

Distribution, local use, and bio-prospecting opportunity of *Ocimum americanum* L around North Western part of Amhara Region, Ethiopia

Edeget Merawi (✉ edegetmerawi@gmail.com)

Ethiopian Biodiversity Institute <https://orcid.org/0000-0002-2950-3176>

Taye Birhanu

Ethiopian Biodiversity Institute

Research Article

Keywords: *Ocimum americanum*, Basil, bio-prospecting, Preservative, Flavor, Ailment, and Aroma

Posted Date: November 18th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-2254106/v2>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Ocimum americanum encompasses various uses. The plant is claimed as a food additive for its aromatic effect on different foods and folk medicine for various complaints. However, the plant genetic resource use category, distribution, and associated community knowledge have not been properly and systematically documented and utilized. Accordingly, this survey was performed to explore the bio-prospecting opportunity of *Ocimum americanum*, and its associated community knowledge to provide baseline data for bio-digging companies. Purposive and proportional samplings were jointly used to select districts, villages, users, and growers who participated in the study. Dembiya, Gonder Zuria, Takusa, Alefa, Bahir Dar city, and Bahir Dar Zuria districts were selected based on the growth potential and user availability. Data was collected through semi-structured interviews, group discussions, and field observation. The community used *Ocimum americanum* for various purposes; for ailment treatment (31.67%), food flavor (26.6%), food preservative (7.7%), and to give aroma to different foods (8.33%). 31.67 % of the respondents replied as they are a user group of the plant for its ethno medicinal purpose whereas the remaining 68.34% of them claimed as they are not used for medical purposes. They are used to treat majorly for depression/headaches, and evil spirits. Concoction (21.05 %), cutting and inserting whole plant (15.79%), grinding (15.79%), melting (5.26%), Fumigation (10.53%), and smelling (31.58%) were used as methods of preparation and administration. Medicinal dosage is not quantized and varied up to the users based on the intensity and the severity of the disease. A total of nine typical basil-spiced traditional foods were listed. The highest fidelity level [a particular use category] of basil was food flavor (18.33%) followed by a similar result [18.33%] for Food flavor/preservative. The output of the direct matrix analysis showed Chilli pepper spice was the preferred local food sweetened by basil for its various purposes by the local people followed by hot-spiced pepper. Therefore, the present survey, inferred the community traditionally uses basil for its aromatic, preservative, flavor, and ailment treatment role. Therefore, novel genetic resources should be further researched and promoted for versatile use. It gives a clue for bio-prospecting companies working in the food and pharmacological industries to access the associated local knowledge and practices documented as well as the plant genetic resource to search for new biochemical compounds responsible for medicinal, preservative, and aromatic effects.

Introduction

Bio-prospecting is the sustainable use of biodiversity that should motivate conservation. Nevertheless, in the tropical biodiversity-rich regions of the world, the level of bio-prospecting is much below its potential. In this regard, bio-prospecting has had a limited impact on conservation. In those areas with high biodiversity, such as the tropics, Bio-prospecting may be an alternative use of biodiversity that effectively promotes habitat protection [12].

Plants are a rich source of many natural products, most of which have been extensively used for human welfare. Many of the chemical products fabricated from plants are used to promote health and fight diseases and some of them are marketed as a food or herbal medicines [4]. Herbal medicines have long been viewed as a source of curative remedies based on religious and cultural traditions [11, 13]. The use of indigenous plant medicines in developing countries became a World Health Organization policy in 1970. Over 20 new drugs launched on the market between 2000 and 2005, originating from terrestrial plants, terrestrial microorganisms, marine organisms, and terrestrial vertebrates and invertebrates, are described [20]. However, the search for plants as a source of potential candidates for drug development is still unsound. Of the 90 drugs that became commercially available in the United States or were approved worldwide from 1982 to 2002, ~ 79% can be traced to a natural product origin [16].

The rationale for the use of *Ocimum americanum* in herbal medicine is largely based on the longstanding experience of traditional medicine practitioners. The Genus *Ocimum* (Lamiaceae), collectively called basil, is extensively used in Eastern Africa in folkloric practice against a wide range of illnesses [4]. It comprises various species which has not been exploited fully. The plants are considered good sources of essential oil used in Food flavoring, oral products, fragrances, and traditional medicines [9]. Out of the total 28 aromatic plants found in Ethiopia, *Ocimum americanum* is one of the aromatic herb species that flourished in different parts of Ethiopia. Basil is one of the aromatic plants consisting of various chemical compositions like linalool (15.3%), camphor (15.1%), and terpinen-4-ol (17.6%) [26]. Ethiopian farmers conventionally cultivate and use basil for house consumption and provide for the local market mainly for spice. The demand for basil is high in the international market and currently, some private Ethiopian companies started cultivation of sweet basil for exportation as a fresh or dried herb to different countries [28, 29].

Local foods have significant contributions to socioeconomic development. However, Comprehensive documentation of the local foods product, associated knowledge, and their sociocultural roles are incomplete [30]. The community has used basil for flavoring and spicing. Besides the aromatic and flavoring role, it has a filtering role during local melted butter processing. The traditional knowledge and practices harbored for many centuries indicate a prospect for industrial potential. In this regard, basil is not properly and systematically utilized. Nevertheless, the local community used *Ocimum americanum* traditionally. Therefore, the research aims to explore the bio-prospecting opportunity of *Ocimum americanum*, identify potential distribution areas of the species, and document the traditional knowledge and practice associated with the species.

