



## **Ethnobotanical Survey and Preliminary Phytochemical Studies of Plants Traditionally Used for Diabetes in Eritrea**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Authors MSD and BGN carried out the Survey. Authors MSD, KPG and KJM drafted the manuscript and participated in the phytochemical analysis. All authors involved in the research concept, data analysis and review of the manuscript read and approved the final manuscript.*

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### **ABSTRACT**

**Aims:** Identify and document medicinal plants used for the treatment of diabetes mellitus. Investigate the secondary metabolites present in those plants.

**Study Design:** A questionnaire was employed for the survey and different chemicals and reagents were used for phytochemical screening.

**Place and Duration of Study:** Ethnobotanical surveys were conducted between November 2013 and April 2014 in certain localities of Central and Southern Zones of Eritrea and the phytochemical screening was conducted in September 2014 in Kenya.

**Methodology:** The ethnobotanical data was collected by interviewing 66 informants using a questionnaire; the majority of informants were herbalist and individuals living with diabetes. The phytochemical screening was done using wet chemical analysis.

**Results:** The survey showed 42 different medicinal plants used for the treatment of diabetes. The

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plants fall into 24 families where by Apiacea (14.29%), Lamiaceae (9.52%), Fabaceae (9.52%) and Asteraceae (7.14%) were the most dominant. The most frequently used plant part was the leaf (42%). The phytochemical screening confirmed the presence of alkaloids, phenols, saponins, glycosides, and other bioactive secondary metabolites.

**Conclusion:** This study revealed that the use of medicinal plants can be of great help in intervention of the burdens for the treatment of diabetes.

**Keywords:** Ethnobotany; diabetes mellitus; phytochemical; herbalist; Eritrea.

## 1. INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both [1]. The chronic hyperglycemia of diabetes is associated with long term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, blood vessels and reproductive organs [2,3]. Diabetes symptoms include frequent urination, increased thirst and hunger, blurred vision, weight loss and fatigue [4].

From the prevalence data reported by WHO, diabetes is becoming a global health burden. It is estimated that there were 381.8 million people with diabetes in 2013 with a projected increase of 55% to 591.9 million by 2035 [5,6]. Diabetes has a major economic impact, especially in low and middle income countries and thus has far-reaching implications to control it as the prevalence continues to rise [7].

In Eritrea, the prevalence of diabetes mellitus of the population ages 20 to 79 in the year 2013 was 3.41% with a global rank of 171 [8]. However, there are a number of cases of diabetes in adults that are undiagnosed because of lack of unawareness and access for diagnosis [9]. This increasing trend in diabetes can be a challenge with regards to the existing socioeconomic status of the population.

In modern medicine, there has been no satisfactory therapy to cure diabetes mellitus. Though insulin therapy is used for the management of diabetes mellitus it still has several drawbacks [10,11]. In recent years, there has been renewed interest in plant medicine for diabetes and thus the demand for the use of plant products has been increasing [12]. The relatively high cost, low availability, and undesirable side effects of synthetic drugs have brought an interest for preference of

hypoglycemic drugs of plants origin, which are believed to be suitable for chronic treatments [13].

Ethnobotanical survey is today recognized as the most viable method of identifying new medicinal plants with bioactive constituents for various ailments [14]. The method is reported to show greater percentage yield of bioactive useful medicinal compounds over other methods of random selection and screening [15]. So far, several survey and investigations have been conducted and many plants have been documented and shown positive activities for diabetes [16]. In Eritrea, even though some efforts were made to document the ethnomedicinal information regarding medicinal plants, there has been no comprehensive scientific research done to assess and validate the biological activities of those plants. This study is thus aimed to identify and document medicinal plants traditionally used in Central and Southern Zones of Eritrea for the treatment of diabetes mellitus.

