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Diversity of Spice Plants, Their Use and Function as Additive in Traditional Ethiopian Gastronomies and Culinary Recipes

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Abstract. Plants used as spices and condiments have historically been added to food for their natural flavouring, aroma and aesthetic appeal as well as for preservation. The traditional plant markets provide these plants with little to no processing for public usage and provide additional household income. The purpose of the current study was to evaluate the types of spice and condiment plants used in Ethiopia's traditional ethnic foods and beverages. After obtaining verbal prior informed consent, a series of semi-structured interviews with spice crop collectors, vendors and users were held in the neighbourhood spice markets of Boditi and Bedessa. A total of 29 different types of spice crops were discovered, belonging to 13 different families. The maximum number of spices were identified in the Boditi local market and had a maximum similarity with Bedessa. The maximum number of spices were belonging to Lamiaceae, Zingiberaceae and Apiaceae families. The majority of the plants sold in the markets were under cultivation. Herbs were the most widely used spices followed by shrubs and climbers. Fresh and leafy herbaceous species were the most prepared used forms of spices. Flavouring and seasoning were top-ranked use categories. *Allium sativum* L. had the highest index measuring cultural importance out of all the relevant species that were chosen. The current study found that indigenous people know how to use plants as spices and condiments in traditional foods and beverages in Damot Woyde and Damot Gale District, Wolaita, Ethiopia. It is therefore hoped that the knowledge presented in this paper will be useful in subsequent ethnobotanical and ecosystem management studies of the area.

Keywords: cultural importance plants, ethnobotany, indigenous knowledge, spice markets, spices, condiments

Introduction

Ethiopia is a nation in Africa that has a high level of biodiversity and a variety of agroecological systems that are home to unique plant, animal and microbial species (IBC, 2005b; Woldu, 2004; Geleta *et al*., 2002). Plants used as spices and condiments have been produced, used and sold in this nation for a very long time (Gobie, 2019) to enhance food and their inherent flavour, aroma and aesthetic appeal as well as for preservation (ESA, 2020). Spices plants with little to no processing are offered for public consumption in the conventional plant market either in dried or raw forms. They can be purchased alone or in combination with other plants to serve this purpose (FAO, 2011). In addition to enhancing food flavour, spices provide physiological advantages like effective pest control and analgesic, antioxidant, hepatoprotective, anti-malarial, anti-inflammatory, anticancer and antitumor properties of phytochemicals (Wendimu and Tekalign, 2020).

Spices are often used when cooking or preparing food, whereas condiments are made from plants or other plant-based materials that are typically presented with already cooked foods at the table (Agize, 2014) to increase the nutritional value of food and garnish it more appetizing to eat.

Ethiopian exports of spices are still in their infancy stages (Vijayalaxmi and Sreepada, 2014) and the spice market is mostly domestic (Woldu, 2004). To make sure that there are always fresh resources available for harvesting close to the kitchen, women grow a variety of spices plants and vegetables in their home gardens (Agize, 2013; Wondimu *et al*., 2006). These plant species are used every day for the preparation of traditional foods and drinks.

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Ethiopian ethnobiological research has mostly centered on how plants have been used traditionally as medicine (Wendimu *et al*., 2021; Tefera and Kim, 2019; Tuasha *et al*., 2018; Melesse *et al*., 2015; Assegid and Tesfaye, 2014; Regassa, 2013; Hailemariam, 2009; Giday, 2003). There has been very little research on spice and condiment crops and there is no research known to have been done in Damot Woyde (Bedessa) and Damot Gale (Boditi) districts. The current study was conducted as a result to enumerate the spice and condiment plants that can be purchased for domestic use and consumption at nearby markets; determine which plants are used in the communities as the most important spices and condiments and note the methods used to prepare and utilize spices into ethnic foods and beverages.

Material and Methods

Description of the study area. In the markets of Boditi and Bedessa, the study was carried out in, Wolaita zone, southern Ethiopia. Boditi and Bedessa are the seats of Damot Gale and Damot Woyde districts, respectively and far to the northeast of Sodo town, the Wolaita zone's capital city by distances of 40 and 63 Km, respectively (Fig. 1). The region is about 350 Km south of the capital Addis Ababa. The region experiences roughly 700 mm of annual rainfall and averages 21 ºC for both temperature and rainfall, respectively. The District's primary sources of income are farming and animal husbandry (mixed agriculture). The Wolaita people are the first inhabitants of Ethiopia and they have different identities, customs, political histories and empires. These people, along with the Dawro, Gofa, Gamo, Kulo and Konta peoples, speak an Omotic language family, according to historians. These tribes are all found in the basins of the Omo river and they all adhere to the same or very similar cultural, linguistic and religious traditions (Lovise, 2011).

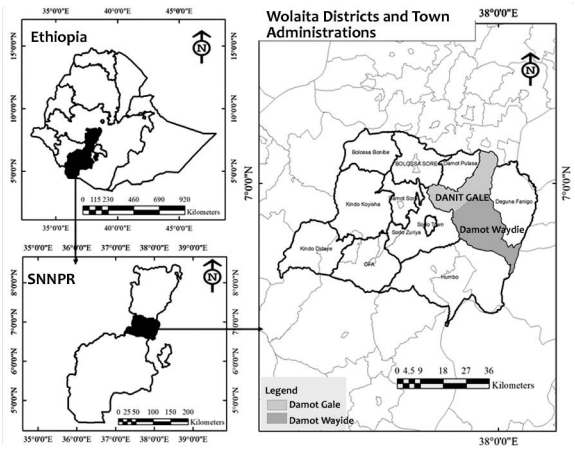

Fig. 1. Districts and Kebeles located in the Wolaita zone of Ethiopia's southern nations nationalities and peoples' region (SNNPR).

Study population. Participants in the study were all regular customers in the regional traditional markets in the towns of Wolaita Boditi and Bedessa towns. They included buyers, vendors and purchasing agents (users). The responders were all between the ages of 18 and 60. Randomly and systematically, the same numbers of respondents were chosen from each market neighborhood.

Ethnobotanical survey and techniques. Ethnobotany surveys were carried out between September 2021 and July 2022. Boditi and Bedessa, two traditional markets, were specifically selected for the study because the spices and condiments gathered from every tiny village in the Damot Doyde (Bedessa side) and Damot Gale (Boditi side) districts, as well as the nearby Hadiya people (Hadiya zone administration side) which were brought to these markets for sale.

Interviews with randomly chosen respondents of all ages and educational levels were used to gather information on spices and condiments after obtaining prior informed consent. The information generally included the plant's name in the region, the part(s) used, growth forms, usage forms, habitat for gathering, method of preparation and consumption and threats to spice crops in the communities. To ensure its accuracy, the gathered data were cross-referenced with other works of published literature. Finally, the regional name for each plant species was included to aid in identification.

Data analysis. The data was entered and processed using Microsoft Excel spreadsheets for Windows 2013. Pairwise comparison was used to assess indigenous knowledge-related information on plant utilization categories, techniques of use and data connected to the collecting and preparation of spices and condiments.