Materials And Methods

Description of the study area

Amhara Region is located in the Northwestern part of Ethiopia; its land area is estimated at 170,000 square kilometers. The region borders Tigray in the North, Afar in the East, Oromiya in the South, Benishangul-Gumuz Region in the Southwest, and the Country of Sudan in the West [5, 21]. The region has an estimated total population of twenty million one hundred thirty-six [6]. Bahir-Dar is the capital city of Amhara Regional State. The region is divided into 11 zones, and 167 Districts. There are about 3,429 villages (the smallest administrative units) [5, 21]. North Gondar is one of the administrative zones found in the region, named for the city of Gondar, the capital of Ethiopia until the mid-19th century, which has often been used as a name for the 20th-century province of Begemder. North Gondar is bordered on the south by Lake Tana, West Gojjam Zone, Awi Zone, and the Benishangul-Gumuz Region, on the west by Sudan,

on the north by the Tigray Region, on the east by Wag Hemera, and on the southeast by Debub Gondar. Towns and cities in North Gondar include Dabat, Debarq, Emfranz, Gondar, Gorgora, and Metema [5, 6].

North gondar Zone has a total population of 2,929,628, of whom 1,486,040 are men and 1,443,588 are women; with an area of 45,944.63 square kilometers. North Gondar has a population density of 63.76. A total of 654,803 households are counted. The main ethnic group reported is Amhara (97.84%) whereas all other ethnic groups made up 2.16% of the population. Amharic is the first language spoken (98.32%) and 95.38% practiced Ethiopian Orthodox Christianity, and 4.29% are Muslim [5, 6, 21].

West Gojjam is the other administrative zone of the region, which is named after the former province of Gojjam. It is bordered on the south by the Great Abay River, which separates it from the Oromia and Benishangul-Gumuz Region, on the west by Awi Zone, on the northwest by North Gondar, on the North by Lake Tana, and the Great Abay River which separates it from the South Gondar Zone, and on the East by East Gojjam. Its highest point is Mount Amedamit. Towns in West Gojjam Zone include Bahir Dar, Adet, Finote Selam, Bure, Quarite, Dega Damot, Sekela, Merawi, Yismala, and Dembecha are towns of west Gojjam. Finote Selam is the capital city of the zone. West Gijam Zone had a total population of 2,106,596, of whom 1,058,272 were men and 1,048,324 were women; with an area of 13,311.94 square kilometers, it had a population density of 158.25. A total of 480,255 households were counted. The largest ethnic group reported was Amhara (99.42%); all other ethnic groups made up 0.52% of the population. Amharic is spoken as a first language by 99.43%; 98.68% of the population practiced Ethiopian Orthodox Christianity, and 1.19% were Muslim [1, 2]. Specifically, the survey study was conducted at Bahir Dar city administration, Bahir Dar zuria, Debiya, Takusa, Alefa and Gonder zuria Districts [Figure-1]. One up to two villages per District which bring a total of ten representative villages (the smallest administrative unit in Ethiopia) was selected for data collection. Zege 01, Ura, Wonjeta, Yigodi, Guraba Michale, Bata, Mekonta-aybega, Chemera na-banberawa, Layiye-duge. Zengaj villages were used as sampled study site.

Research and sampling design

The potential distribution of *Ocimum americanum* was assessed from regional, Zonal, and District annual reports. Checklists were given to the agricultural officers. They used their report document and previous field experiences to prioritize and sort the growing villages from the highest to lowest production. Generally, districts and villages were selected purposively based on the wealth of *Ocimum americanum*, Knowledge, and habit of traditional consumption of the resources with the assistance of information obtained from regional, Zonal and district Agricultural offices. A purposive sampling method was employed to identify *Ocimum americanum* potential growing sites. In addition, proportional sampling was used to select Respondents who participated in the study. A total population [N] of 1200 cultivators and users of *Ocimum americanum* were sorted and proportionally, 10% of individual participants were selected using a lottery method. A total of 120 key informants (males and females) were selected proportionally [1, 2, 5, and, 23]. Ethno botanical data Collection

A reconnaissance survey of all sampled sites [villages] was conducted with growers and users to obtain the overall conditions of the study area. Guided Field walk and observation were carried out to collect field data based on a checklist. Representative specimens and photographs of *Ocimum americanum* were taken for taxonomic identification and confirmation. A semi-structured interview translated into Amharic language was administered to respondents. Data associated with bio-prospecting potential, opportunities, distribution, and local use of *Ocimum americanum* were gathered from respondents with the aid of agricultural officers. Group discussion was conducted with systematically selected key informants/elderly farmers. Medicinal, flavor, aroma, and preservative traditional use of the species were discussed and a consensus was reached with interactive meeting [1, 2, and 5].

Data analysis and interpretation

All collected data were subjected to SPSS software version 21 and Excel for analysis and then interpreted using descriptive statistics, fidelity level, direct matrix ranking and Jaccard's coefficient of similarity. Descriptive statistic like percentage and frequency were used to analyze and summarize the data of use category, ethno-medicinal use and associated knowledge.

Fidelity level (FL in %)

percentage of informants claiming the use of *Ocimum americanum* for the same major purpose was calculated using the general formula $FL (\% = NP/N)$ where NP is the number of informants claiming the use of *Ocimum americanum* for a particular purpose and N is the number of the informant that use *Ocimum americanum* to fill for any given purpose following [1, 2 and 3]

Direct matrix ranking

It was tabularized in order to compare *Ocimum americanum* spiced local foods commonly reported by informants with their use categories. All of the spiced local foods were considered for the computation and 4 selected use category of *Ocimum americanum* as described by the respondents were listed. Five key informants were selected to assign use values for each attributes (5 = excellent, 4 = very good, 3 = good, 2 = less and 1 = least used). From the total of eleven use categories, Food flavor (FF), Ailment treatment (AT), Food preservative (FP), and Aroma to foods (AF) were selected [24].