## 2. MATERIALS AND METHODS

### 2.1 The Study Area

Eritrea has six administrative Zones; the Central Zone (Zoba Maekel) and Southern Zone (Zoba Debub) were selected for the ethnobotanical survey. Central Zone is the smallest region in the country, and contains the major city and national capital, Asmara; the area of Central Zone lies between 15°10' – 15°35'N latitude and 38°41'-39°30'E longitude with an average elevation of 2,343 meters. The Southern Zone lies along a portion of the national border with Ethiopia 14°25'-15°10' N latitude and 38°15'-39°-45' E longitude and it has an elevation of 1915 meters above sea level. Fig. 1 shows the geography of Eritrea and the areas (zones) where the ethnobotanical survey and plant collection was made.

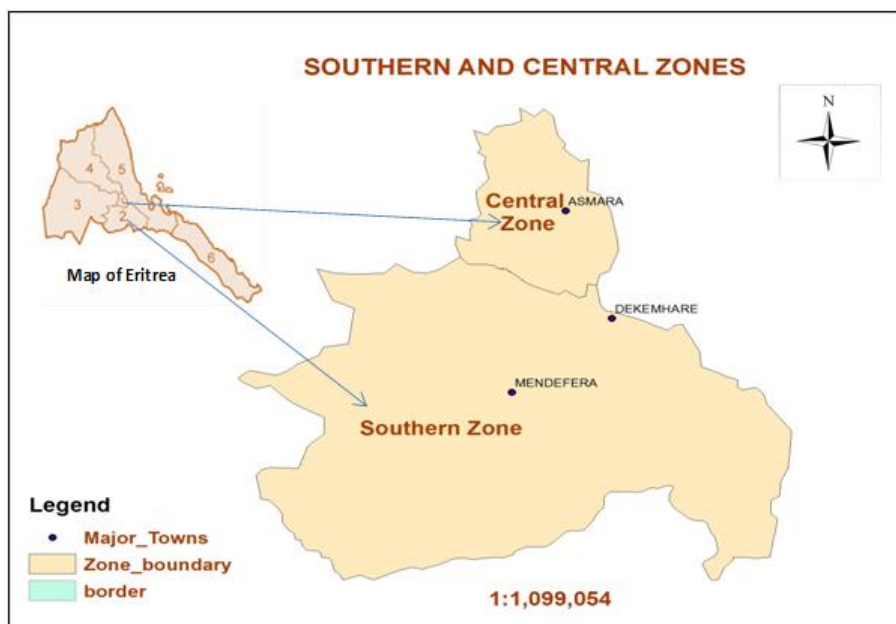


Fig. 1. Map of Eritea and the study areas (Central and Northern Zones)

## 2.2 Collection of Information and Plants

The ethnobotanical surveys were carried out from November 2013 to April 2014, in the selected localities of the two zones, using semi structured questionnaire with about 66 informants. Prior to the use of the questionnaire, conversations with the informants were held with the assistance of community administrators in order to explain the objectives of the study and to build on trust with the relevance of documenting and preserving the indigenous knowledge. The informants were majority traditional healers (herbalists), and individuals living with diabetes. The data collected included local names of the plants, plant parts' used, methods of herbal preparation and administration.

Based on the frequency of their use and wider application, 11 plants were chosen for preliminary phytochemical screening. Majority of the plants of interest were collected during the field trips and some from market areas guided by the herbalists. The plants were identified by their vernacular names, and later validated by a plant taxonomist of Eritrea Institute of Technology (EIT), Prof. Ghebrehiwet Medhanie. Voucher specimens were also prepared and deposited in the herbarium of EIT.

## 2.3 Preliminary Phytochemical Analysis

The plants were dried under the shade for more than two months and the dried plant parts were crushed and then blended using an electrical blender. The powdered plants were stored in sealed plastic containers and thus kept for extraction and further studies.

Three different extracts were prepared for each plant using hexane, methanol and water. The hexane and methanol extracts were prepared as follows: A 10 g portion of the powdered plants were macerated into 100 ml of solvent for 7 days with occasional stirring where by the mouth of the flasks were covered with aluminum foil. The extracts were filtered through Whatman No. 1 filter paper and concentrated under reduced pressure at about 40°C using a rotary evaporator. The aqueous extracts were prepared by soaking 10 g of the powered plants in 100 mL of distilled water for 48 hours in conical flasks. The contents of the flasks were filtered with Whatman No. 1 filter paper and the filtrates were concentrated using water bath at about 40-50°C. After extraction, the extracts were immediately subjected to preliminary phytochemical studies to screen for the presence of bioactive metabolites like alkaloids, saponins, phenols, steroids, tannins, terpenoids, flavonoids, coumarines, glycosides and others by using standard protocols [17-19].