Cultural importance index (CI). The relevance of each species to each local culture was assessed using the cultural value index (CI). It was determined by adding up each use category cited in a species' use report (UR) for the area divided by the participants' total number (N) for that area. Reyes-Garca *et al*. (2006)

works were followed to compute the mean cultural significance index (mCI) for a chosen group of plants that are the most significant culturally.

$$CI = \sum_{i=1}^{i=NU} \left(\frac{URi}{N}\right)$$

By adding the cultural importance index (CI) of the species from each family, the cultural significance of each family (CIf) was calculated (Wendimu and Tekalign, 2020).

Results and Discussion

Socio-demographic profiles of participants. Females made up 85.7% (92/103) of the consumers (purchasing agents), commercial resellers (vendors) and rural harvesters who participated in this survey, compared to males' 14.3% (11/103). This indicated that female participants purchased a greater proportion of plants that are being used as spices and condiments in the study area. About 68.9% of the respondents (71/103) were between the ages of 18 and 30, whereas 26.2% (27/103) and 4.9% (5/144) were respectively between the ages of 31 and 41. Fifty-two point five percent of the participants (54/103) had finished elementary school, whereas 16.5% (17/103) and 31.1% (32/103) had finished secondary school and were respectively illiterate.

Taxonomic diversity of spices. Several plant species are used as seasonings and condiments in food and traditional drinks by people in the Bodit and Bedessa. The identified species of spice and condiment plants were classified into 13 families and comprised a total of 29 distinct species. The predominant species were *Aframomum corrorima*, *Allium* sp., *Capsicum* sp., *Piper longum* L. and *Zingiber officinale.* Followed by *Carum carvi* L., *Curcuma longa* L. and *Trigonella foenum* graecum around the markets (Table 1).

The most popular families in both communities were Amaryllidaceae, Apiaceae, Asteraceae, Lamiaceae, Solanaceae and Zingiberaceae. Communities in Damot Gale near the Bodit market use a little bit more species from the Brassicaceae, Cannabaceae, Fabaceae, Lamiaceae and Piperaceae families in contrast to the Bedessa market community of Damot Woyde (Fig. 2).

Herbs were used most frequently in the communities in light of how spices and condiments are growing, followed by shrubs, trees and climbers. Residents of the Bodit community used herbs a little bit more than those of the Bedessa community (Fig. 3).

Both the Bodit and Bedessa market communities preferred fresh spices and condiments over dried and fresh dry forms (Fig. 4). As their preferred source of seasonings and condiments, both of the chosen communities preferred leaves to seeds, fruit and plant components. The community had the least preference for bulbs and rhizomes compared to the other plant parts (Fig. 5).

Four additional groups of spice and condiment plants were created based on the ethnobotanical observations made by the studied communities in the Bodit and

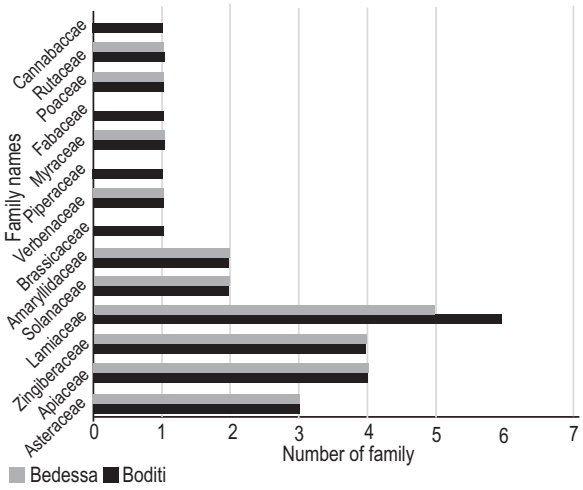

Fig. 2. A comparison of the spices and condiments sold in Boditi and Bedessa markets on a family basis.

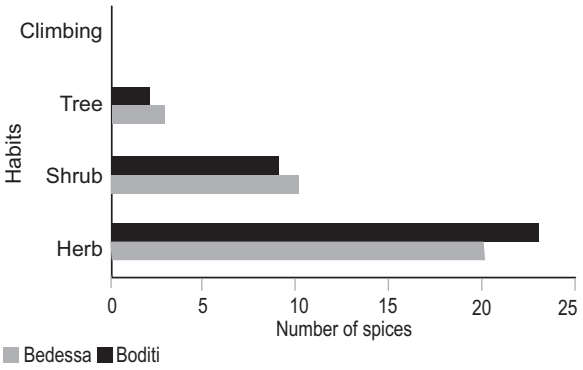

Fig. 3. The growth form of the plants used in the Boditi and Bedessa markets for spices and condiments.

Table 1. The plant species that the locals of both Boditi and Bedessa markets use as spices and condiments

Scientific and family name	English and local names	Parts used	Use category	Growth category	Used in	References
Aframomum corrorima (A. Braun) P.C.M.Jansen, Zingiberaceae	Cardamom (E), Korerima (A), Okashiya (W)	Seed	F	C	Tb, Mk, Ms, Sj	(Demeke *et al*., 2020; Tesfa *et al*., 2017; Agize, 2014)
Allium cepa L. Amaryllidaceae	Onion (E), Key shinkurt (A), Sunkkuruutuwa (W)	Bulb	F, S	C	Ms, Kt, Dw, Sw, Dt	(Demeke *et al*., 2020; Tesfa *et al*., 2017; Agize, 2014)
Allium sativum L. Amaryllidaceae	Garlic (E), Nech shinkurt (A), Tuummuwa (W)	Bulb, Leaf	F, S	C	Tb, Ms, Kt, Sw, Nk, Bk, Mt, Sj, Ns	(Demeke *et al*., 2020; Tesfa *et al*., 2017; Agize, 2014)
Amomum subulatum Roxb. Zingiberaceae	Black cardamom (E), Tikur azmud (A), Karetta sawuwa (W)	Seed	F	C	Br, Sj	(Demeke *et al*., 2020)
Brassica nigra (L.) K. Koch, Brassicaceae	Black mustard (E), Senafich (A), Santta ayfiya (W)	Seed	F, C	C	Sj, Dt	(Demeke *et al*., 2020; Agize, 2014)
Capsicum frutescens L. Solanaceae	Chili (E), Karia (A), Qaariya (W)	Fruit	F, S, Co	C	Ms, Sw, Dw, Mt, Kb	(Demeke *et al*., 2020; Tesfa *et al*., 2017)
Carthamus tinctorius L. Asteraceae	Safflower (E), Suff (A), Suufiya (W)	Seed	F	C	Sj	
Carum carvi L. Apiaceae	Caraway (E), Nech azmud (A), Anugga (W)	Leaf, Seed	F	C	Sj, Nk, Ms, Tb, Et	(Demeke *et al*., 2020)
Coriandrum sativum L. Apiaceae	Coriander (E), Dimbilal (A), Deebbuwa (W)	Leaf	F, C	SC	Dt,Kb	(Demeke *et al*., 2020; Tesfa *et al*., 2017; Awasthi and Pandey, 2016)
Curcuma longa L. Zingiberaceae	Turmeric (E), Irid (A), Irddiya (W)	Rhizome	Co	SC	Ms, Aw	(Demeke *et al*., 2020; Awasthi and Pandey, 2016)
Foeniculum vulgare Mill. Apiaceae	Fennel (E), Qundoberbere (A), Qunddo barbbarriya (W)	Seed	F, S	W	Ms, Mk, Dt, Sw, Wt	(Demeke *et al*., 2020; Agize, 2014)
Lippia javanica (Burm.f.) Spreng. Verbenaceae	Fever tea (E), Koseret(A), Kosrotiya (W)	Leaf	F	W, SC	Sj, Ms, Nk, Ab, Wt, Et	(Demeke *et al*., 2020)
Piper longum L. Piperaceae	Long pepper (E), Timiz (A), Gojobaa bambbariya (W)	Fruit	F, C, Co	C	Ms, Sw, Dw, Mk	(Demeke *et al*., 2020)
Syzygium aromaticum (L.) Merr. & L.M.Perry, Myrtaceae	Clove (E), Qerenefude (A), Qurunffudiya (W)	Flower buds	F, S	C	Mk, Si, Dw, Tb	(Demeke *et al*., 2020; Awasthi and Pandey, 2016)
Thymus schimperi Ronniger, Lamiaceae	Thyme (E), Tosign (A), Zimbanuwaa (W)	Leaf	S, C	W	Ab, Si	(Tesfa *et al*., 2017; Agize, 2014)
Zingiber officinale Roscoe, Zingiberaceae	Ginger (E), Zinjibil (A) Yenjjeeluwa (W)	Rhizome	F, S	C	Ms, Ns, Nk, Dt, Kb, Si	(Demeke *et al*., 2020; Agize, 2014)
Cymbopogon citratus (DC.) Stapf, Poaceae	Lemon grass (E), Tej sar (A), Guccacha (W)	Leaf	F, S	W, SC	Et, Si	