Jaccard's coefficient of similarity (JSC)

The degree of similarity was computed to evaluate basil spiced local foods of Alefa District that contain the maximum composition (88.88%) of the basil spiced local foods with the remaining five surveyed districts that contain the lowest (44.44%) of basil spiced local foods composition, up to the second highest (77.77%) of the food list composition. The formula used to calculate, $JSC = C/a + b + c$, where, JSC is Jaccard's coefficient of similarity, a is number of

basil sweetened local foods in District **a**, **b** is number of basil sweetened foods in District **b**, and **c** is number of common basil spiced local food in District **a** and **b**, modified following [25].

Result And Discussion

Socio demographic characteristics

The socio demographic variables include: gender (male/female), religion, ethnicity (Amhara/others), education (illiterate/ informal/primary/ high school), occupation (farmer/ merchant/others), economic status (high/ medium/low), marital status (married/ unmarried/divorced), age category, and respondents existence in the study area. Most of the respondents were married (93%) and farming was the main profession of respondents (95%). Similarly, 64% of males and the remaining 36% of females were participated in the interview session of the study. 70.8% of respondents were grouped under the medium Economic class based on their thought. The remaining respondents were grouped under the low economic status (21.7%) and (7.5%) high economic class. (Table 1 show socio economic data of respondents in the study area).

Table 1

Cross tabulation of Gender, religion, ethnicity, education, Occupation and economic status of respondents by their Zone, districts and

Socio-demography		Respondents Categories	Study zone- Western Gojjam Zone, Northern Gonder and Bahir city special															
			BDR -S/Z		West Gojjam Zone District				Central Gonder Zone Districts									
Bahir Dar city		Bahir Dar zuria						Gonder Zuria				Dembia				Takusa		Alefa
Zegie 01		Ura		wonjeta		yigodi		Layiye dugie		Zengaji		Guramb michael		Gurama/bata		Mekayebege		Chern
Gender	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
	Male	8	7	6	5	5	4	6	5	7	6	8	7	7	6	6	5	10
	Female	6	5	4	3	5	4	4	3	5	4	4	3	5	4	6	5	4
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
religion	Orthodox	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
	Muslim	—		—		—		—		—		—		—		—		—
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
ethnicity	Amhara	14	12	10	8	10	8	10	10	12	10	12	10	12	10	12	10	14
	Other	—		—		—		—		—		—		—		—		—
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
Education	Illiterate	3	2.5	3	2	2	1.5	3	2.5	4	3	4	3	3	2.5	5	4.5	4
	Informal	4	3	3	2	3	2.5	3	2.5	3	2	3	2.5	3	2.5	4	3	4
	Primary	5	4	2	2	4	3	4	3	4	3	5	4.5	3	2.5	3	2.5	4
	H/school	2	2.5	2	2	1	1	—	—	1	1	—	—	3	2.5	—	—	2
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
Occupation	Farmer	13	11	9	7	9	7	9	7	10	9	12	10	12	10	12	10	14
	Merchant	1	1	1	1	1	1	1	1	2	1	—	—	—	—	—	—	—
	Other	—		—	—	—		—		—		—		—	—	—	—	—
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
E/status	High	3	2.5	2	1	1	.8	2	1	4	3.5	4	3.5	2	1.5	2	1.5	3
	Medium	8	7	5	4.	7	5	8	7	8	6.5	8	6.5	10	8.5	10	8.5	11
	Low	3	2.5	3	2.	2	1.2	—	—	—	—	—	—	—	—	—	—	—
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
Marital status	Married	12	10	9	7	8	6.5	9	7	12	10	12	10	12	10	12	10	14
	Unmarried	1	1	—	—	1	.75	1	1	—	—	—	—	—	—	—	—	—
	Divorced	1	1	1	1	1	.75	—		—	—	—	—	—	—	—	—	—
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
Age category	Adult	5	4.2	3	2	4	3	3	2	3	2	1	0.8	3	2	3	2	5
	Middle age	8	7	7	6	6	5	7	6	9	8	10	8.4	9	8	9	8	8
	Senior age	1	0.8	—	—	—	—	—	—	—	—	1	0.8	—	—	—	—	1
	Total	14	12	10	8	10	8	10	8	12	10	12	10	12	10	12	10	14
Grand Total		120	100	120	100	120	120	100	120	100	120	100	120	100	120	100	120	100
N = number of respondents from villages, % percent of respondents within villages, — = no value, BDR-S/Z = Bahir dar special zone,																		
Traditional use category of Ocimum americanum																		

Out of the total respondents, 53.2% [26.4 *2] of them described, basil was used for increasing food aroma and flavor, whereas, a substantial amount of respondents (24%) described as they used the species for Ailment treatment. The other respondents (1.2% up to 14.4%) replied as they used it for different

purposes more than one or independently. [Figure2]. Similar finding was reported by [28] as basil widely used in Ethiopia for its spice and medicine role. While unlike our findings [28] was also reported basil has been used for feed of honey bees, ornamental and as an industrial row material.

Fidelity level

The highest FL (percentage of informants claiming *Ocimum americanum* particular purpose for food flavor was 18.33% followed by a similar result [18.33%] for food flavor and preservative. The lowest Fidelity level value was given to for Food flavor/ preservative/ Aroma use category [0.84%] [Table 2].

