Linalool, coriandrin [14, 57, 63, 65, 66]
<i>Curcuma domestica</i>	Turmeric	Curcumin, sesquiterpenic [14, 57, 63, 65, 66]
<i>Lepidium sativum</i>	Cress	Synaptic acid, 2-phenylethyl isothiocyanate[14, 57, 63, 65, 66]
<i>Mentha x piperata</i>	Spearmint	Menthol, limonene[14, 57, 63, 65, 66]
<i>Nigella sativa</i>	Black cumin	Nigellon, damascenine or damasceine, thymoquinone[14, 57, 63, 65, 66]
<i>Piper nigrum</i>	Black pepper	Phenolic amides, flavonoids, coumaperine, sarmentosine, piperine[14, 57, 63, 65, 66]
<i>Rosemarinus officinalis</i>	Rosemary	Rosemarinic acid, carnosol[14, 57, 63, 65, 66]
<i>Ruta chalepensis</i>	Rue	Dictamine, rutarin, xanthotoxin, rutin (flavonoid) [14, 57, 63, 65, 66]
<i>Salvia officinalis</i>	Sage	Carnosol, carnosic acid, rosmanol, rosmarinic acid[14, 57, 63, 65, 66]
<i>Solanum nigrum</i>	–	Solamine, solasonine, solasodine, solamargine, solanigrine[14, 57, 63, 65, 66]
<i>Thymus vulgaris</i>	Thyme	Thymol, carvacrol, p-cunene-2,3-diol, biphehyls, flavonoids[14, 57, 63, 65, 66]
<i>Trigonella foenum-graecum</i>	Fenugreek	Alkaloid(carpain) [14, 57, 63, 65, 66]
<i>Zingiber officinale</i>	Ginger	Gingerol related compounds, diarylheptanoids[14, 57, 63, 65, 66]

shown promise in preventing cardiovascular disease and intestinal cancer.

Spices are therefore valuable not only for culinary purposes, but also as sources of powerful natural compounds with significant health implications. For instance, gingerol, found in ginger, acts as an intestinal stimulant and can enhance the bioactivity of various drugs. Capsaicin, derived from chili peppers, is widely used as a counter-irritant in pharmaceutical and cosmetic products. Additionally, fenugreek, onion, and garlic have been demonstrated to contribute to cholesterol reduction.

Spices and condiments, rich in antioxidants and phytochemicals, are increasingly acknowledged for their applications in the pharmaceutical, cosmetic, and perfumery industries [8], as well as their potential roles in disease prevention and treatment [64]. The abundance of bioactive compounds in these ingredients highlights their multifaceted health benefits that extend well beyond basic nutritional value.

Selected Ethiopian spices and their traditional medicinal uses

Spices have long been used to treat a variety of ailments, including diabetes, cardiovascular diseases, arthritis, cancer, malaria, digestive disorders, skin diseases, and many others [15, 33, 34, 67–70]. Across Ethiopia, different communities and cultural groups employ various spice and condiment plants for medicinal purposes, as detailed in Table 4. Below are some selected species known for their traditional therapeutic uses:

Zingiber officinale: Commonly known as ginger, this species has a rich history of medicinal use in traditional

herbal systems such as traditional Chinese medicine, Ayurveda, and Western herbal medicine [59]. Its rhizome is used to treat dyspepsia, flatulence, colic, nausea, vomiting, colds, flu, migraines, and muscular and rheumatic disorders [71]. In Ethiopia, the rhizome is traditionally chewed to alleviate stomachache [11, 67, 70], toothache, mental illness, cough, common cold, and various other ailments [34, 39, 67].

Allium sativum: Garlic is widely used in modern traditional medicine [69] and is known for its diuretic properties [68]. The juice is applied to treat boils, while a honey paste made from its powder serves as an anti-tussive. The powder is also effective against ascaris, tapeworm, gout, leg edema, and bronchial asthma. Additionally, garlic functions as a spasmolytic and analgesic agent and is used in the treatment of sciatica (Table 4). Outside Ethiopia, garlic has been used for heart problems, headaches, bites, worms, and tumors [69].