Continued

Scientific and family name	English and local names	Parts used	Use category	Growth category	Used in	References
Artemisia afra Jacq. ex Willd. Asteraceae	Wormwood (E), Ariti (A), Naatiraa (W)	Leaf	F	W, C	Kb, Tb,	(Agize, 2014)
Ruta chalepensis L. Rutaceae	Rue (E), Tena adam (A), Xalotiya (W)	Leaf, Seed	F	W, C	Sj,Tb, Kb, Si, Wt, Dt	(Tesfa *et al*., 2017; Agize, 2014)
Cuminum cyminum L. Apiaceae	Cumin (E), Ensilal (A), Katikalla (W)	Leaf	F	W	Kb, Dt	(Demeke *et al*., 2020; Tesfa *et al*., 2017; Awasthi and Pandey, 2016)
Rosmarinus officinalis L. Lamiaceae	Rosemary (E), Yetibs Kitel (A)	Leaf	F	W, SC	St, Mt, Ms, Dw, Sw, Kb	(Demeke *et al*., 2020)
Myrtus communis L. Mytraceae	Myrtle (E), Aguppiya (W), Ades (A)	Leaf	F	W	Kb	
Plectranthus caninus Roth, Lamiaceae	Scaredy Cat (E), Mudhdhaa (W)	Leaf	F	W	Kb	
Ocimum tenuiflorum L. Lamiaceae	Scared basil (E), Besobila(A), Keppuwa (W)	Leaf	F, C	W, SC	Kb,Wt, Ms, Dt	
Ocimum lamiifolium Hochst. ex Benth. Lamiaceae	Basil (E), Dama kessie (A), Guluwa (W)	Leaf	F, C	W, SC	Kb, Wt	(Tesfa *et al*., 2017)
Artemisia absinthium L. Asteraceae	Wormwood (E), Chikugn (A), Cuqqunniya (W)	Leaf	F	W	Kb, Ms	(Agize, 2014)
Rhamnus prinoides L'Hér. Cannabaceae	Hop (E), Gesho (A), Geeshuwa (W)	Leaf	F	W, C	Tl, Tj, Ak	
Capsicum annum L. Solanaceae	Chili (E), Kariya (A), Qaariya (A)	Fruit	F, C, Co	C	Ms, Sw, Dw, Aw	(Tesfa *et al*., 2017; Agize, 2014)

Keys: For names: E=English; A = Amaharic; W = Wolaita; UE = Use category; F = Flavouring; S = Seasoning; C = Culinary; Co = Colouring; HF = Harvested; W = Wild; C = Cultivated; SC = Semi cultivated; Sw = Siga wot; Ts = Tire siga; Nk = Niter kibbeh; Mk = Mekelesha; Ms = Mitin shiro; Tb = Tikur buna or Jebena buna; Ns = Nech shiro; St = Siga tibs; Kb = Kitel buna; Ab = Ayb; Wt = Wotet; Si = Shai; Et = Bul'a or itimaa; Tf = Teff flour; Kt = kulet; Bk = Bekolt; Dw = Doro wot; Mt = Mitmita; Sj = Siljo; Br = Dabo; Sh = Shamet; Tl = Tella; Tj = Tej; Ak = Areki; Aw = Alcha wot; Dt = Datta.

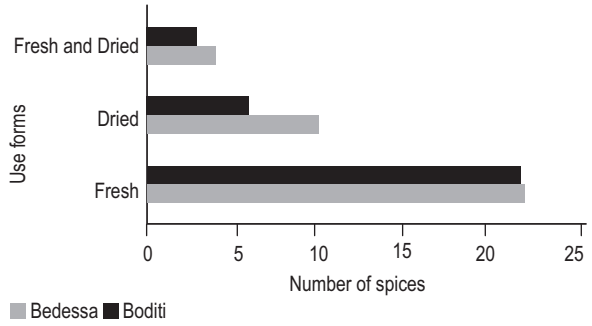

Fig. 4. The way that the plants from the Boditi and Bedessa markets are used as spices and condiments.

Bedessa markets: seasoning, flavouring, culinary and colouring. In both the Bodit and Bedessa market communities, flavouring took the lead among these categories, proceeded by seasoning, culinary and colouring. Some of the 30 species of plants that were described were employed in more than one of the categories indicated. The mean cultural important index indicated that *Allium sativum* L. had the highest mean cultural importance, followed by *Capsicum frutescens* L. in all the use categories (Fig. 6).

According to the habit-wise classification of the plants, most plant species used as seasonings and condiments were cultivated (43%) by the villagers. Other plants were gathered from forests and semi-agricultural land (both semi-cultivated and wild), while other plants were wholly wild (Fig. 7).

To investigate the cultural significance of the plants for the community, the cultural importance index was

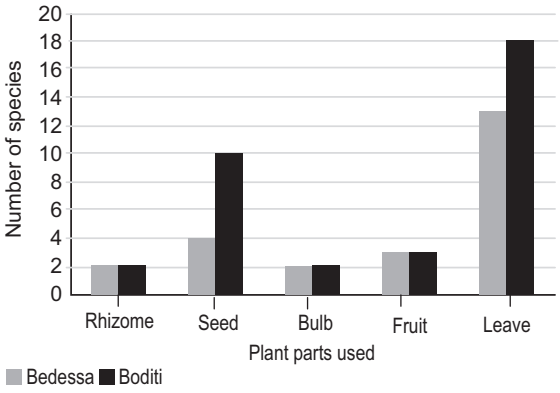

Fig. 5. Plant parts of spices and condiments used by market communities of Boditi and Bedessa.