### 3. RESULTS AND DISCUSSION

The ethnobotanical survey was conducted in Central and Southern Zones of Eritrea; the two Zones were chosen on their ease of access and greater number of traditional medical practitioners reported from previous survey [18]. The geography of Eritrea and the two Zones are shown in Fig. 1. The 66 informants of different sex and age (Fig. 2), shared relevant information and the data recorded using the questionnaires was entered into excel worksheet and analyzed using SPSS. During the survey, a total of 42 antidiabetic plant species belonging to 24 families were recorded among the peoples of the two zones (Table 1). According to the survey data shown in Fig. 3, the dominant families include Apiacea (14.29%), Lamiaceae (9.52%), Fabaceae (9.52%) and Asteraceae (7.14%).

Different plant parts were employed for the preparation of the herbal drugs; leaf (42%), stem bark (21%) and seed (14%) were the most commonly used plant parts in the herbal preparations for diabetes (Fig. 4). Moreover, the methods of herbal preparation and administration for diabetes were documented (Table 2). The commonest methods of herbal preparation were maceration, decoction, and infusion.

Apart their uses for diabetes, most of the plants were used for the treatment of different ailments. The common ailments treated by these plants and their frequency of citation are as follows: diarrhea [12], hypertension [12], diuretics [11], malaria [10], gastrointestinal problems [10], wound healing [9], anthelmintic [8], bronchitis [9], asthma [8] and skin problems [7] (Table 2).

Even though the practices of herbal medicinal practices for bacterial and fungal diseases were common among the different population of Eritrea, the knowledge of herbs for diabetes and other cardiovascular diseases has not been as such prominent. Work is in progress on the pharmacological validation, toxicity studies and characterization of some of these plants.

Some of the plants were predominantly cited with higher frequency than the others. These include *Meriandra dianthera*, *Trigonella foenum-graceum*, *Aloe camperi*, and *Allium sativum*. Most of the antidiabetic plants recorded from the survey were also reported in the scientific literatures to have either direct or indirect effect on diabetes. However, some of the anti-diabetic plants like *Meriandra dianthera*, *Aloe camperi*, *Psiada punctualata*, *Steganotaenia araliaceae* and *Otostegia integrifolia* have not yet been reported to have antidiabetic activity in the literature survey.

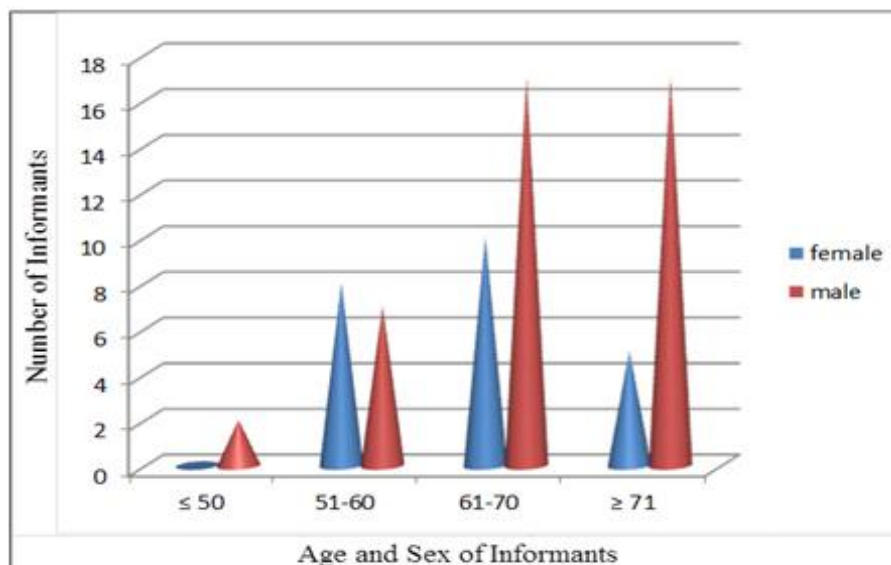


Fig. 2. Number of informants involved in the survey vs their age

From the ethnobotanical survey, some polyherbal combinations used for the treatment of diabetes include:

1. The dried and powdered seeds of *Lepidium sativum*, *Brassica nigra* and *Nigella sativa* are mixed in equal proportion and thus macerated in water overnight, filtered and the filtrate is drunk twice a day until the patients gets better.
2. Three teaspoon of *Nigella sativa*, a teaspoon of *Trachyspermum ammi* and seven pieces of the seeds of *Acacia*

*nilotica* were pounded together and immersed in water for few hours, the filtrate of the mixture is drunk every morning before breakfast.

As shown in Table 3, the preliminary phytochemical analysis of the methanol and aqueous extracts confirmed that most of the antidiabetic plants contain alkaloids, saponins, phenols, steroids, flavonoids, glycosides, etc. The hexane extracts did not show the presence of the common bioactive metabolites.

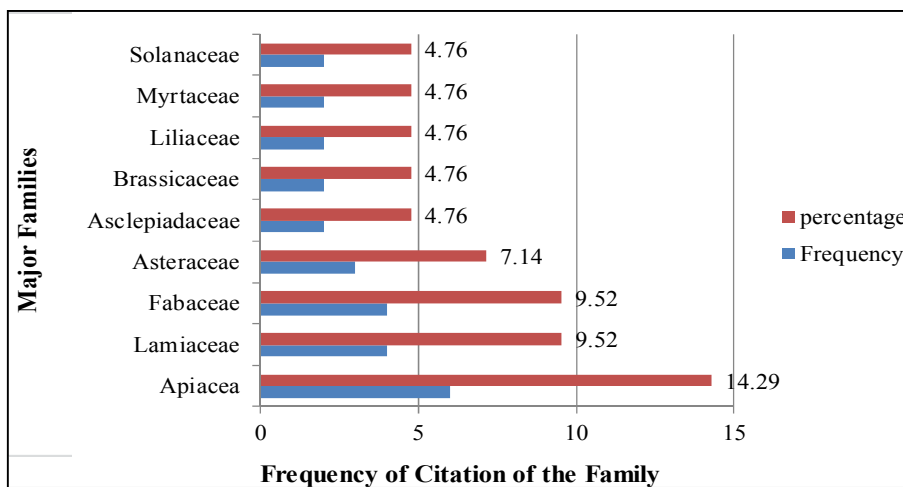


Fig. 3. The frequency of citation of the major families

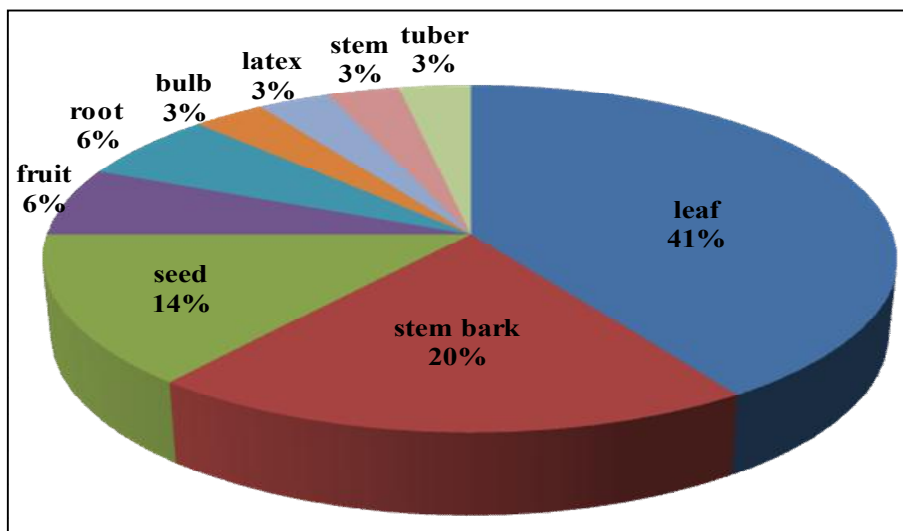


Fig. 4. Frequency of plant's parts used for the treatment of diabetes

**Table 1. List of antidiabetic plants used in Central and Southern Zones of Eritrea**

<b>Scientific name</b>	<b>Family</b>	<b>Vernacular name</b>	<b>Common / English name</b>	<b>Plant Part/s used</b>	<b>Frequency citation</b>
<i>Acacia nilotica</i> (L.)	Fabaceae	Ghered	Gum Arabica	seed, stem bark	3
<i>Allium cepa</i> L.	Liliaceae	Shiguerti-keyih	Onion	bulb	6
<i>Allium sativum</i> L.	Liliaceae	Shiguerti-tsaeda	Garlic	bulb	15