Ruta chalepensis: This species is traditionally used as an antitussive, anti-epileptic, tranquilizer, and analgesic for colic [67]. The aerial parts, leaf juice, or powder are applied for eye diseases, cough, colic, evil eye, nosebleeds, and menorrhagia [19, 28, 29, 68].

Lepidium sativum: The seeds and leaves are used by local communities to treat skin conditions, colds, evil spirits, malaria, fever, wounds, tonsillitis, gingivitis, epiglottitis, stomach upsets, and swollen glands [8, 29, 37–39, 67, 68]. Seeds are often ground with ginger, black pepper, and black cumin, then mixed with honey and taken before breakfast to treat gastritis and as an aphrodisiac [68].

Thymus serrulatus: An overnight infusion of the whole plant is taken once in the morning to treat ascaris (wos-fat). The aerial parts are chewed, and the juice swallowed up to three times daily as a vermifuge. A decoction of the whole plant is used for bathing or internal consumption to treat *Tinea capitis* and *Tinea nigra* (Quwa'qucha). The decoction of leaves is also employed against chloasma (madiat).

Coriandrum sativum: This plant is used to treat skin abrasions and stomach problems. A sauce made from its fruit powder is consumed for tapeworm treatment [67, 68]. It also aids in relieving flatulence and cramps, improving indigestion, and serves as an aphrodisiac [33].

Trigonella foenum-graecum: Powder made from germinating seeds is taken for heart failure after fermenting with water for three days. The seed powder decoction is used as a diuretic, and the plant is employed against anemia [68]. Local herbalists use it for rheumatic pain, bone setting, urinary retention, wounds, and cough [8, 35, 39, 68]. According to Abebe [33], fenugreek lowers blood glucose and cholesterol, soothes indigestion and gastritis, heals gum abscesses, boils, burns, and ulcers, and induces milk production.

Capsicum annuum: Pepper is consumed alone or as an ingredient to relieve stomach complaints. It is traditionally used against eczema, internal parasites, as an antitussive, and for respiratory diseases [11, 68].

Nigella sativa: The powdered fruit is used to treat bronchial asthma. Fried seeds mixed with melted butter and sniffed relieve common cold and headaches [67]. This species also acts as a spasmolytic, antimicrobial, diuretic, and has cancer-preventive properties [33].

Beyond their culinary applications, spices and condiments fulfill a wide range of additional functions. Several species such as *Anethum graveolens*, *Carthamus tinctorius*, *Mentha* × *spicata*, *Origanum majorana*, *Papaver somniferum* subsp. *hortense*, *Rosmarinus officinalis*, and *Trachyspermum ammi* are utilized in the distillation of essential oils for purposes including food flavoring, perfume production, and soap manufacturing (Table 5). This table offers valuable insight into the rich ethnobotanical uses of selected Ethiopian spices and condiments, highlighting their roles far beyond the kitchen. It underscores their significance within traditional medicine and diverse cultural practices. The documented data reveals a wide array of ailments these plants help to address, including respiratory and gastrointestinal disorders, dermatological conditions, and infectious diseases [73, 75, 76].

The cultural significance of spices in Ethiopia extends far beyond their culinary uses, being deeply embedded in local health beliefs and practices. Mental health conditions, often perceived through the frameworks of “mental illness” or “evil spirits,” are commonly treated with these

plants, underscoring their profound cultural integration. Many spices also serve practical roles in community health, frequently employed as vermifuges and wound healers. Several spices hold important sociocultural value; notable examples include *Anethum graveolens*, *Artemisia abyssinica*, *A. afra*, *Cyperus esculentus*, *Foeniculum vulgare*, and *Mentha spicata* [30]. Among these, *Artemisia abyssinica* is especially integral to Ethiopian rituals, particularly during the New Year and Meskel festivals. Other species are valued for their use as perfumes, such as *Coriandrum sativum*, *Myrtus communis*, *Trachyspermum ammi*, and *Rosmarinus officinalis*, while some serve ornamental purposes, including *Foeniculum vulgare*, *Carthamus tinctorius*, *Salvia officinalis*, and *Schinus molle* [28].