Table 2
Fidelity level (percentage of informants claiming *Ocimum americanum* for particular purpose/use

S.N	Use category	Tabulated, FL=[NP/N*100]	FL (%)	Remark
1	Food flavor	22/120*100	18.33	
2	Ailment treatment	20/120*100	16.66	
3	Food preservative	9/120*100	7.5	
4	Aroma to food	10/120*100	8.33	
5	Food flavor and ailment treatment	6/120*100	5	
6	Food flavor and preservative	22/120*100	18.33	
7	Food flavor and Aromatic	12/120*100	10	
8	Ailment treatment and food preservative	8/120*100	6.67	
9	Ailment treatment and food aroma	2/120*100	1.67	
10	Food Flavor, ailment treatment and food preservative	4/120*100	3.33	
11	Food flavor, preservative and Aroma	1/120*100	0.84	
12	Ailment treatment, Food preservative and Aroma	4/120*100	3.34	
Total			100	

Ethno medicinal use of *Ocimum americanum*

31.66% of the respondents used and practiced *Ocimum americanum* as a traditional medicine against/for various diseases while 67.34% of them did not practice and use the plant for medicinal purposes [Figure3]. Similar research that supports the traditional use of *Ocimum americanum* was done on the anti-fungal, anti-bacterial, and anti-viral properties of the essential oil of most of the *Ocimum* species [22]. It is used for the treatment of depression or headache followed by evil spirit. Balcha Abera [31] reported *Ocimum* species used for headache in Ghimbi district. It is supported by [10] which reported, the essential oil extracted from the leaves of *Ocimum americanum* have anti-bacterial activity and anti-tubercular activities against *Mycobacterium* strains. *Ocimum americanum* is mixed with other additive ingredients extracted from plants such as *Allium sativum* and *Nigella sativa* to use for ailment treatment. A similar result has also been reported by [7] which stated that *Ocimum americanum* could provide anti-bacterial or antioxidant activity. Similarly, [20] also reported on the antioxidant and antimicrobial activities of *Ocimum americanum*. These results included extracts of *Ocimum americanum* which might have essential secondary metabolites responsible for the above-mentioned medicinal effects.

Role of *Ocimum americanum* in Ethiopian spiced butter preparation

The majority of the respondents (84%) used *Ocimum americanum* to prepare spiced butter while the remaining 14% of them did not use it for the said purpose [Figure5]. The result implied that *Ocimum americanum* has crucial role in spiced butter production. The advantage imparted by the respondent adding *Ocimum americanum* to the butter is to give flavor, aroma, and preservative [Figure5]. Addition of *Ocimum americanum* during spiced butter preparation has varied based on the view, knowledge, and understanding of the local people in a different part of the study area. About half of the respondents (49%) added *Ocimum americanum* for flavorings and preservative role. The result inferred several secondary metabolites produced if a further detailed study would go on the plant, which is responsible for aromatic, flavoring, and preservative effects. According to [8] reported supportive findings about aromatic compounds which constitute essential oils of *Ocimum* such as eugenol, methyl eugenol, citral, linalool, geraniol, and thymol, which are used as raw materials for food industries. 29% of the respondents added *Ocimum americanum* to butter to make flavorings while 12% of them used it for its preservative effect. The remaining respondents (59%) used it for its aromatic property (Fig. 5). The preservative nature of *Ocimum americanum*, in terms of time, varies from 2 up to 10 years depending on the knowledge and practice of the community around the study area. The local people used *Ocimum americanum* for flavoring foods like hot spice or red pepper ('Berbere'), spiced stew ('Wot'), tea and for making traditional food prepared from grain flour ('Atmit'), roasted grain and spiced butter. This

result is supported by [17] showing the species as one of the aromatic plants with a wide range of essential oils rich in phenolic compounds and a wide array of other natural products including polyphenols such as flavonoids and anthocyanin. All of the respondents reported uses of *Ocimum americanum* as an additive, flavoring, aromatic, and preservative while preparing spiced butter and dilute spiced paste ('chew'). Generally, the result showed the traditional knowledge of the community about *Ocimum americanum* potential in the study area is diverse and endowed with much critical and empirical observation for centuries. Consequently, it is a clue and springboard for bio-prospecting companies to conduct further research and utilization of genetic resources.

Distribution of *Ocimum americanum* in the study area

88% of the respondents cultivated *Ocimum americanum* in their home gardens and in the main fields to make the genetic resource accessible on the market while the remaining 12% of them grew it for self-use. This result indicated that the potential market has been accessible so that bio-prospecting companies can easily access the genetic resource from the local people on a sustainable basis. The local people cultivated and harvested *Ocimum americanum* in the range of 20–300 kgs. The average price of *Ocimum americanum* in the study area was about 2 USD (40 ETB) per Kg at the time of data collection (**Plate1 (A, B, and C)**).

Ocimum americanum spiced Local foods description and composition

The local people prepared various types of traditional foods using *Ocimum americanum* as a flavoring, preserving, and aromatic agent (**Table 3 and plate1**). Some of the local or cultural foods which are processed using *Ocimum americanum* are hot pepper spice; water dissolved hot spice, Spiced butter, white fleshy food, hot chili pepper spice, spiced stew, vegetable stew, lentil stew and powdered hot spice (Table 3). Ethiopian cultural foods are usually well-flavored with so many spices. *Ocimum americanum* is one of the most known spices, which is added to many local foods and used as a flavoring or aromatic agent.