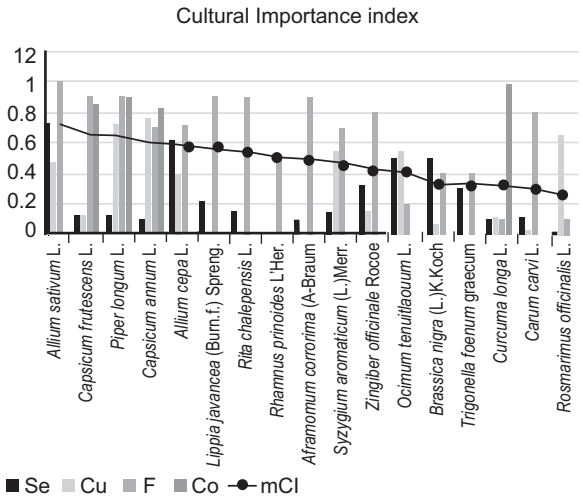

Fig. 6. The 17 most significant plant species' mean cultural importance index (mCI).

evaluated. Four categories of data were created: colouring, seasoning, culinary and flavouring and for each category, the cultural importance (CI) and mean cultural importance (mCI) values were determined using the top 17 culturally significant species. According to the findings, *Allium sativum* L. had the highest mean cultural importance, followed by *Capsicum frutescens* L. (Table 2).

In contrast to Bedessa communities, the majority of the species in the Bodit market displayed the highest mean cultural importance index (mCI) for the selected species of spice and condiment plants (Fig. 8). The Piperaceae, Solanaceae and Amaryllidaceae families had the greatest mCIs compared to the other families, based on the two market communities' average cultural value indices for selected important species of spice and condiment plants (Fig. 9).

Plant used in Ethiopian traditional cuisines and traditional home grading recipes. According to regional customs, various types of spices and condiments were consumed in various ways. The spices used in dried forms (48%), e.g. *Brassica nigra* (L.) K.Koch, *Carthamus tinctorius* L., *Carum carvi* L., *Curcuma longa* L., *Trigonella foenum* graecum, *Cuminum cyminum* L., *Rhamnus prinoides* L'Hér.; in fresh (32%), e.g. *Allium* species*, Zingiber officinale, Artemisia afra, Ruta chalepensis* L., *Rosmarinus officinalis* L., *Mytrus communis* and both in dried and fresh (20%), e.g. *Capsicum annum* L., *Piper longum* L., *Ocimum tenuiflorum* L., *Ocimum lamiifolium* Hochst. ex Benth. Some of them are used raw directly and some others are used in a mixture with other spices and thus call for a more or less difficult preparation procedure (Table 3).

Ethiopia is a country in Africa with a lot of biodiversities, listed in the eastern Afro-mountain biodiversity and the Horn of Africa biodiversity hotspots for plant diversity and endemism, with which spices and condiments account for the lion's share (Elgorashi *et al*., 2019).

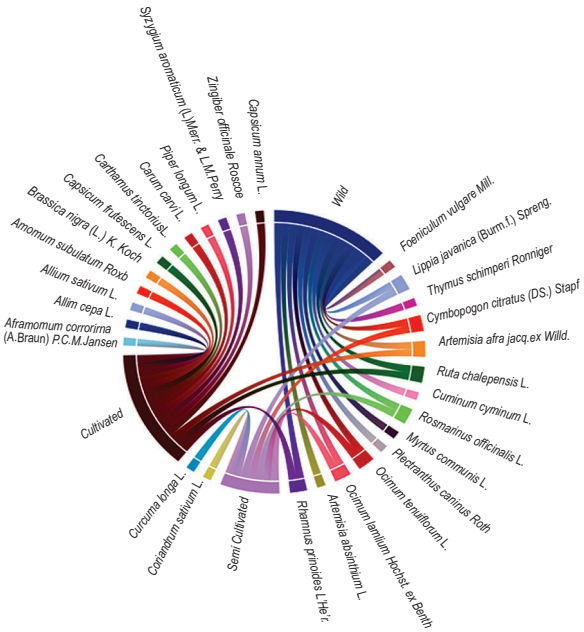

Fig. 7. The habits of the plants used to make spices and condiments.

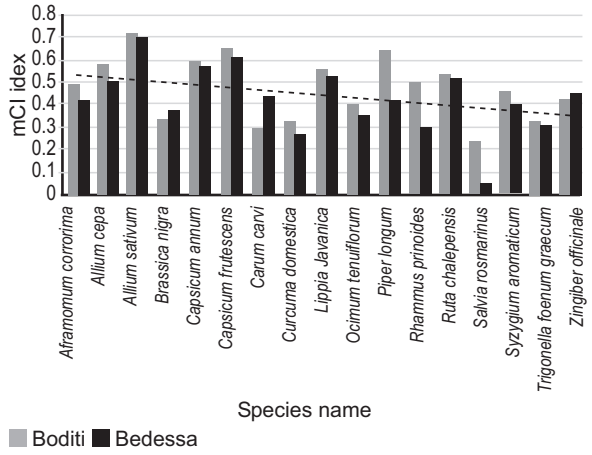

Fig. 8. The average cultural important index (mCI) of selected relevant species of spice and condiment plants in two market communities.

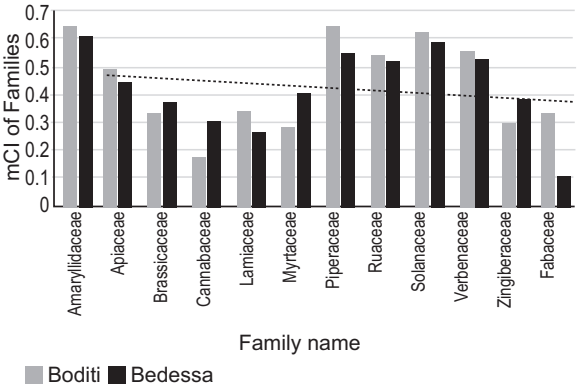

Fig. 9. The index of cultural significance for the chosen families of pertinent species in the two market communities.

Plants such as black cumin, cardamom, Ethiopian long pepper, thyme, coriander, bishop's weed and fenugreek are associated with Ethiopia as a source of origin.

Spices cover around 222,700 hectares on average, with annual production exceeding 244,000 tons. Ethiopia produces more than 50 spices and the overall 200,000 hectares which are thought to be suitable for low-land spice farming (Goshme and Ayele, 2019). Spices play numerous roles in Ethiopia and their importance can be regarded concerning their level of consumption. For a long time, they have served as a key source of income and nutrition for both rural and urban communities. Additionally they are typically labour intensive and inexpensive to transport, they present a unique opportunity to speed up both rural and urban household development (Habtewold *et al*., 2017).