Spices also play a significant role in supporting local economies, especially empowering rural women, as demonstrated by Zuberi et al. [19]. Beyond culinary uses, many members of the Lamiaceae family such as *Rosmarinus*, *Lavandula*, *Salvia*, *Thymus*, and *Mentha* are globally important sources of honey. In Ethiopia, species of *Ocimum*, *Salvia*, *Satureja*, and *Thymus* are vital for beekeeping. Notably, *Thymus schimperi* produces a distinctive amber honey in highland regions like the Bale and Simien mountains [55], and is also used as animal forage and a natural fumigant [58].

Marketability and production of spices and their wild relatives

Ethiopia boasts a vibrant spice sector that relies on both cultivated crops and wild-harvested resources. Key spices such as black and white cumin, pepper, paprika, turmeric, fenugreek, garlic, coriander, ginger, sage, cardamom, and basil are essential not only for domestic consumption but also for international trade [10, 24, 72]. These spices are integral to traditional Ethiopian cuisine and are marketed nationwide, either individually or as blends, significantly contributing to the country's distinctive flavor profile, as seen in local markets such as Debre Markos (Fig. 4). Ethiopian cardamom, in particular, is a major commercial spice, especially in the Basketo and Kefa districts [28], with its dried fruits widely traded across Ethiopia, North Africa, Arabia, and India [73]. Likewise, *Elettaria cardamomum* and *Cuminum cyminum* are commonly available in markets within the Flora region [11, 44]. Across the country, the spice market is predominantly led by ginger, turmeric, cumin, and Ethiopian cardamom, which together command a significant share of the national market.

The exact quantity of wild-harvested chili pepper remains unknown; however, it has become naturalized in regions such as Gambella. In contrast, Ethiopian cardamom and long pepper are predominantly collected from

