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A review on the ethnobotanical study of medicinal plants used for the treatment of gonorrhea disease in Ethiopia

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This review literature aimed to compile and document the ethnobotanical knowledge of medicinal plants used for the treatment of gonorrhea problem in Ethiopia. A total of 48 published and unpublished ethnobotanical studies meeting specific inclusion criteria were used to assess the ethnobotanical study of medicinal plants used for the treatment of gonorrhea in Ethiopia. Ethnobotanical literature data was entered in an Excel spreadsheet and analyzed using SPSS statistical software used to summarize relevant ethnobotanical information using descriptive statistics, frequency, percentage, tables, bar graphs and pie charts. A total of 100 anti-gonorrhea plants belonged to 80 genera and 46 families was compiled in this review. Families Euphorbiaceae (13 species), Cucurbitaceae (9 species) and Solanaceae (8 species) were found to be represented by the highest number of anti-gonorrhea medicinal plant species. A higher diversity of anti-gonorrhea plants was reported from south and southwestern parts Ethiopia. Herbs represented 48 % of species followed by shrubs (26 %), trees (17 %) and climbers (9 %). Root were the most commonly used medicinal plant parts, it accounts 42 % followed by leaves (9 %), Latex (5 %) and stem (3 %). 39 % of the plant medicines were prepared from fresh plant parts, followed by dried (9 %) and the remaining 26 % from both fresh and dried parts. The majority of anti-gonorrhea plants were collected from wild habitat (63 %), followed by homegarden (16 %) and the remaining 21 % were collected from both homegarden and wild. Advanced phytochemical analysis is required to validate the therapeutic potential of anti-gonorrhea compounds from promising plant species.

Key words: Ethiopia, Ethnobotany, Gonorrhea diseases, Medicinal plants.

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Introduction

Ethiopia has a long history of traditional medicine practice to combat different human diseases. In Ethiopia around 800 plant species are used to treat nearly 300 mental and physical disorders in ethiopia[1]. Approximately 80 % of the populations use traditional medicine due to the cultural acceptability of healers and local pharmacopeias, the relatively low cost and difficult access to modern health facilities[2-4].

Sexually transmitted infections (STIs) are illnesses that have a high probability of transmission between humans through human sexual behavior, including vaginal intercourse, oral sex, and anal sex. Gonorrhea and Syphilis are among the common Sexually transmitted infections/diseases occurring throughout the world[5,6]. In Ethiopia the prevalence of these diseases typically gonorrhea is in alarming situation due to the rapid spread of the diseases, high cost of treatment and the increased risk of transmission. More than 340 million new cases of curable sexually transmitted infections occur worldwide every year[7]. Gonorrhea is one of sexually transmitted disease caused by the bacteria called *Neisseria gonorrhoeae.* Humans are the only natural host and it is one of the most common infections in developing countries[8]. According to WHO reports, around 42 million new case of *N. gonorrhoeae* was investigated among adults incidence in the world[9]. Therefore, majority of the rural communities use different types of medicinal plants to manage the gonorrheal problem in different parts of the country and worldwide.

Herbal medicines provide rational means for the treatment of many sexually transmitted infections. The herbal medicines is preferred by numerous population for the treatment of sexually transmitted diseases notably Gonorrhea diseases by having many advantages like no side effects, better patient tolerance and relatively less expensive. Indigenous herbal healers have practiced in similar direction since the ancient time. Furthermore the acceptability of herbal medicines are greater to control these

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infections due to the social stigma associated with them and in case of women it is much more acceptable to discuss their problem with the herbal medical practitioners[10],[11]. Therefore, the aim this review is to document the ethnobotanical knowledge of medicinal plants used to treat Gonorrheal disease and associated indigenous knowledge for better scientific approaches in the future in Ethiopia.

Materials and Methods

Data retrieval

The traditional uses of medicinal plants used for the management of Gonorrhea problem in Ethiopia were collected from different research literature conducted in different part of Ethiopia starting from May to July, 2017. The published and unpublished MSc and PhD ethnobotanical literature data were used to assess the ethnobotanical study of medicinal plants used for the treatment of gonorrhea problem in Ethiopia.

The published literature was search on journal articles using international scientific databases such as MEDLINE, Science Direct, Scopus, Google Scholar, PubMed, Web of Science, AJOL, Research Gate, etc.