<i>Aloe camperi</i> Schweinfurth	Aloaceae	Sandai-ere	Aloe	leaf, latex	8
<i>Ammi visnaga</i> (L.) Lam.	Apiacea	E'bna	Khella/Picktooth	leaf	2
<i>Anethum graveolens</i> Linn	Apiacea	Shilan-maedo	Dill	leaf	2
<i>Azadirachta indica</i> A. Juss.	Meliaceae	Neem	Neem	leaf, stem bark	6
<i>Balanites aegyptica</i> (L.) Del.	Balanitaceae	Mekie	Desert Date	leaf, fruit	4
<i>Brassica nigra</i> Koch.	Brassicaceae	Adri	Black Mustard	seed	5
<i>Calotropis procera</i> (Ait.)	Asclepiadaceae	Ghinde'a	Sodom Apple	stem bark, latex	3
<i>Capparis decidua</i> (Forssk.)	Caparidiacea	Sorob	Caper Berry	stem bark, leaf	3
<i>Carica papaya</i> L.	Caricaceae	Papayo	Papaya	leaf, seed	4
<i>Carissa edulis</i> (Forssk)	Apocynaceae	Agam	Num-num	stem bark	2
<i>Cichorium endivia</i> L.	Asteraceae	Shikoria	Succory	leaf	4
<i>Clerodendrum myricoides</i> (Hochst)	Lamiaceae	Sur-betri	Ugandense	stem bark, leaf	2
<i>Clutia lanceolata</i> (Forssk)	Euphorbiaceae	Tish-belalito	Cerra Cipapau Apple	leaf	1
<i>Daucus carota</i> L.	Apiacea	Caroti	Carrot	tuber	4
<i>Entada abyssinica</i> Steud. ex A.	Fabaceae	Halke	Tree entanda	stem bark, leaf	1
<i>Eucalptus globulus</i> (Labill.)	Myrtaceae	Tsaeda-kelamintos	Eucalyptus	leaf	5
<i>Ferula communis</i> L.	Apiacea	Diog	Giant fennel	seed, leaf	3
<i>Gymnema sylvestre</i> Roxb.	Asclepiadaceae	Shankuk	Australian Cow Plant	leaf	2
<i>Kigelia africana</i> (Lam.) Benth.	Bignoniaceae	Mederba/Zelzale	Sausage Tree	fruit	1

Continued (Table 1)