Table 3
Ocimum americanum spiced Local foods summarized Menu list and definition as described by the respondents

S.N	Local Name in Amharic	Corresponding English Name	Definition as described by the respondents	Remark
1	Shiro	Pea/bean flour stew	A typical Ethiopian food, ground dried or Curry powder, usually made from <i>Pisum sativum</i> or <i>Faba bean</i> sweetened with many spices.	
2	Berbere	Hot-spiced pepper	Hot spice is a powder paste composed of many spices such as chili powder, fenugreek, ginger, garlic, and a whole bunch of supplementary spices added up in the interest of the local chemist [the Ethiopian Mothers].	
3	Mitmita	Chilli pepper spice	An orange, red ground dried spice mixture, typically made from hot chili pepper added with many food spices such as cardamom, cloves, and salt.	
4	Awaze	Dissolved hot spice	Water-dissolved hot spice [Plate 2] is a semi-solid or amorphous mixture of hot spice, water, oil, spiced butter, and salt	
5	Shiro Wet	Spiced stew	Fully ground grain paste, prepared usually from <i>Faba bean</i> or <i>Pisums sativum</i> , which are used to make up a traditional spiced stew [Shiro wet].	
6	Misir Wet	Lentil stew	A typical Ethiopian stew made from semi grinded lentils spiced with several flavorings.	
6	Sillijo	White fleshy spiced food	A portion of traditional fermented food prepared from the mixture of cooked powdered horse bean (<i>Vicia faba</i> , and safflower (<i>Carthamus tinctorius</i>) extracts, processed into a semi-solid product, and added to untreated black mustard (<i>Brassica nigra</i>) powder after being cooled.	
7	AterAichaWot	Vegetable stew	It is a type of stew made from a semi-ground Faba bean or <i>Pisum sativum</i> with the absence of hot spiced pepper.	
8	Dillih	Water dissolved hot spice	A mixture of hot spice pepper with hot water which form a semi solid or thick fleshy structure.	
9	Nitir qibe	Spiced butter	A traditional purified (melted) mixture product, usually Cow milk as the primary ingredient with several added spices principally Ginger and <i>Ocimum americanum</i> for their food/stimulant drink [like coffee and tea] flavoring role.	

Direct matrix ranking

Key informants evaluated the functionality of local foods spiced by basil to the local people and indicated their scores for each local foods (on a scale of 1 to 5). Nine *Ocimum americanum* spiced local foods were evaluated in four selected usage categories. The output of the direct matrix analysis was showed, Chilli pepper spice was the preferred local food sweetened by basil for its various purposes [flavoring, preservative, and aromatic and ailment treatment] by the local people, followed by hot-spiced pepper, Pea/bean flour stew, and dissolved hot spice (Table 4).

Table 4
Direct matrix ranking of *Ocimum americanum* spiced local foods by key informants from Alefa and Debiya District (15 up to 19) based on four selected usage categories

spiced local foods	L/ name	preservative					Flavor					Aromatic					Ailment treatment					Total	Rank
Key Informants		Key informants					Key informants					Key informants					Key informants					5	-
		15	16	17	18	19	15	16	17	18	19	15	16	17	18	19	15	16	17	18	19		
Pea/bean flour stew	Shiro	4	3	5	3	5	4	3	5	3	5	5	3	5	3	5	5	3	5	3	5	82	3rd
Hot-spiced pepper	Berbere	5	4	4	5	5	5	4	4	5	5	5	4	4	5	5	5	4	4	5	5	92	2nd
Chilli pepper spice	Mitmita	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	4	5	5	5	97	1st
Dissolved/ hot spice	Awaze	5	4	4	3	5	5	3	4	3	5	5	3	4	3	5	5	3	4	3	5	81	4th
Spiced stew	Shiro Wet	4	4	3	2	4	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	72	6th
Lentil stew	Misir Wet	3	2	2	4	5	3	2	2	4	5	3	2	2	4	5	3	2	2	4	5	64	7th
fleshy spiced food	Silijo	1	1	2	5	2	1	1	2	5	2	1	1	2	5	2	1	1	2	5	2	44	9th
Spiced butter	Nit/qibe	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1	1	80	5th
Veg/Spiced stew	A/k-Alich	2	3	1	5	1	2	3	1	5	1	2	3	1	5	1	2	3	1	5	1	48	8th
Total		157					182					167					120						
Rank		3rd					1st					2nd					4th						

Basil spiced foods list with their Method of preparation, dosage, role and plant parts used

Ocimum americanum is added to hot pepper spice [Plate1] as a preservative, stabilizer, and aromatic role. It is essential in cooking cultural foods and is used to spice many foods. One of the most delicious cultural, regular and typical foods i.e. invigorated by *Ocimum americanum* is spiced stew or vegetable stew. During its raw material preparation dried seeds of *Ocimum americanum* are added to the semi-processed *Faba bean* or *Pisum sativum* to increase the flavor and extend the shelf-life of the spiced stew, or for its preservative role. A live cut plant of *Ocimum americanum* is inserted to the vegetable stew or spiced stew to provide good flavor, aroma and to increase the shelf-life of the food. During the preparation of White fleshy amorphous food, dried seeds of *Ocimum americanum* and other spices are inserted there to give flavor and a preservative effect. The local people mix the seeds of *Ocimum americanum* to Water-dissolved hot spice during the first step of preparation [Plate 2] to make it more flavorful.

Traditional or cultural foods are prepared by drying, screening, and mixing a variety of spices at different stages of the local prepared food. According to the information obtained from all interviewed respondents, the amount of *Ocimum americanum* added to powdered hot spice (Dilih or Dikus) and local foods listed in (Table 5) is proportional and based on the amount of the local food intended to prepare. Generally, the purpose of using *Ocimum americanum* by the local people can be classified as a preservative, aromatic and flavoring agent despite the various food lore, perceptions, knowledge, and attitude of the interviewed respondents. The results showed that the local people had versatile knowledge and practices in the methods, dosage, plant parts used, and role of additives during local food preparation [Plate-2]. Local foods preparation may varies from one area to the other area depending up on the nature of individuals usually associated with mothers local knowledge, creativity, resource availability, culture, linguistic and extra factors.