Table 5 Multiple ethnobotanical uses of selected Ethiopian spices and condiments

Species	Family	Parts used	Disease treated and/or other uses	Reference
<i>Aframomum corrorima</i>	Zingiberaceae	Seeds	Mental illness, evil spirit	[67]
<i>Allium sativum</i>	Alliaceae	Bulbs	Cough, ringworm, rabies, scabies, helminthiasis, mange, dermatophilosis, eczema, common cold, asthma	[29, 37–39, 70]
<i>Allium cepa</i>	Alliaceae	Cloves	Cough, honeybee source	[55, 67]
<i>Anethum graveolens</i>	Apiaceae	Fruits	Cough, unspecified lung disease; oil bearing	[67]
<i>Artemisia abyssinia</i>	Asteraceae	Leaves	Heart travel & cough; ceremonial/rituals	[51]
<i>Capsicum annum</i>	Solanaceae	Fruits	Antitussive, respiratory disease, eczema, internal parasites	[11, 67]
<i>Capsicum frutescense</i>	Solanaceae	Roots/leaves	Taeniasis, stomachache	[29, 44]
<i>Carthamus tinctorius</i>	Asteraceae	Seed, flower	oil bearing, ornamental, cosmetics for making a rouge	[55, 59]
<i>Coriandrum sativum</i>	Apiaceae	Roots/leaves	Skin abrasion & stomach problems, oxytocics, tapeworm; used in soap making & in the perfume industry	[67, 68]
<i>Foeniculum vulgare</i>	Apiaceae	Leaves	Epistaxis, dysentery, stomachache, lymphadenopathy	[29, 38, 39]
<i>Lepidium sativum</i>	Brassicaceae	Leaves & Seeds	Colds, stomach upsets, skin complaints, swollen glands, evil spirit Antiprotozoals/antifungals; malaise, fever, wound, tonsillitis, gingivitis, epiglottitis, indigestion	[29, 37–39, 47, 67, 68]
<i>Mentha x spicata</i>	Lamiaceae	Leaves	In confectionary for its essential oil	[40, 55]
<i>Myrtus communis</i>	Myrtaceae	Leaves	To extract a perfume	[48]
<i>Nigella sativa</i>	Ranunculaceae	Seed /fruits	Mental illness/migraine, stomachache, hemorrhoids, common cold, urinary retention, asthma, bronchitis & rheumatism	[11, 29, 39, 67, 68]
<i>Origanum majorana</i>	Lamiaceae	Leaves	For distillation of volatile oils, honeybees forage	[40, 55]
<i>Papaver somniferum</i> susp. hortense	Papaveraceae	Seeds	Produce the edible poppy-seed oil	[48]
<i>Piper nigrum</i>	Piperaceae		Bacterial and analeptic agent	[67, 68]
<i>Rhamnus prinoides</i>	Rhamnaceae	Aerial parts	Tonsillitis, epiglottitis	[29, 37–39]
<i>Rosmarinus officinalis</i>	Lamiaceae	Leaf	Wound, halotisis, source of perfume, pollen & nectar for honeybee, distillation of volatile oils, source	[28, 31, 38, 40, 55]
<i>Rumex abyssinicus</i>	Polygonaceae	Shoots	Diabetes	[38, 39]
<i>Ruta chalepensis</i>	Rutaceae	Leaves, aerial parts, Wp	Epistaxis, constipation, abdominal pain/colic, bacteria, common cold, evil eye, influenza, elapsing fever, urinary retention, snake bite; source of honeybee	[11, 19, 28, 29, 31, 37, 55, 67, 68]
<i>Salvia officinalis</i>	Lamiaceae		Ornamental, forage	[55]
<i>Schinus molle</i>	Anacardiaceae	Seed/leaf	Rabies, epidemic, leech, dysentery, as ornamental	[38, 50, 55, 67]
<i>Sesamum angustifolium</i>	Pedaliaceae	Seed	Cough, colic, dandruff, epidemic	[38]
<i>Solanum nigrum</i>	Solanaceae	Fruit/root leaf	Tropical ulcer, leprosy, gonorrhoea, boil, itching	[37, 68]
<i>Thymus schimper</i>	Lamiaceae	Leaf	Hypertension, source of pollen & nectar	[29, 55]
<i>Thymus Serrulatus</i>	Lamiaceae	Leaf, wp	Vermifuge, leprosy, acne, <i>Tinea capitis</i> , <i>T. nigra</i> , chloasma, gonorrhoea, ascaris; forage use	[29, 39, 55, 67, 68]
<i>Trachyspermum ammi</i>	Apiaceae	Fruit & root	Stomach complaints, as vermifuge & abortifacient, for making perfume soaps, source of oil & honey	[11, 43, 55, 68]
<i>Trigonella foenum-graecum</i>	Fabaceae	Fruit/seed/root	Skin & stomach disorders, cough, wound, rheumatic pain, bacteria, bone setting; honeybee source	[28, 53, 55, 68]

forested areas. While thymes are also gathered from the wild, their commercial potential is constrained by inconsistent supply, variable quality, and low harvest volumes. The economic importance of Ethiopia’s forest-derived spices is highlighted by the notable increase in the production of Korarima (Ethiopian cardamom) and long pepper. Between 2005–06 and 2013–14, the total value added, expressed in Ethiopian Birr (ETB), rose sharply

from 85 million ETB to 335 million ETB (Table 6). This substantial growth over nine years reflects expanding markets and rising demand, indicating the increasing economic relevance of these spices within Ethiopia [76].

Korarima consistently accounts for the majority of the sector’s economic value, although long pepper has shown a gradual increase in its contribution. When values are converted to US Dollars (USD), the trend appears

Table 5 (continued)

Species	Family	Parts used	Disease treated and/or other uses	Reference
<i>Zingiber officinale</i>	Zingiberaceae	Rhizome	Stomachache, mental illness, bloat, poor appetite, blackleg, bloody diarrhea, cough, constipation, common cold, asthma, malaria, tonsillitis, indigestion, flatulence	[11, 28–31, 33, 37–39, 67, 68]



Fig. 4 Selected spices traded in Debre Markos town marketplace

Table 6 Value chain and economic significance of forest-derived spices in Ethiopia (2005–06 to 2013–14)