Scientific name	Family	Vernacular name	Common/english name	Plant Part/s used	Frequency citation
<i>Lepidium sativum</i> L.	Brassicaceae	Shinfae	Garden Cress	seed	6
<i>Mangifera indica</i> L.	Anacardiaceae	Mangus	Mango	leaf, stem bark	3
<i>Meriandra dianthera</i> (Roth) Briq.	Lamiaceae	Nehiba/Mezeguf	-	leaf	11
<i>Moringa oleifera</i> Lam.	Moringaceae	Moringa	Horseradish Tree	leaf	4
<i>Nigella sativa</i> L.	Ranunculaceae	Abosoda	Black Cumin	seed	5
<i>Otostegia integrifolia</i> Benth.	Lamiaceae	Ch'endog	-	leaf	3
<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Aftooh	Leadwort	root, stem	3
<i>Psiada punctulata</i> (DC.) Vatke	Asteraceae	Tsehaiferhet	-	leaf, root	2
<i>Psidium guajava</i> L.	Myrtaceae	Zeitun	Guava	leaf	3
<i>Rosmarinus officianilis</i> L.	Lamiaceae	Azmarino	Rosemary	leaf, stem	4
<i>Solanum incanum</i> L.	Solanaceae	Uengule	Poison Berry	fruit	2
<i>Steganotaenia araliacea</i> Hochst.	Apiaceae	Mewets denagl	Carrot Tree	leaf, seed	2
<i>Tamarindus indica</i> L.	Fabaceae	Humer	Tamarind Tree	fruit	3
<i>Terminalia brownii</i> Fresen	Combretaceae	Weiba	Terminalia	stem bark, leaf	2
<i>Trachyspermum ammi</i> (L.)	Apiaceae	Kamun/Tsakida	Bishop's Weed	seed	5
<i>Trigonella foenum-graecum</i> L.	Fabaceae	Abe'ake	Fenugreek	seed	9
<i>Vernonia amygdalina</i> Del.	Asteraceae	Grawa	Bitter Leaves	leaf, stem bark	2
<i>Withania somnifera</i> (L.)	Solanaceae	Agol	Winter Cherry	root, leaf	2
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Zingible	Ginger	root	3
<i>Zizyphus spina-christi</i> (L.)	Rhamnaceae	Gaba	Christ's Thorn Jujube	leaf	2

**Table 2. Methods of herbal preparations for the treatment of diabetes and other ailments treated by the antidiabetic plants**

<b>Medicinal plant</b>	<b>Method of preparation and/or administration</b>	<b>Other ethnomedicinal uses of the plant</b>
<i>Accacia nilotica</i>	Decoction of the seed or bark is used regularly	Malaria, cough, diarrhoea, dysentery, insect repellent
<i>Allium cepa</i>	Freshly cut bulb is often used	Antipyretic, gastrointestinal disorders, antiseptic, anthelmintic
<i>Allium sativum</i>	Fresh bulb is eaten raw or added in sauce	Asthma, antiseptic, diuretic, hypertension, expectorant,
<i>Aloe camperi</i>	Extract of the latex or leaf is used regularly	Skin burns, dandruff, stomach pain, hypertension, hair fall
<i>Ammi visnaga</i>	Leaf extract is used in the morning	Diuretic, hypotensive, hair-care, antispasmodic, asthma
<i>Anethum graveolens</i>	Tea of the leaves is taken twice daily	Diarrhea, eye problems, indigestion, stomachache , antispasmodic
<i>Azardicha indica</i>	Leaf or bark decoction used for drinking	Insect repellent, malaria, skin diseases, anthelmintic, diuretic
<i>Balanites aegyptica</i>	Leaf extract or ripe fruit is taken	Purgative, insecticidal, laxative, diarrhoea, stomach aches
<i>Brassica nigra</i>	Seed decoction is used regularly	Gastrointestinal disorder, stimulant, diuretic, bronchitis
<i>Calotropis procera</i>	Crushed bark or latex are mixed with butter	Skin diseases, anthelmintic, expectorant, wounds, diarrhoea
<i>Capparis decidua</i>	Infusion of stem bark or leaf is used	Tooth ache, cough, arthritis, anthelmintic, malaria, inflammation
<i>Carica papaya</i>	Decoction of seed or leaf is drunk 1 beaker in the morning	Amoebicide, hypertension, constipation, expel worms, laxative
<i>Carissa edulis</i>	Extract of stem bark is drunk regularly	Anthelmintic, inflammation, hypotensive, diuretics, headache
<i>Cichorium endive</i>	Cooked properly and eaten with enjera	Appetizer, febrifuge, anti-allergic
<i>Clerodendrum myricoides</i>	Leaf or stem bark extract is drunk regularly	Abdominal pains, snake bites, hemorrhoids, eye disease
<i>Clutia lanceolata</i>	Leaf extract is taken twice a day	Malaria, diarrhea, colds, gynecological problems
<i>Daucus carota</i>	Tuber is eaten in raw or with salad	Diuretic, inflammation, leprosy, worms troubles
<i>Entada abyssinica</i>	Decoction of the stem bark or leaf	Gastrointestinal problems, cold, candidiasis
<i>Eucalyptus globulus</i>	Leaf extract is taken 1 cup per day	Insect repellent, tuberculosis, bronchitis, malaria, skin diseases
<i>Ferrula communis</i>	Decoction of fresh leaf or dried seed	Antispasmodic, diarrhea, expectorant ,dermatitis
<i>Gymnema sylvestre</i>	Leaf extract is taken daily	Cough, inflammations, constipation, haemorrhoids, bronchitis
<i>Kigelia Africana</i>	Fruits are eaten	Constipation, tapeworm, dysentery, gynecological disorders
<i>Lepidium sativum</i>	The seed extract is taken before bed	Diuretic, cough, laxative, asthma, diarrhea, malaria
<i>Mangifera indica</i>	Decoction of leaf or stem bark is used regularly	Diuretic, diarrhea, dysentery, anemia, bronchitis, hypertension
<i>Meriandra dianthera</i>	Extract of the leaf is taken 1 cup daily	Hypertension, gastritis, bronchial asthma, purgative, diarrhea
<i>Moringa oleifera</i>	Fresh leaf juice taken every morning in empty stomach	Asthma, constipation, skin diseases, diarrhea, stomach pain, hypertension