Table 5
Summarized local basil spiced foods list with their Method of preparation, dosage, role and plant parts used

local foods list	Preparation Methods	Dosage	Role of <i>basil</i>	Plant parts used	District	Remark
hot pepper spice	DM	P	PR	S	ATD	-
water dissolved hot spice	DM	P	AR	S	ATD	-
white fleshy food	DM	P	AR	S	ATD	-
hot chili pepper spice	DM	P	AR	S	ATD	-
spiced stew	CI	P	AR	CP	ATD	condiment
vegetable stew	CI	P	AR	CP	ATD	condiment
powdered hot spice)	DM	P	PR	S	ATD	-
Spiced Butter	MP	p	PR/AR/FL	S	ATD	condiment
Lentil stew	CI	P	AR/FL	CP		-
DM = drying and mixing, CI = cutting and inserting, ATD = all targeted district, PR = preservative, CP = Cut part, S = seeds, AR = aromatic, FL = flavor, P = proportional, MP = Melting and purifying						

Ways of administration and methods of preparation during traditional medical use (TMU)

The local people have acquired different medicine-related practices, customs, skills, and knowledge of using *Ocimum americanum* over the last centuries. The concoction, cutting and inserting of the whole plant, grinding, melting, and smelling are identified as frequent methods of preparation for various diseases [Figure 5].

Disease treated, route of administration, Dosage, plant parts used and additive

The plant parts used for medicinal purpose were reported as leaves, steams, whole plant cut and fruits or seeds. The dosage to be taken is varied and unlimited based on the intensity and severity of the disease. Additive like tea/coffee, water and butter were reported in different amount based on the kind of disease treated [Table 6]

Table 6
Summarized data on Disease treated, rout of administration, plant parts used, additive and method of preparation in TMU

DT	MP	F	RA	F	PPU	F	AD
DP	whole plant	2	anal	3	Whole plant	2	Tea/ coffee
TB	Ground	1	anal	1	Leaves	2	Water
C	Concoction	3	anal	2	leaves	3	-
SW	Ground	4	dermal	2	Whole plant	1	Butter
SA	melting	5	anal	1	leaves	2	coffee
DB	melting	2	anal	2	Leaves and stems	1	water
IW	grinding	1	anal	1	Leaves and stems	2	butter
ES	smelling	2	anal	1	leaves	4	water
SU	concoction	1	anal	1	leaves	2	water
DP = depression, TB = tuberculosis, C = cancer, SW = swelling, SA = stomach ache, DB = diabetes, IW = intestinal worm, ES = evil spirit, SU = stomach ulcer, F = Frequency, DT = Disease treated, MP = Method of preparation, RA, Route of administration, PPU = Plant parts used, AD = Additive							

Jaccard's coefficient of similarity

The highest Jaccard's coefficient of similarity was found between Alefa and three districts namely; Bahir dar zuria, Gonder zuria and Takusa (30%), whereas, the lowest degree of similarity was showed in Alefa and Bahir Dar city (20%). (Table 7). Cultural, life style, indigenous knowledge, geographic barrier, modernization, and etc. might be considered as possible reasons for the similarity and differences observed between the comparison districts.

Table 7

Study Districts	Basil spiced Local foods in a or b	Common basil spiced local foods in a\b=(c)	Jaccard's coefficient	%of similarity	Remarks
Alefa	8	–	-	-	
Bahir Dar City	4	3	0.20	20	
Bahir Dar Zuria	5	4	0.30	30	
Gonder Zuria	6	6	0.30	30	
Dembia	7	6	0.28	28	
Takusa	6	6	0.30	30	

Declarations

Acknowledgments

We are gratefully acknowledging all of the actors who helped us in various ways to accomplish data collection and commenting the draft document.

Ethics approval and consent participate

Permission to conduct the survey study was obtained from the regional, district and village respective administrative office of the study area. The purpose of the study was explained to all participants, and they agreed to provide information. All photographs were taken up on the oral consent of individuals or owners.

Authors' contributions

Edeget. M.B and **Taye. B.B** designed the study, performed the computations, and verified the analytical methods. All authors discussed the results and contributed to the final manuscript. The author(s) read and approved the final manuscript.

Funding

The fieldwork of this study was financed by the Ethiopian Biodiversity Institute. The authors did not received financial support for study design, data analysis, the decision to publish, or preparation of the manuscript.

Availability of data and materials

The datasets related to this article can be accessed from the Corresponding author on reasonable request.

Competing interests

The authors declare that we have no conflict of interest in the research.

References

1. Alexiades, M. N. (1996). Protocol for conducting ethno botanical research in the tropics. *Advances in Economic Botany*, 10, 5–18.
2. Alexiades, M. N. (1996). Collecting ethno botanical data: an introduction to basic concepts and techniques. *Advances in economic botany*, 10, 53–94.
3. Alexiades, M. N., & Sheldon, J. W. (1996). Selected guidelines for ethno botanical research: a field manual. New York Botanical Garden.
4. Ali, H. M., Nguta, J. M., Mapenay, I. O., Musila, F. M., Omambia, V. M., & Matara, D. N. (2021). Ethno pharmacological uses, biological activities, chemistry and toxicological aspects of *Ocimum americanum* var. *americanum* (Lamiaceae). *J Phytopharmacol*, 10, 56–60.
5. Amare S.A, Ashenafi. A.H, Edeget M. B, Taye B, Abiyessellassie M.G, Yibrehu. E.K, (2016); Bio-prospecting Potential of *Ocimum basilicum* for Access and Benefit Sharing Around Bahir Dar City Administration, West Gojam and Northwest Gondar, Amhara Region, Ethiopia. *Advances in Bioscience and Bioengineering*. Vol. 4, No. 4, pp. 35–42.
6. Central Statistical Agency (2015). The 2015 (2007 E. C.) Population and housing census: Result of Ethiopia. Central Statistical Agency. Addis Ababa, Ethiopia.
7. Chen, S. Y., Dai, T. X., Chang, Y. T., Wang, S. S., Ou, S. L., Chuang, W. L., & Ku, H. M. (2013). Genetic diversity among 'Ocimum species based on ISSR, RAPD and SRAP markers. *Australian Journal of Crop Science*, 7(10), 1463–1471.
8. Chin, Y. W. Balunas, Y. W. (2019). Ethnobotanical uses, phytochemicals, and pharmacological activities of *Ocimum* species: A review. *Journal of Ethnopharmacology*, 235, 112–130.