Literatures were searched on databases comprising information on medicinal plants used for the management of Gonorrhea problem were browsed using the following main search terms: 'Gonorrhea/Anti-gonorrhea', 'Anti-gonorrhea plants in Ethiopia', 'Medicinal plant in Ethiopia', 'Ethnobotanical study of medicinal plants', Ethnomedicinal study in Northern/ Southern/ Western and Eastern Ethiopia, 'Traditional knowledge and Traditional medicinal plants in Ethiopia', Ethnopharmaceutical and Ethnopharmacology.

Data on Ethnobotanical study of medicinal plants used for management of gonorrhea problem collected from the web based literatures were included the scientific and local names, habit of the plant, medicinal parts used, mode of preparation and route of administration of the species as well as specific region/districts utilizing the medicinal plants was gathered and compiled after assessing all available ethnobotanical documents in Ethiopian. Literature search was also done to document the pharmacological activities of the documented plant species.

Inclusion and exclusion criteria

The published and unpublished ethno-botanical literature surveys reporting on anti-gonorrhea plants conducted at any time period in Ethiopia were used as inclusion criteria for review research data while the published and unpublished ethno-botanical surveys lacking any one of information about the scientific name of plants, medicinal plants parts used for treatment, study areas, not reporting information about anti-gonorrheal medicinal plants; and journal articles that have no open accessed were excluded criteria for review research data.

Data analysis

Ethnobotanical literature data was entered in an Excel spreadsheet and analyzed using SPSS (Version 20.0) statistical software. The collected ethnobotanical literature data were analyzed through statistical analysis. Quantitative literature data were compiled and analyzed by using descriptive statistics to identify the number and percentage of species, genera and families of anti-gonorrhea plants, their growth forms and percentage of commonly utilized plant parts. The analyzed data were expressed in tables, graphs and pie-chart. The output of this review can serve as a basis for future pharmacological studies on medicinal plants used for gonorrhea treatment in Ethiopia.

Results

Anti-gonorrhea plant diversity and its distribution in Ethiopia

The distribution and diversity of medicinal plants were campaigned in different parts of the country. Based on this, the highest diversity of medicinal plants used to treat gonorrhea was reported and compiled for this review from the Oromia region (67 plant species) followed by Southern Nation and Nationality peoples regional states (34 Species), Amhara (9 species), Dire Dawa city administration (6 Species) and Tigray region (6 Species). In agreement with[12] indicated that medicinal plants diversities were concentrated in southern and southwestern parts of Ethiopia, which possess high biological and cultural diversity. The majority of the plants reported in eight Ethiopian regions (36.22 %) were shared by each other. Moreover, the limited number of medicinal plants were reported from Somali (2 species), Harari (1 species) and Benshangul - Gumuz regions (2 species) (Table 1). This may reflect a lack of pertinent ethno-medicinal cultural practices; however, the prevailing gap is probably attributed to serious lapses in ethno-botanical research and documentation of medicinal knowledge in these three regions.

A total of 48 ethnobotanical studies representing eight different regions in Ethiopia were included in this review. Both published and unpublished research reports were used for compiling the review. A total of

Table 1 — Floristic distribution of the reported Anti-gonorrhea plants in Ethiopia

Administrative region (Total no of anti-gonorrhea plant species)	No of Plant(s) confined to respective region	No of shared plant(s) with other regions	Floristic areas: district/s	References
Southern Nation and Nationality Peoples Regional States (n= 34)	19	15	SE: Amaro Special District, Benna Tsemay, Wondogenet, Hawassa, Hadiya, Dale district Dawuro, Wonago, Kochere SWE: Sheko, Sokoru, Gummer	13, 17, 22, 27, 28,35,38, 42, 44, 51, 52, 56
Amhara regional states (n = 9)	3	6	NWE: Bahirdar zuria, Gondar, Shinasha and Agew- Awi NE: Dek Island, Wello SEE:Minjar-Shenkora	16, 19, 37, 40, 45, 55
Oromia regional states (n = 67)	50	17	CE:Fiche town market, in and around Fiche District WE:Gindeberet, Ejaji Area, Wayu Tuka, Jima Rare, Nekemete, Tulu Korma SWE: Mana Angetu, Gimbi,Goma, Seka Chekorsa, SEE: Bale, Dawa Kechene, Ada'a NEE: Awash National Park SE: Abaya (Borana)	14, 15, 25, 26, 30, 31, 32, 33, 41, 46 - 50, 53, 54, 57-59
Tigray regional states (n= 6)	1	5	NE: Seharti Samre, Kunama ethnic, Central Zone of Tigray,	29, 39, 43
Somali regional states (n= 2)	2	0	EE: Jigjiga	23, 24
Benshangul - Gumuz regional states (n= 2)	2	0	WE: Mandura	34
Harari regional states (n = 1)	1	0	EE: Babile District	12
Diredawa city administration (n = 6)	3	3	EE: Diredawa SEE (Harla and Denegego)	20, 36
Total (N) = 127	81 (63.78%)	46 (36.22%)		