With 18 major agro-ecological zones and numerous agro-ecological sub-regions, Ethiopia has ideal climate conditions for growing more than 146 different varieties of crops. The nation produces upto 50 of the 109 spices, herbs and aromatic plants recognized by the International

Table 2. The 17 most significant plant species' mean cultural importance index (mCI)

Spices and condiments	F	Se	Cu	Co	mCI	Rank
Allium sativum L.	1	0.72	0.48	0	0.72	1
Capsicum frutescens L.	0.9	0.12	0.76	0.85	0.65	2
Piper longum L.	0.9	0.13	0.72	0.89	0.64	3
Capsicum annum L.	0.7	0.1	0.76	0.82	0.59	4
Allium cepa L.	0.7	0.62	0.39	0	0.58	5
Lippia javanica (Burm.f.) Spreng.	0.9	0.22	0	0	0.56	6
Ruta chalepensis L.	0.9	0.15	0	0	0.54	7
Rhamnus prinoides L'Hér.	0.5	0	0	0	0.50	8
Aframomum corrorima (A.Braun)	0.9	0.1	0	0	0.49	9
Syzygium aromaticum (L.) Merr.	0.7	0.15	0.54	0	0.46	10
~~*Zingiber officinale* Roscoe~~	~~0.8~~	~~0.32~~	~~0.15~~	~~0~~	~~0.42~~	~~11~~
Ocimum tenuiflorum L.	0.2	0.5	0.54	0	0.41	12
Brassica nigra (L.) K.Koch	0.4	0.5	0.07	0	0.33	13
Trigonella foenum graecum	0.4	0.3	0	0	0.325	14
Curcuma longa L.	0.1	0.1	0.11	0.98	0.32	15
Carum carvi L.	0.8	0.11	0.02	0	0.30	16
Rosmarinus officinalis L.	0.1	0.02	0.65	0	0.26	17

F = Flavouring; Se = Seasoning; Cu = Culinary; Co = Colouring

Table 3. Spice plants in Ethiopian cuisines and culinary recipes

Spices	Used in	Way of preparation
Cardamom	Tikur buna	The powder is added after the seed has been ground to make coffee.
	Mekelesha	The dried seed of cardamom together with cinnamon, clove, ginger, fennel and black pepper mixed and ground to make powder called mekelesha (fines herbs) which would be added to 'Doro wot'.
	Mitin Shiro	The dried seed of cardamom is added to flavour all kinds of 'wot' and the ground powder is usually mixed with other spices to make 'Mitin shiro'.
	Siljo	The dried cardamom seed is ground is added to 'Siljo' together with other spices.
	Dabo	Black cardamom-dried seed is ground and added to the wheat dough to make 'Dabo'.
Onion	Mitin Shiro	With a mortar and pestle, peeled onion, garlic, cloves, caraway, cardamom and other spices are combined. Then, those mixtures are combined with raw, dried pulses, which are then ground.
	Kulet	All types of 'Wots' first start with 'Kulet'. Kulet is prepared with peeled onion which would be dissected into thin slices and boiled together with water or vegetable oil with or without powdered pepper (*Capsicum* sp.).
	Doro wot	Onions are fine ground with mortar and pestle in fresh and mixed with other spices to make 'Datta'. Most of the time 'Datta' is prepared for important holidays like 'Gifaataa'. This is the leap year of the Wolaita people.
	Siga wot	The primary components of every "wot" are onion, garlic, butter or vegetable oil. But in the case of 'Siga wot' the quantity of onion is very high. Fresh onion is peeled and cut into small slices and boiled in hot water or vegetable oil to start the preparation process of the 'Siga wot'.
	Datta	Ginger, ruda plant seeds, onion and garlic that have been peeled are combined and ground in a mortar and pestle. Pepper is then added to the mixtures and ground once more. The fresh ground is called 'Datta'.
Garlic	Tikur buna	The peeled garlic, clove, caraway and cardamom are ground with mortar and pestle and added to coffee with butter. Buttered coffee is common everywhere in Ethiopia.
	Datta	Garlic cloves that have been peeled, ruda plant seeds, onion and ginger are combined and ground. The mixtures are then combined with pepper and ground once more to create "Datta".
	Mitin Shiro	Peeled fresh or dry ginger, ruda plant seeds and peeled garlic are combined and ground with a mortar and pestle. Pulses are then combined with blended spices and ground to make Mitin Shiro.
	Kulet	Peeled garlic is mixed with onion and used as a starter during the preparation of all kinds of 'wots'. The starter mixtures are roasted with vegetable oil or water (Kulet) and then the next steps are continued.
	Siga wot	To make "Siga wot", peeled garlic is finely ground in a mortar and pestle or peeled garlic together with onion, ginger and chilies fine ground and added to 'Siga wot' during preparation.
	Niter kibbeh	When refining butter, peeled garlic, ruda plant seeds and ginger are ground together and added. The spiced butter after the full refining process is called 'Niter kibbeh'.
	Siljo	Along with other spices like black mustard, safflowers, bean flour, salt, fennel and others, peeled garlic is ground and added together to make "Siljo".
	Bekolt	In a mortar and pestle, peeled garlic is ground before being combined with coriander, chili and onion in a bean dish. Thereafter, the mixed preparation is called Bekolt.
	Mitmita	While "Mitmita" can be made in the same manner as "Datta", its use is constrained due to its strong flavour. It is used as "salt" to flavour all kinds of food in powder form (along with other spices). "Kitfo", which is raw meat, is a common dish. It's lightly roasted and then sprayed with "mitmita" powder. The number of additional spices added to the mixtures mentioned can change. Typically, green peppers are roasted with meat or used right away in "wot".
	Nech Shiro	Combined with coriander and other spices, ground peeled garlic is added to the beans. Thereafter, the mixture is ground and the resulting powder is called Nech Shiro.
Mustard	Datta	The seed is roasted mildly and milled with pepper

Continued

	Tire siga	The ground seed of mustard flour would be mixed with pepper powder and dipped with 'Tire siga'.
	Bekolt	The dried seed of mustard is ground and the flour is mixed with sprouting faba bean.
Chili	Datta	The chilli distinguishes between three types of capsicum spices: (1) *"Karya,"* which are the immature green fruits; (2) *"Berbère,"* which are the majority of the mature red pungent fruits; these are combined with fresh garlic, basil, ginger and rue and ground using a traditional grinding mill with water and salt to create "Datta." The ground powder is known as "Dilih" if the pod is dried before grinding and no water is used. (3) "Mitmita," tiny, incredibly pungent fruits.
	Siga wot	Most of the time red and dried pungent fruits of chilies are mixed with fresh garlic, basil and ginger ground by a traditional grinding mill and added to 'Siga wot'.
	Mitin Shiro	The bulk of red and dried pungent fruits of chilies are mixed with other spices and milled with pulses.
	Kitel buna	'Karya', the immature green fruits of the chili either in thin sliced or fine ground sauce form is added to 'Kitel buna' in a little amount. 'Kitel buna' is mainly made from coffee leaves and other spices. It means leaf coffee.
	Mitmita	The extremely pungent small chilli fruits are dried, ground with other spices and used as "Mitmita," though its use is restricted due to its pungency. It is used as "salt" in the form of a powder (along with other spices) to flavour all kinds of food. "Kitfo," a dish made with raw meat, is very popular. It is typically lightly roasted and sprayed with "mitmita" powder.
Safflower	Siljo	Safflower that has been peeled and dried is ground up and mixed with other seasonings like black mustard, garlic, bean flour, salt, fennel and others to make "Siljo."
Caraway	Siljo	The seed of caraway is fine ground and added to 'Siljo' together with other spices like; black mustard, garlic, bean flour, salt, fennel, etc.
	Mitin Shiro	The dried leave and sometimes the seed of caraway together with garlic, basil, ginger and rue are mixed and ground. Then the mixture is dried in the sun. Pulses are mixed with those mixtures and ground again.
	Tikur buna	The dried leaves of caraway together with fresh garlic, cardamom and ginger are ground with or without water and added to 'Tikur buna' or 'Kibbeh buna' with salt.
	Bul'a	The white seed of caraway is milled and added to 'Bul'a' or 'Itimaa' during the preparation process.
Coriander	Datta	The fresh leaves of coriander are roasted mildly and milled with pepper.
	Mitin Shiro	The dried leaves of coriander are roasted mildly and milled with pulses.
	Kitel buna	The fresh leave of coriander is directly added to 'Kitel buna' during the preparation process.
Turmeric	Mitin Shiro	Turmeric's dried rhizome combined with black pepper, salt, cardamom, garlic and ginger. To create "Mitin Shiro," the mixture is ground, sieved, dried and ground again to a fine powder with pulses.
	Alcha wot	The dried rhizome of turmeric is mixed with garlic, ginger and salt. The mixture is ground to a fine powder is added to 'Alicha wot'.
Fennel	Mitin Shiro	Using a mortar and pestle, dried fennel seeds, ruda plant seeds and fresh or dried ginger that has been peeled are combined. After that, pulses are ground and combined with those mixtures. The finished powder is known as "Mitin shiro."
	Mekelesha	Fennel seeds with cinnamon, clove, ginger, cardamom and black pepper are ground together in mortar and pestle to make powdered mekelesha (fine herbs) which would be used as 'Mekelesha'.
	Datta	Ginger, ruda plant seeds and peeled garlic are all ground in a mortar and pestle. Pepper is then added to the previously ground mixtures and reground. The fresh form of the sauce is 'Datta'. The milled powder of fennel is added to already prepare the sauce as required.
	Siga wot	The dried ground powder of fennel seed is added to 'Siga wot' in a minimal amount as per the wot volume.
	Wotet	The dried and ground seeds of fennel are added to cold frozen yogurt and stirred well before consumption.