color:#DDDDDD;vertical-align:sub;>M. J.</background-color:#DDDDDD;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;></background-color:#BCBCBC;vertical-align:sub;>Chai</background-color:#BCBCBC;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;></vertical-align:sub;></background-color:#DDDDDD;vertical-align:sub;>H. B.</background-color:#DDDDDD;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;>&</vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#BCBCBC;vertical-align:sub;>Kinghorn</background-color:#BCBCBC;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#DDDDDD;vertical-align:sub;>A. D.</background-color:#DDDDDD;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#66FF66;vertical-align:sub;>2006</background-color:#66FF66;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#CCCCFF;vertical-align:sub;>Drug discovery from natural sources</background-color:#CCCCFF;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#CCFF99;vertical-align:sub;>The AAPS journal</background-color:#CCFF99;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#FFCC66;vertical-align:sub;>8</background-color:#FFCC66;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#C8BE84;vertical-align:sub;>2</background-color:#C8BE84;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>vertical-align:sub;></background-color:#D279FF;vertical-align:sub;>E239-E253</background-color:#D279FF;vertical-align:sub;>vertical-align:sub;></vertical-align:sub;>

- [illegible]

[illegible]

Literature suggests the plant has been claimed as a food additive for its aromatic effect and folk medicine for various complaints. The current survey also confirmed that local people traditionally use basil for aromatic, preservative, flavor, and ailment treatment roles. It inferred the plant is 'neglected' while having multiple use values. Specifically, it has a preservative, flavoring, and aromatic effect during the preparation of local foods including spiced butter, spiced stew, and hot pepper spice. The short period of agronomic practices, moisture efficiency, and the repetitive harvesting of basil have given an advantage to users and producers. Thus, the present study advises *Ocimum americanum* has a prospect for pharmaceutical and industrial uses. Therefore, interested bio-prospecting Companies can access the plant and its associate local knowledge and practices documented to search for new biochemical compounds. The government, the local people, and interested bio-prospecting companies should work cooperatively via local knowledge and practices as a trigger to search for biochemical compounds responsible for various use values.

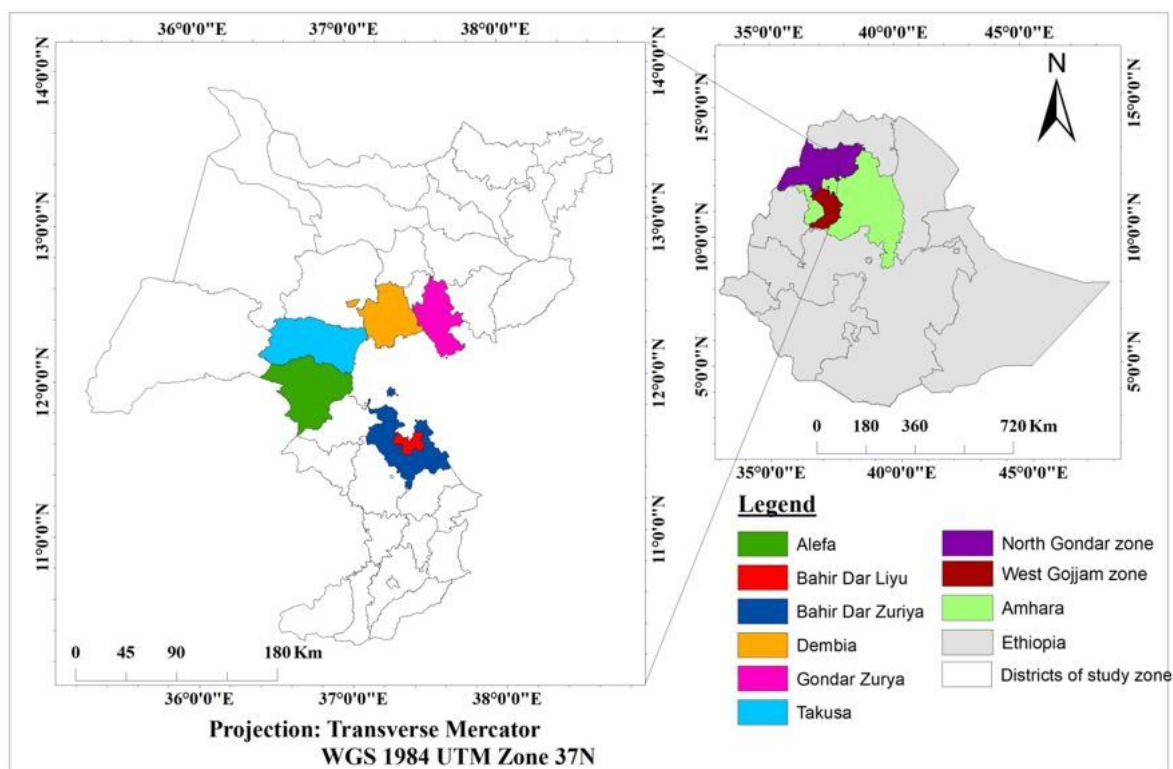


Figure 1

See image above for figure legend.