Key: NEE: North East Ethiopia, CE: Central Ethiopia, NWE: North West Ethiopia, NE: Northern Ethiopia, WE: West Ethiopia, EE: Eastern Ethiopia, SE: Southern Ethiopia, SWE: South West Ethiopia, SEE: South East Ethiopia.

100 anti-gonorrhea plant species were identified in different region of Ethiopia belonged to 80 genera and 46 families. The ethnobotanical literature survey of cited plant families included: Euphorbiaceae (13 species), Cucurbitaceae (9 species), Solanaceae (8 species), Asteraceae (7 species), Fabaceae (5 species), Asclepiadaceae (4 species), Amaranthaceae, Acanthaceae, Verbenaceae (3 each), Apocynaceae, Meliaceae, Vitaceae, Ebenaceae, Rubiaceae, Rosaceae, Polygonaceae and Uriticaceae (2 each) and the remaining 29 families were represented by only a single species (Table 2). The more frequently cited species by different authors of the literatures from different ethnic groups and parts of the country were: *Croton macrostachyus and Phytolacca dodecandra* (9 each), *Acokanthera schimperi and Foeniculum vulgare* (5 each), *Catha edulis*, *Carissa spinarum, Justicia schimperiana* and *Solanum incanum* (4 each), *Brucea antidysentrica*, *Cucumis ficifolius*, *Senna occidentalis*, *Prunus africana,* and *Uritica simensis* (3 each), *Calpurnia aurea*, *Cucumis dipsaceus, Euphorbia candelabrum*, *Crateva adonsani*, *Gomphocarpus integer*, *Entada abyssinica*, *Euclea divinorum, Ipomea cicatricosa*, *Lageneria siceraria*, *Momordica foetida*, *Plumbago zeylanica*, *Securidaca longepedunculata*, *Solanum americanum*, and *Solanum anguivi* (2 each). Frequent citation of particular plant species could indicate potentially higher bioactive anti-gonorrhea content. Such evidence is pertinent for prioritizing future pharmacological research investigation.

Habit, habitat and medicinal parts used for Gonorrhea treatment

Growth form analysis of the reports of medicinal plants used for treatment of gonorrhea diseases, herbs were represented with the highest number of plant species (48 %) followed by shrubs (26 %), trees (17 %) and climbers (9 %). The majority of anti-gonorrhea medicinal plants were collected from wild (63 %) followed by home garden (16 %) and the remaining (21 %) were collected from both home garden and wild habitats[13-61]. This indicated that the majority of anti-gonorrhea plants in Ethiopia were collected from natural vegetation.

Table 2 — Medicinal plant species, families, local name, habit, parts used, habitat, method of preparation and route of administration used for the treatment of Gonorrhea in Ethiopia