Table 2 (Continued)

Medicinal plant	Method of preparation and/or administration	Other ethnomedicinal uses of the plant
<i>Nigella sativa</i>	Seeds added in bread or a spoon of powdered seeds taken orally before meal	Asthma, anthelmintic, dysentery, hypertension, gastrointestinal problems
<i>Otostegia integrifolia</i>	Extract of the leaves taken in the evening	Gynecological problems, inflammation, insecticidal, antioxidant
<i>Plumbago zeylanica</i>	Decoction of stem or roots used trice a day	Stimulant, abortifacient, inflammation, bronchitis, itching
<i>Psiada punctualata</i>	Decoction of the leaves or roots is used	Cough, anti-abortion, asthma
<i>Psidium quajava</i>	Decoction of the leaves is used regularly	Wounds, ulcers, bronchitis, dysentery, antiseptic, antispasmodic
<i>Rosmarinus officianilis</i>	A spoon of leaf or stem is added in daily food	Stomach pains, gynecological problems, bad breath, migraine
<i>Solanum incanum</i>	Fruits boiled in hot water or mixed with yogurt	Expectorant, stomach ache, fever, snake bite, bronchitis
<i>Steganotaenia araliacea</i>	Decoction of either leaf or seed mixed with milk is taken in the morning	Sore-throat, ulcer, diuretic, stomach ache, dysentery, hypotensive
<i>Tamarindus indica</i>	Extract of the fruit is taken twice a day	Malaria, fever, stomach ache, wounds, purgative
<i>Terminalia brownie</i>	Decoction of the stem bark or leaf	Wounds, malaria, dermatitis, tuberculosis
<i>Trachyspermum ammi</i>	Seed powder is soaked in water or milk	Hypertension, diarrhea, asthma, anthelmintic, diuretic
<i>Trigonella foenum-graceum</i>	Extract of the dried and powered seed used regularly	Diuretic, antipyretic, stomachic, anemia, hypertension, gastrointestinal pains
<i>Vernonia amygdalina</i>	The extract of fresh leaves in water is used	Stomach ache, skin infections, tooth ache, cough, malaria,
<i>Withania somnifera</i>	Roots are immersed in hot water and the juice of the leaves	Constipation, skin infection, rheumatism
<i>Zingiber officinale</i>	Tea of the rhizome frequently used	Digestive disorders, stimulant, bronchitis, throat infections
<i>Ziziphus spina-christi</i>	Infusion of the leaves used regularly	Diarrhea, dandruff, skin infections, bronchitis, malaria