Year	Korarima	Long peeper	Total value added		Share of GDP
	Million ETB (Ethiopian Birr)		Million ETB	Million USD	Percent (%)
2005–06	75	10	85	40	0.08%
2006–97	85	11	96	41	0.07%
2007–08	99	13	112	42	0.06%
2008–09	143	19	162	48	0.06%
2009–10	155	21	175	42	0.05%
2010–11	167	22	190	45	0.05%
2011–12	223	30	253	51	0.05%
2012–13	274	37	310	46	0.04%
2013–14	296	39	335	50	0.04%

less stable due to fluctuations in the ETB-USD exchange rate, highlighting how currency dynamics can affect perceived economic performance. Despite the significant rise in absolute value, the spice sector's share of Ethiopia's Gross Domestic Product (GDP) declined from 0.08% in 2005–06 to 0.04% in 2013–14. This apparent decline does not contradict the sector's growing importance; rather, it reflects that other sectors of the Ethiopian economy expanded at a faster rate, resulting in a relative reduction in the spice sector's contribution to GDP. In absolute terms, however, the increasing ETB value underscores genuine growth, driven by heightened consumer awareness, expanding domestic and international markets, and increased export activities.

Ethiopia produces approximately 244,000 tons of spices annually on about 222,700 hectares of land, encompassing both wild and cultivated sources [16, 27]. Nevertheless, compared to other agricultural sectors, spice cultivation remains small-scale [77], contributing less than 1% to the national economy [72, 77]. This limited contribution is attributed to challenges including a lack of diverse spice varieties, inadequate agronomic practices, pest and disease pressures, and deficiencies in pre- and post-harvest handling [16, 27, 72].

Indigenous knowledge and spice conservation

Ethiopia's indigenous knowledge, passed down orally through generations, plays a central role in the conservation and sustainable use of spices. This knowledge encompasses plant ecology, cultivation practices, and diverse culinary and medicinal applications [78]. Community practices reflect deep cultural and ecological contexts, guiding the management of food, medicine, and homegardens [79, 80]. However, modernization threatens this oral tradition [81], making it essential to integrate traditional ecological knowledge with modern conservation approaches to safeguard both biodiversity and cultural heritage.

Forests remain a major source of culturally significant spices while providing vital ecosystem services [35]. The commercialization of forest products such as *A. corrorima* and *Piper capense* offers economic incentives for local communities, encouraging stewardship that preserves both biodiversity and associated knowledge [28]. The ecological and historical value of these forests [82], coupled with their growing contribution to national income, underscores the urgency of strengthening conservation policies [76].

At the institutional level, the Ethiopian Biodiversity Institute (EBI) has established field gene banks across multiple agro-ecological zones, conserving more than 6,000 accessions of horticultural crops, including spices [22]. Homegardens complement these efforts by

providing food, income, and in situ conservation [7, 36, 83]. Commonly cultivated species include *Allium sativum*, *C. sativum*, *Foeniculum vulgare*, *Lepidium sativum*, *Lippia adoensis* var. *koseret*, *Ocimum* spp., and *Ruta chalepensis* [7, 11, 28, 31, 36, 39]. While field crops such as *C. annuum* dominate large-scale cultivation [11, 28, 31], species like *A. corrorima*, *Piper capense*, and *Zingiber officinale* are grown in homegardens, particularly in regions such as Kefa and Dawro where they also occur wild [28, 31, 74]. This highlights the role of homegardens as critical hubs for conserving spice diversity (Fig. 5).

Despite their cultural and economic importance, few Ethiopian spices have formal conservation assessments. *A. corrorima*, an endemic species, is currently listed as Not Evaluated (NE) under the IUCN Red List, though some sources classify it informally as Least Concern (Table 7). *Aframomum melegueta* is categorized as Data Deficient (DD). For many widely used species such as *N. sativa*, *C. sativum*, *C. annuum*, and *Piper longum* no IUCN assessments are available. Conservation concerns for these species, including habitat loss, cultivation pressures, and genetic erosion, are therefore inferred from field studies and ethnobotanical reports. This gap highlights the urgent need for systematic conservation evaluations of culturally and economically significant spices in Ethiopia.