Continued

Fever tea	Niter kibbeh	Fever tea dried leaves are manually crushed and added to butter, while it is being refined.
	Wotet	The dried or fresh leave of fever tea is added to 'Wotet' directly before consumption.
Clove	Doro wot	The clove's dried flower buds are ground and added to "Doro wot" along with onions, garlic, ginger, niter kibbeh, chili, pinch, pepper and other spices.
	Tikur buna	The dried clove bulb is added to the coffee directly during preparation and ground with coffee seeds.
	Shai	The dried clove bud is ground and added to 'Shai' or tea.
	Mekelesha	The dried clove buds are combined with other spices such as fenugreek, coriander, caraway, black cumin, cinnamon and cardamon to make "Mekelesha," which is used in cooking.
Thyme	Datta	The already prepared 'Datta' would be garnished with about 2 sprigs of fresh thyme.
	Shai	To make thyme tea, or "Shai," dried thyme leaves are chopped and water is boiled with them.
Fenugreek	Shameta	The dried seed of fenugreek is boiled, sun-dried and milled. Then, the powder is added to 'Shameta'.
	Niter kibbeh	When butter is refined, the dried fenugreek seed is ground and added.
	Dabo	The dried seed of fenugreek is washed, roasted and milled with wheat or maize dough to make 'Dabo'.
	Teff flour	The dried seeds of the fenugreek are washed, roasted and milled with cereals and dusted onto the baking large pan before preparation of 'Enjera' and sometimes even added to the 'Teff flour' before preparation of Enjera.
Ginger	Mitin Shiro	Peeled fresh garlic, rue seeds and ginger rhizome are combined and ground in a mortar and pestle. Then, to create "Mitin shiro," pulses are combined with those mixtures and again ground.
	Datta	The peeled ginger rhizome is milled with pepper, garlic, onion and other spices to make 'Datta'.
	Nech Shiro	The ginger rhizome is ground either in fresh or dried form and added to Shiro which is commonly known as 'Nech shiro' or 'Alicha wot' during preparation.
	Niter kibbeh	The dried or fresh rhizome of ginger with other spices is milled and added to butter during refining.
	Kitel buna	The dried or fresh rhizome of the ginger is chopped or finely ground and added to 'Kitel buna' with other spices.
	Shai	The peeled ginger rhizome is ground and boiled in hot water with a tea tree. And also the peeled ginger rhizome only can be used without a tea tree to make 'kishir shai'.
Basil	Niter kibbeh	Mildly roasted, ground with a pestle and mortar and then added to butter. To be used in 'Niter kibbeh' or butter during refining, inflorescences and leaves of basil needed to be dried first.
	Ayb	Both dried and fresh inflorescences and leaves of basil are added to 'ayb' before cooking. It is removed during preparation.
	Kitel buna	The fresh leaf of basil is added directly to 'kitel buna' during preparation.
	Mitin Shiro	Sometimes the dried and powdered leave of basil is milled with pulses and other spices.
	Alcha wot	All varieties of "wot" are prepared using basil leaves and inflorescences, both fresh and dried. During or after preparation, the stem and the leaves are also added to "alcha wot."
	Datta	Typically, dried, ground basil leaves, flowers, fruits and tender stems are combined with other spices to make "Datta."
	Wotet	Basil leaves, both fresh and dried, are added to "Wotet" in small amounts based on the volume of the "Wotet."
Lemon grass	Bul'a	The leaf of lemon grass is added to 'Bul'a' to keep its aroma for future delayed preparation but removed during preparation.
	Shai	Lemon grass is sometimes pinched either in dried or fresh form and added to 'Shai' after preparation.
Wormwood	Kitel buna	The fresh leave of wormwood is added to 'Kitel buna' mainly during preparation with other spices.

Continued

	Tikur buna	Sometimes the leaves of the woodworm are added to already-prepared coffee after being pinched ‘Tikur buna' or 'Jebena buna'.
Rue	Siljo	Usually, the fresh leave of the rue or ruda plant is added directly to the already prepare 'Siljo'.
	Mitin Shiro	Garlic, ginger and other spices are ground together with rue plant seed. Thereafter, the pulse is added to those mixed spices and ground again to make 'Mitin shiro'.
	Tikur buna	The plant flowering bud and leave at the green stage is pinched and directly added to already prepared coffee.
	Shai	The plant flowering bud and leave at the green stage is pinched and directly added to already prepared tea.
	Datta	The rue plant seed is mixed with garlic and ginger in addition to other spices. After that, pepper is added to the mixture of spices, which is then ground with a little water to create a sauce known as "Datta."
	Niter kibbeh	The rue plant seed is mixed with garlic, ginger and other necessary spices. Thereafter, ground and added to butter to make 'Nitir kibbeh' during refining.
	Wotet	The rue plant leave at the green stage is pinched and directly added to 'Wotet' before serving.
	Nech Shiro	The rue plant seed is ground with garlic, ginger and other important spices. Thereafter, the pulse is mixed with those spices and ground to make 'Nech shiro'.
	Kitel buna	The rue plant flowering bud and leave at the green stage are pinched and added to 'Kitel buna' with other spices during preparation.
Cumin	Niter kibbeh	The dried leave of cumin is ground with other spices and added to butter during refining.
	Mitin Shiro	The dried leave of cumin is mixed and milled with pulses to make 'Mitin shiro'.
	Datta	The dried leaves of cumin are mixed and milled with pepper.
Rosemary	Siga tibs	The leaf at the early green stage is added to 'Siga tibs' after all the necessary spices.
	Mitmita	The leaf at the early green stage is added to 'Mitmita' with all other necessary spices.
	Mitin Shiro	The fresh leaf at green stage is added to 'Mitin shiro' with all other necessary spices.
	Doro wot	The leaf at the early green stage is added to 'Doro wot' finally after all the necessary spices.
	Siga wot	The fresh and green leaves are added to 'Siga wot' after all other necessary spices.
	Kitel buna	The leave at the early green stage is added to 'Kitel buna' with other necessary spices.
Myrtle	Kitel buna	Sometimes the fresh leaf of myrtle is added to 'Kitel buna' with other important spices.
Basil	Kitel buna	Sometimes the fresh leaves of scaredy cat or scared basil are added to 'Kitel buna' with other important spices.
	Wotet	The fresh leaf of scaredy basil is pinched and added to 'Wotet' directly.
	Mitin Shiro	The dried leaf of basil is roasted with cardamom, fenugreek, coriander, rue seed and salt. Thereafter, milled with pulses to make 'Mitin shiro'.
	Datta	Sometimes the fresh leaf of sacred basil with fennel and other spices is added to 'Datta'.
	Wotet	The fresh leave of the scaredy basil is added to 'Wotet' directly.
Wormwood	Kitel buna	Sometimes the fresh leaf of wormwood is added to 'Kitel buna' with other important spices.
Hop	Tella	A sour beer that is cloudy, foaming and made from water, malt, flour and hops (leaves and woody parts). It is made from any grain that is available and is the most widely consumed alcoholic beverage. About 7% of the total volume is made up of alcohol.
	Tej	A nearly clear, aromatic, mildly sour, honey drink made with water, honey and hops (only woody parts). It is the "beer" of any poor Ethiopians who have the no money to purchase pricey synthetic beer. By substituting sugar for up to three quarters of the honey, a lower quality 'tej' is created. Once more, the volume fraction of alcohol is around 7%.
	Areki	A kind of gin, prepared from water, malt, flour and leave of hop. It is also prepared by distillation of 'talla' or 'tej' or fermented 'Enjera'.