S. No	Scientific Name	Family	LN	Ha	PU	Hb	Method of preparation	RD	CoU	Floristic areas (districts)	Freq.
1.	*Achyranthes aspera* L.	Amaranthaceae	Begegechoo (Kr)	Cl	FS	Wd	Crushing [13]	Oral	Fresh	*SE (Amaro)*	1
2.	*Acokanthera schimperi* (A.DC.) Schweinf	Apocynaceae	Merez (Am); Kararo (Or)	T	Le, R, Rb, Sb, Se,	Wd	Squeezing [14]; crushing and boiling[15]; chewing[16] crushing and pounding[17]; infusion [18]	Oral	Fresh	*CE (in and around Fiche); SWE (Mana angetu); SE (Wondogenet); WE (Nekemete); NE (Dek Island)*	5
3.	*Adhatoda schimperiana* Hochst. ex Nees	Acanthaceae	Sensel (Am)	S	Le	Hg	Squeezing [19]	Oral	NS	*NWE: Bahirdar Zuria*	1
4.	*Aerva javanica* (Burm.f.) Schultes	Amaranthaceae	Wanad (So)	S	R	Wd	Crushing [20]	Oral	NS	*EE: Diredawa*	1
5.	*Ageratum conyzoides* L.	Asteraceae	Not specified	H	R	Wd	Crushing and boiling[15]	Oral	Fresh	*SWE: Mana angetu*	1
6.	*Albizia anthelmintica* (A. Rich.) Brogn.	Fabaceae	Hawachoo (Or)	T	R	Wd	Decoction [21]	Oral	NS	*SEE (Bale)*	1
7.	*Allium sativum L.*	Alliaceae	Nechi shinkurt (Am)	H	Bu	Hg	Crushing [27]	Oral	Both	*SE (Hawassa)*	1
8.	*Aloe trichosantha* Berger	Aloaceae	Hargisa Guracha (Or)	H	La	Wd	Squeezing [21]	Oral	NS	*SEE (Bale)*	1
9.	*Artemisia afra* L.	Asteraceae	Chiyanchiy (Gu)	H	SL	Hg	Grinding and powdering[22]	Oral	Dry	*SWE (Gummer)*	1
10.	*Asepalum eriantherum* (Vatke) Marais	Cyclocheilaceae	Ajaboot/gagabot (So)	S	R	Wd	Decoction[23]	Oral	NS	*EE: Jigijiga*	1
11.	*Azadirachta indica* A. Juss.	Meliaceae	Jabto (So)	T	Le	Both	Decoction [24]	Oral	Fresh	*EE: Jigijiga*	1
12.	*Bidens pilosa* L.	Asteraceae	Maxanee (Or)	H	R	Both	Squeezing [25]	Oral	NS	*SWE: Goma*	1
13.	*Brucea antidysentrica* J. F. Mill.	Simaroubaceae	Kilisa adi; Qabanyoo (Or); Aballo/ Waginos(Sd)	S	LSe	Wd	Crushing and boiling[15,26]; infusion[27]	Oral	Both	*SWE (Mana angetu); WE (Tulu Korma) SE (Hawassa)*	3
14.	*Calpurnia aurea* (Aiton) Benth.	Fabaceae	Cheketa (Sd); Hetsawets (Tig)	T	L Se	Wd	Roasting, grinding and powdering[28, 29]	Oral	Dry	*SE (Dale district) NE: Seharti Samre*	2
15.	*Caralluma peckii* Bally	Asclepiadaceae	Hadama (Or)	H	R	Wd	Crushing [15]	Oral	Fresh	*SWE (Mana angetu)*	1
16.	*Catha edulis* (Vahl) Forssk. ex Endl. /	Celasteraceae	Chati (Or);	S	SL	Hg	Crush and boil[15]; cooking [25,30]; infusing [27]	Oral	Fresh	*SWE (Mana angetu); SWE (Goma); SEE (Bale)*	4
17.	*Carissa spinarum* L	Apocynaceae	Hagamsa(Or); Agam (Am)	S	RSb	Wd	Pounding[31-33]; powdering and decoction[13]	Oral	Both	*SWE (Gimbi) WE (Jima Rare, Ejaji Area); SE (Amaro)*	4
18.	*Celosia trigyna* L.	Amaranthaceae	Dagiso (Or)	H	Le	Wd	Squeezing [25]	Oral	Fresh	*SWE (Goma)*	1
19.	*Clerodendrum umbellatum* Poir	Lamiaceae	Odzige (Gu)	H	R	Wd	crushing and squeezing [34]	Oral	Fresh	*WE (Mandura Woreda)*	1
20.	*Cissus quadrangularis* L.	Vitaceae	Chopi (Or)	Cl	R	Wd	Crushing and boiling [15]	Oral	Fresh	*SWE (Mana angetu)*	1
21.	*Cissus rotundifolia* (Forssk.) Vahl	Vitaceae	Shumbur lubu (Or)	Cl	Le	Wd	Concoction [12]	Oral	NS	*EE (Babile district)*	1
22.	*Coccinia abyssinica* (Lam.) Cogn.	Cucurbitaceae	Usik'iya/ Ushushiya (Dw)	Cl	R	Hg	Crushing[35]	Oral	NS	*SE (Dawuro)*	1
23.	*Commicarpus sinuatus* Meikle	Nyctaginaceae	Kontom (Or)	H	LF	Wd	Concoction [36]	Oral	NS	*SEE (Harla and Denegego)*	1
24.	*Crabbea velutina* S. Moore	Acanthaceae	NS	H	R	Wd	Crushing and boiling[15]	Oral	Fresh	*SWE (Mana angetu)*	1
25.	*Crateva adonsani* DC.	Capparidaceae	Qolladi (Or)	S	R	Wd	powdering [31,32]	Oral	Dry	*SWE (Gimbi); WE (Ejaji Area)*	2

(*Contd*.)