Conclusion

Ethiopia's rich diversity of spices and condiments represents a vital component of the country's cultural heritage, traditional medicine, economy, and biodiversity. These plants, sourced from both cultivated fields and wild forests, contribute uniquely to the nation's distinctive culinary identity and hold significant sociocultural and therapeutic value. Indigenous knowledge systems, passed down through generations, have been instrumental in guiding the sustainable use, conservation, and multifaceted applications of these species, from food flavoring and preservation to the treatment of a wide range of ailments. The presence of bioactive compounds such as antioxidants, flavonoids, and essential oils in many Ethiopian spices underscores their potential as natural remedies and functional foods with health-promoting properties. Species like *Zingiber officinale*, *Allium sativum*, *Ruta chalepensis*, and *N. sativa* illustrate the important intersection of traditional medicinal practices and modern pharmacological interest. Beyond health, spices also play key roles in rituals, ornaments, honey production, and the manufacture of perfumes and soaps, reflecting their deep cultural integration.

Economically, spices contribute substantially to both local livelihoods and national trade. The increasing market value of forest-derived spices like Korarima and long



Fig. 5 Home garden cultivation of spices in Ethiopia

pepper signals growing demand and commercial potential. Nevertheless, the sector faces challenges, including small-scale cultivation, inconsistent quality, pest pressures, and limited pre- and post-harvest infrastructure, which constrain broader economic impact and productivity. Furthermore, the sector’s relative share of Ethiopia’s GDP has declined amid faster growth in other industries, highlighting the need for targeted development and support. Conservation efforts remain crucial to preserving Ethiopia’s vast spice biodiversity and the indigenous knowledge that sustains it. Homegardens and field gene banks play important roles in maintaining genetic diversity and supporting local food security and income generation. At the same time, community-based stewardship of forest ecosystems ensures the protection

of wild spice populations and associated cultural practices. Integrating traditional ecological knowledge with contemporary conservation strategies is essential to safeguard these resources amid ongoing environmental and socio-economic changes. Thus, Ethiopian spices are invaluable assets that transcend culinary use, embodying a rich tapestry of health, culture, economy, and biodiversity. Their continued preservation and sustainable development require a holistic approach that respects indigenous knowledge, enhances market opportunities, improves agronomic practices, and strengthens conservation frameworks. Such integrated efforts will not only protect Ethiopia’s spice heritage but also contribute to improved livelihoods, public health, and ecological resilience.

Table 7 Sample species-level conservation status notes

Species	Conservation/status information	Notes
<i>Aframomum corrorima</i> (korarima)	Not Evaluated (NE) under the IUCN Red List	Although listed as NE in some Ethiopian endemic species tables, several secondary sources (e.g., Wikipedia) indicate "Least Concern." Due to inconsistent and non-formal assessments, this species is treated here as having no formal threat status in the wild, but genetic erosion risks are reported
<i>Aframomum melegueta</i> (alligator pepper)	Data Deficient (DD) on IUCN	Listed as DD in World Flora Online. Other databases (e.g., plantpono.org) describe it as "low risk," but these ratings are non-IUCN and not standardized
Other species (e.g., <i>Piper longum</i> , <i>Nigella sativa</i> , <i>Coriandrum sativum</i> , <i>Capsicum annum</i> , <i>Cuminum cyminum</i>)	No formal IUCN Red List status recorded (or status not readily available)	Reliable IUCN or national conservation assessments are lacking for many common spices. Most are widely cultivated and traded, and thus formal evaluations are seldom prioritized. For example, <i>Piper longum</i> is occasionally mentioned in medicinal plant conservation works but without a formal Red List category

Electronic supplementary material

Below is the link to the electronic supplementary material.

Supplementary material 1

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Author contributions

NA was responsible for drafted the manuscript, developing the review protocol, study design, literature review, data collection, data extraction, data analysis, and interpretation. LB drafted the manuscript, contributed to the data analysis and interpretation, as well as editing the manuscript. AA contributed to the data analysis and interpretation, as well as editing the manuscript. All authors read and approved the final manuscript.

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Declarations

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