Keys: **Sigawot** is meat stew; **Teresiga** is raw beef; **Niter kibbeh** is spiced Ethiopian butter; **Mekelesha** is a mixture of spices used to give a “wot” more flavour; **Meten Shiro** is measured flour mixture of pulses with other spices, **Tikurbuna** or **Jebenabuna** is common Ethiopia coffee, **Nechshiro** is a group of stew without capsicum pepper, **Sigatibs** is usually fried meat, **Kitelbuna** is the boiled drink that is primarily made from coffee leaves that are fading, **Ayb** is traditional Ethiopian cheese, **Wotet** is churned milk made to free from butter, **Shai** is Ethiopian tea, **Bul’a** or **itimaa** is powdered enset that is used

to make a porridge and flavoured with niter kibbeh other spices, **Teff** is a gluten-free grain native to Ethiopia used to prepare Enjera, **Kulet** is serving as a starter to stew or other sauces. It is made from peeled onions by fine-cutting the peels into smaller pieces and cocked with vegetable oil or niter kibbeh and other spices. It serves as the basis for all Wot dishes; **Bekolt** is a dish that includes sprouted beans that have been boiled and served with hot sauce or spiced with berbere, mitmita and other herbs and spices; the dish **"Doro wot"** is a thick, spicy stew made with chicken legs (or occasionally thighs) that are served with a hard-boiled egg. The dish is frequently referred to as Ethiopia's national dish and is typically served on holidays or special occasions; **"Mitmita"** is a very spicily spiced pepper powder or sauce that is added to a few dishes (like kitfo) or served on the side to make food hotter; A shiro-like puree known as siljo is made from ground fava beans and other spices; **Dabo** is leaved traditional Ethiopian bread; **Shamet** is thick alcohol-free drink mainly made from linseed or flax; **Tella and Tej** is alcohol drink mainly made from maize or wheat malt and hop tree; **Areki** is alcohol liquor made from distilled malt.

Organization for Standardization (ISO), of which 23 are sold as export commodities. Ethiopia is primarily known for its production of timiz, korarima, turmeric, cumin, rosemary, cardamom, capsicum, coriander, fenugreek, ginger, black pepper, hot pepper, celery, rue and thyme (EIC, 2016).

Ethnic groups are renowned for having in-depth indigenous knowledge as well as their values, traditions and ways of preparing food and drinks (Srivastava, 2009). The Wolaita people, like other Ethiopian ethnic groups, have their endogenous knowledge of how to use spices and condiments. The present study, therefore, investigated the spice and condiment plants used by Wolaita peoples living in around Damot Woyde and Damot Gale districts of local markets *viz*. Boditi and Bedessa. Altogether 29 plant species were discovered and distributed in 13 different families. The communities surrounding the traditional Boditi market utilized the greatest variety of plant species. Furthermore, it was observed that the two market communities shared the maximum number of species to almost the same extent. According to the study, there are overlaps in the communities near Boditi and Bedessa markets' ethnobotanical use the knowledge of spices and condiments.

The three spice families represented by the largest number of the two market communities were Apiaceae, Lamiaceae and Zingiberaceae. Boditi communities used the families Brassicaceae, Cannabaceae, Fabaceae and Piperaceae more frequently, while both Boditi and Bedessa communities had a significant representation of the Myrtaceae, Poaceae, Apiaceae, Lamiaceae, Zingiberaceae, Solanaceae, Amaryllidaceae and Verbenaceae, families. The results of the current study are consistent with those of other researchers who noted that the families Lamiaceae, Apiaceae and Zingiberaceae produced the most spices in southern and northern Ethiopia (Wendimu and Tekalign, 2022; Demeke *et al*., 2020; Tesfa *et al*., 2017; Agize, 2014).

In terms of growth forms for spices and condiments, herbs were the most widely grown crop in both market communities, followed by shrubs and climbers. The majority of the herbs were seasonal, easy to grow and have a strong aroma, which may account for their high reported rates of usage. Additionally, it was discovered that the communities used the plants fresh, indicating that the plants have more aromas in their fresh form and are also readily available nearby. Compared to other plant parts, the leaf was the one that was used the most frequently. Other communities in northern and southwestern Ethiopia have also been known to use leaves as spices and condiments (Wendimu and Tekalign, 2022; Tesfa *et al*., 2017; Agize, 2014). The community's flora was preserved because leaves rather than roots were primarily used for seasoning and flavouring.

To enhance the colour and fragrance and to serve in other gastronomic activities, spices and condiments were used in traditional foods of Ethiopia. According to the current study the most of plants were used for flavouring, seasoning, culinary purposes and colouring. The highest amount of plants was used for flavouring in the areas around Damot gale district in Bedessa traditional market. For other categories like seasoning, cooking and colouring, the two of the markets had nearly the same number of spices use reports. *Aframomum corrorima*, *Allium cepa*, *Allium sativum*, *Syzygium aromaticum*, *Lippia javanica*, *Capsicum annum*, *Capsicum frutescens*, *Piper longum and Zingiber officinale* were common plants for flavouring all kinds of foods in two of the communities.