Table 3. Preliminary phytochemical screening of the selected antidiabetic plants

Medicinal plant	Solvent	Phytochemicals											
		alkaloids	saponins	Steroids	phenols	tannis	flavonoids	resins	glycosides	carbohydrate	proteins	Coumarines	terpenoids
<i>Accacia nilotica</i>	Methanol	+	+	+	+	+	+	+	+	+	-	+	
	Hexane	-	+	-	-	-	-	-	-	-	+	+	
	Aqueous	+	-	+	+	+	+	-	+	-	+	+	
<i>Aloe camperi</i>	Methanol	-	+	+	+	+	-	+	+	+	+	+	
	Hexane	-	+	+	-	-	-	-	-	-	+	+	
	Aqueous	+	-	+	+	+	+	+	+	-	+	+	

Medicinal plant	Solvent	alkaloids	saponins	Steroids	phenols	tannis	flavonoids	resins	glycosides	carbohydrate	proteins	Coumarines	terpenoids
<i>Azadirachta indica</i>	Methanol	+	+	+	+	+	+	-	+	+	+	-	+
	Hexane	-	+	-	-	-	-	-	-	-	-	+	-
	Aqueous	+	+	+	+	+	+	+	+	+	+	+	+
<i>Balanites aegyptica</i>	Methanol	-	+	+	+	+	-	+	+	+	+	-	-
	Hexane	-	+	-	-	-	-	-	-	-	-	-	-
	Aqueous	+	+	+	+	+	+	+	+	+	+	+	+
<i>Brassica Nigra</i>	Methanol	+	-	+	+	+	+	-	+	+	-	+	-
	Hexane	-	+	+	-	-	-	-	-	-	-	-	+
	Aqueous	+	-	-	-	+	+	-	+	-	-	+	-
<i>Eucalyptus globulus</i>	Methanol	+	-	+	+	+	-	+	-	+	-	+	-
	Hexane	-	+	-	-	-	-	-	-	-	-	-	-
	Aqueous	+	+	+	+	+	+	+	+	+	+	+	+
<i>Lepidium sativum</i>	Methanol	+	+	+	+	+	+	+	+	-	+	+	+
	Hexane	-	-	-	-	-	+	-	-	-	-	-	-
	Aqueous												
<i>Meriandra dianthera</i>	Methanol	-	+	+	+	+	-	+	+	+	+	-	-
	Hexane	-	-	+	-	-	-	-	-	-	-	+	+
	Aqueous	+	+	+	-	+	+	+	+	+	-	+	+
<i>Nigella sativa</i>	Methanol	+	-	+	+	+	+	+	+	+	+	-	-
	Hexane	-	-	-	+	-	-	-	-	-	-	-	-
	Aqueous	+	+	+	+	-	-	-	+	+	+	-	-
<i>Trachyspermum ammi</i>	Methanol	+	+	+	+	+	+	+	+	+	+	+	+
	Hexane	-	-	-	-	-	-	-	-	-	-	-	-
	Aqueous	+	-	+	+	+	+	-	+	+	-	+	+
<i>Trigonella foenum-graceum</i>	Methanol	+	+	+	+	+	+	-	+	+	+	-	-
	Hexane	-	-	-	+	-	-	-	-	-	-	-	-
	Aqueous	+	+	+	+	+	+	-	+	+	+	-	+

+ = presence; - = absence

#### 4. CONCLUSION

The new estimates of diabetes in adults confirm the large burden of diabetes, especially in developing countries like Eritrea. This study has revealed the use of medicinal plants for diabetes as they play a major role in the primary health care of the people of these zones. The available data regarding the antidiabetic activity of the plants is not adequate enough to evaluate or endorse their use. Pharmacological studies are thus required to provide suggestion for a safe and effective use of the identified plants in the treatment of diabetes. Moreover, majority of the informants were above 60; it has been illustrated that they are dying without transferring the indigenous knowledge of plants to others. Thus, it demands extra and extensive ethnobotanical survey in Eritrea in order to document the traditional medical practices.

#### CONSENT

It is not applicable.

#### ETHICAL APPROVAL

It is not applicable.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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