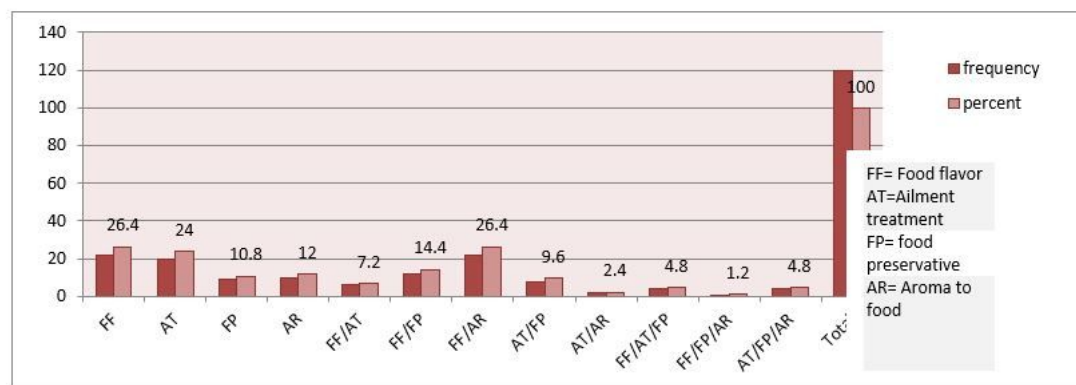


Figure 2

See image above for figure legend.

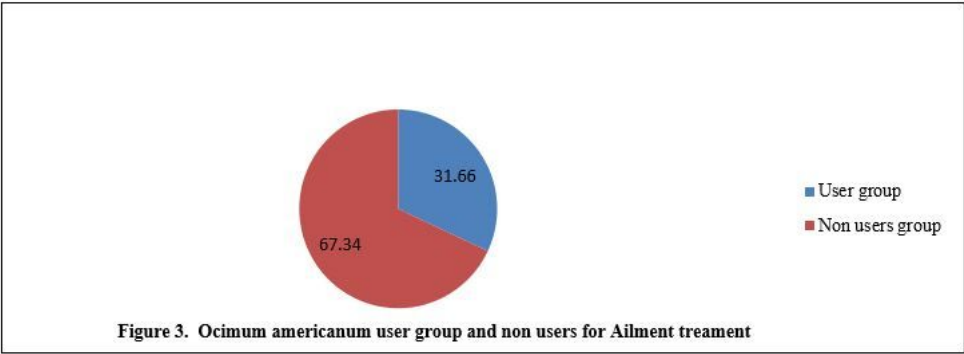


Figure 3

See image above for figure legend.

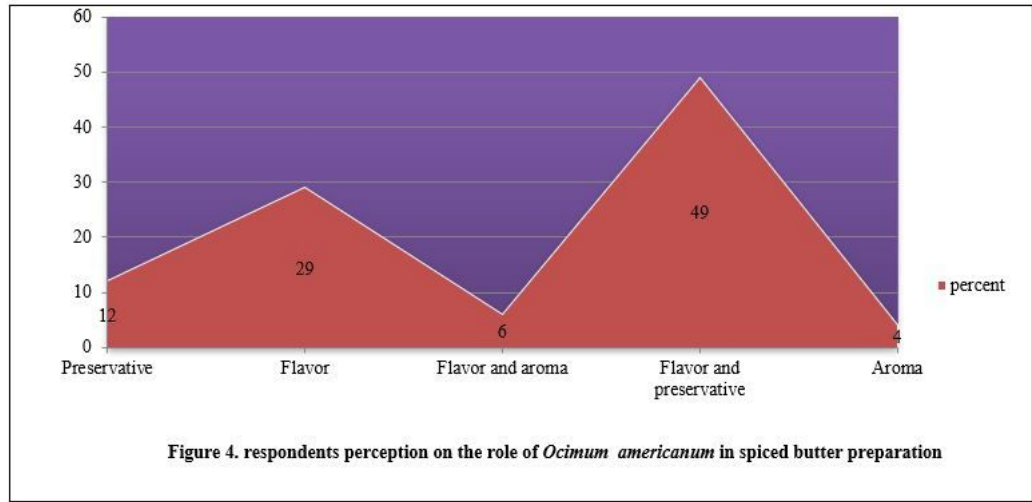


Figure 4

See image above for figure legend.

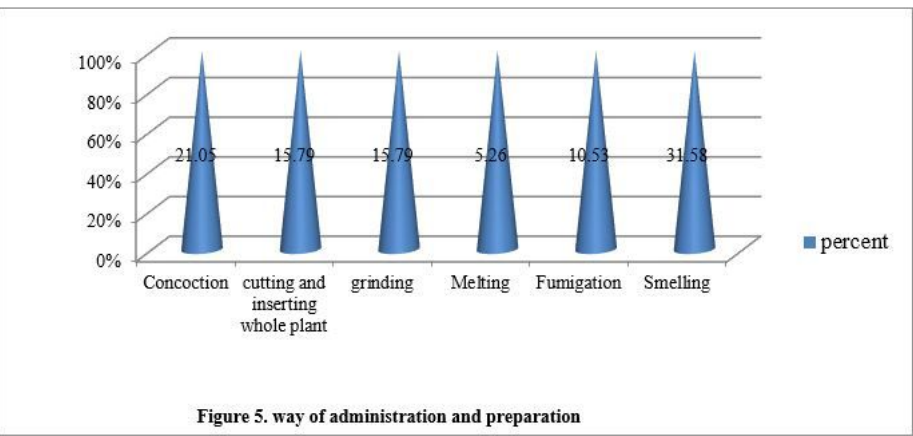


Figure 5

See image above for figure legend.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Plate1.jpg](#)
- [Plate2.jpg](#)