To flavour alcoholic beverages like "Talla", "Tej", "Areki" or "Katikala", *Rhamnus prinoides* is used. The community typically used *Capsicum frutescens*, *Capsicum annum*, *Curcuma domestica* and *Piper longum* to give food colour. The main purpose of *Curcuma domestica* is to colour the white "wot" or "Alicha wot". Wot is a thick soup that is typically very spicy and is eaten with Enjera. A type of grain-based unleavened

bread known as "Enjera" exists. Teff, or *Eragrostis tef* which is used to make the best Enjera. However "teff" is quite pricey, "Enjera" of lower quality is frequently made from maize, sorghum, barley, wheat, or a combination of grains. Enjera is frequently consumed cold, torn into pieces and dipped in "Wot". Two types of "wot" are typically recognized in the communities. The first one ('kai-wot' = red, pungent 'wot') is made with Capsicum pepper ('berbere') as the primary spice, while the second ('alicha wot' = non-pungent 'wot') is made without Capsicum pepper. Except for *Curcuma domestica*, the other species *Piper longum*, *Capsicum frutescens* and *Capsicum annum* which were used as colouring and flavouring agents in meat soups (siga wot, chicken wot, misir wot), pulses (kik wot, pea wot and shiro wot) and other spicy foods.

One of the most useful significant indices for assessing the cultural significance of plant species is the culturally important index (Reyes-García *et al*., 2006). It helps assess CI differences between species of spice and condiment plants in different use categories. The literature frequently uses the terms "cultural importance" and "relative importance" to describe the significance of specific plants to a given culture (Albuquerque *et al*., 2005). The cultural importance index (CI) clarifies not only the distribution of uses (number of informants) for each species but also its value (Tardio and Santayana, 2008). It is reasonable to assume that the CI index is a useful tool for identifying species that strongly agree with the survey culture and for identifying the common knowledge of the people. *Allium sativum* was ranked as the most significant plant in the current study out of the relevant species that were chosen. Given that it can be used as both a flavour and a seasoning, it has more reports of use than other species, which might account for why it has the highest average cultural importance. Moreover, the plant is serving as a starter for every recipe. Similarly, the mean cultural importance index placed *Capsicum frutescens*, *Piper longum*, *Capsicum annum* and *Allium cepa* in the second, third, fourth and fifth positions (mCI). The cultural importance indices for *Carum carvi* and *Rosmarinus officinalis* are extremely low.

Ethiopian cookery relies heavily on spices. Peoples enjoy bread, butter, meat, bone broth and spiced vegetables. Numerous spices are thought to originate in Ethiopia, including fenugreek, cardamom, cinnamon, sage, long red pepper, black cumin, white cumin/bishop's plant, cilantro, turmeric and ginger (ITC, 2010). Spices were sold separately or in a mixture with other spices. Throughout the year, all markets were typically remarkably well stocked with both domestic and foreign spices. The majority of spices grown in home gardens were interplant with crops like enset, coffee, pulses, maize, sorghum and others and harvested at different times, which is beneficial for agroecology, conservation and agroecosystems (Agize, 2014).

In addition to being added or mixed into the main dishes, spices and condiments are prepared by milling, pounding, smashing and cooking. The main meals are Enjera, Kita (unleavened bread) and bread. The spices were used in their fresh, dried and powdered forms in the main dishes before while cooking.

In terms of medicine, spices lower cholesterol, treat diabetes, reduce inflammation, ease arthritic pain, fight cancer and act as antioxidants (Wendimu *et al*., 2021). Additionally, it has been claimed that a natural pesticide made of spices like chili peppers exists (Wendimu and Tekalign, 2020). Nearly 6000 plant species with widespread therapeutic applications are thought to exist in Africa (Shewamene *et al*., 2017). To meet their basic medical needs and about 80% of country residents still use un-processed medicinal plants (Wendimu *et al*., 2021; Hostettmann and Marston, 2002; Abebe *et al*., 2001). Although spices have a variety of uses, claim that the research and extension activities were very unsatisfactory. As a result, producers are not knowledgeable about the cultivation, processing, storage and marketing of spices. Traditional farming methods were used and the yield was typically very low. Similarly to that, there are no systematic efforts made to manage the marketing system. Individual preferences govern spice prices rather than market factors like supply, demand and price information. Individual decisions regarding the marketing of spices result in a market that is both inefficient and ineffective. As a result, farmers are not receiving the expected benefits from this industry. Therefore, the system needs to undergo a fundamental adjustment to fully utilize the benefits of these neglected crops.

Masresha (2010) cites several issues as challenges for the production of spices, including inadequate post-harvest handling practices, post-harvest wastage, a lack of high yielding varieties, a lack of private commercial investors, the need for improved spice agricultural research in existing and new and locally adaptable varieties that offer opportunities for increased yield and

poor quality of final output. In addition to poor and fake seeds sold by dishonest traders, diseases like Fusarium wilt, Blight, Powdery mildew, downy mildew, leaf spot, root rot, damping off, rust, stem gal and grain mold are the main factors in the overall decline in productivity and quality of the production system. For poor households to be able to meet their basic needs, the socio-economic importance of income from the sale of spice crops is crucial. Smallholders have limited opportunities to participate in supply chains and actively promote establishing links between businesses. The most common limitations are those resulting from market deficiencies in terms of finances, information and access (FAO, 2011). Therefore, spice marketable supply was found to be adversely affected by low average output price (Mekdes *et al*, 2017) and spice and spice-related product production, processing and marketing are relatively small-scale business operations (ACP, 2010). Spices marketing was impacted by issues with adulteration, quality, capital constraints, demand issues, a lack of government support, a lack of supply, transportation issues, theft issues and a lack of government regulation of unlicensed traders (Mekdes *et al.*, 2017). Lack of access to safe drinking water and appropriate waste disposal facilities could jeopardize sanitation and consequently, product safety (Melanie and Michael, 2011). Inadequate market information systems, farmers' limited bargaining power, oligopolistic market structures, adulteration, natural quality, capital shortages, demand, government support, supply shortages, access to credit, farmers' reluctance to sell, administrative issues, competition with licensed traders, road, theft, competition with licensed and unlicensed traders, storage, telephone services, information flow and health are all factors that affect the marketing of spices (Abay, 2010; Rehima, 2006).

Conclusions

The present study identified the flavouring, seasoning, colouring and culinary uses of spice and condiment plants in traditional beverages and foods. A total of about 29 different plant species from 14 different families were identified in the two Boditi and Bedessa markets. Lamiaceae, Apiaceae and Zingiberaceae were widely used in two of the communities. Brassicaceae, Piperaceae, Fabaceae and Cannabaceae were the most prevalent families employed by the Boditi community, while the Boditi and Bedessa market communities in commonly used Asteraceae, Apiaceae, Zingiberaceae, Lamiaceae, Solanaceae, Amaryllidaceae, Verbenaceae, Myrtaceae, Poaceae and Rutaceaes for their respective sizes. In contrast to shrubs and climbers, fresh leafy herbaceous plants were preferred for use. Along with adding or mixing to the main dishes, milling, pounding, smashing and cooking were methods used to prepare spices and condiments for dishes. Some of the crops under study also have marketable qualities that offer the possibility of additional household income in addition to their nutritional and therapeutic benefits. Agricultural land expansion, excessive harvesting, excessive grazing and the collection of fuel wood were among the common threats to spice crops, according to the locals.

Limitations of the study. This study only covered a portion of the Wolaita zone, Ethiopia. There is a suggestion to conduct the same study throughout the country.

Ethics approval. The International Society of Ethnobiology Code of Ethics was applied to this research to ensure that the methods used to collect ethnobiological data were ethical. All study participants provided oral and written informed consent before this and approvals from an ethical committee were needed.

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Conflict of Interest. The author declare that they have no conflict of interest.

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