Table 2 — Medicinal plant species, families, local name, habit, parts used, habitat, method of preparation and route of administration used for the treatment of Gonorrhea in Ethiopia

S. No	Scientific Name	Family	LN	Ha	PU	Hb	Method of preparation	RD	CoU	Floristic areas (districts)	Freq.
26.	*Croton macrostachyus* Del.,	Euphorbiaceae	Bisana (Am); Bakkannisa (Or); Asisi (Shn); Masinna (Sd)	T	LS; Sb; R; St	Both	Squeezing [14]; powdering[31,33]; crush and extract[15]; powdering [37]; Cooking [25]; chewing[5]; crushing, pounding and filtering [17]; crushing [38]	Oral	Both	*CE (in and around Fiche); SWE (Gimbi, Goma); SWE (Mana Angetu); WE (Jima Rare); NWE (Shinasha and Agew-awi); SWE (Gummer) SE (Kochere, Wondogenet)*	9
27.	*Cucumis dipsaceus* Ehrnb. ex spach.	Cucurbitaceae	Sandewo (Ku), Hafafilo (Tig); Hare Goge (Or)	H	LR	Both	Concoction [36]; pounding, crushing and powdering [39]	Oral	Fresh	*NE (Kunama); SEE (Harla and Denegego)*	2
28.	*Cucumis ficifolius* A. Rich.	Cucurbitaceae	Hanchote (Or) Faca'aa (Or)	H	RF;	Wd	Crushing [15]; powdering and infusion [40]; chewing[41]	Oral	Both	*SWE (Mana Angetu); WE (Wayu Tuka); NE (Wello)*	3
29.	*Cucumis prophetarum* L.	Cucurbitaceae	Basubaqula (Sd)	Cl	Fr	Both	pounding and powdering[17]	Oral	Dry	*SE (Wondogenet)*	1
30.	*Cucurbita pepo* L.	Cucurbitaceae	Buqqee (Or)	H	Se	Hg	powdering and filtering[31]	Oral	Dry	*SWE (Gimbi)*	1
31.	*Datura stramonium* L.	Solanaceae	Asangiraa (Or)	H	Se	Both	Crushing[25]	Oral	NS	*SWE (Goma)*	1
32.	*Dioscorea alata* L.	Dioscoriaceae	Boyna (Sd)	Cl	St	Hg	Cooking [27]	Oral	Fresh	*SE (Hawassa)*	1
33.	*Dichrocephala chrysanthemifolia* (Bl.) DC	Asteraceae	Gurbii (Or)	H	R	Wd	Crushing[27]	Oral	Fresh	*SWE (Mana Angetu)*	1
34.	*Discopodium penninervium* Hochst.	Solanaceae	NS	S	Le	Wd	Crushing[26]	Oral	Fresh	*WE (Tulu Korma)*	1
35.	*Dorstenia foetida* (Forssk.) Schweinf.	Moraceae	Kurtee ree (Or)	H	St	Wd	Chewing [21]	Oral	Fresh	*SEE (Bale)*	1
36.	*Echinops kerebicho* Mesfin	Asteraceae	Qarabicho (Or)	H	R	Hg	Pounding[32]	Oral		*WE (Ejaji Area)*	1
37.	*Entada abyssinica* Steud. ex A. Rich.	Fabaceae	Haambaltaa (Ym)	T	R	Wd	Crushing and squeezing[42, 43]	Intve	Fresh	*SWE (Sekoru); NE (Central Zone of Tigray)*	2
38.	*Erthrina brucei* Schweinf	Fabaceae	Korch (Am)	T	Sb	Both	Crushing and powdering[27]	Oral	Fresh	*SE (Hawassa)*	1
39.	*Euclea divinorum* Hiern	Ebenaceae	Dedaho (Am); Meiesa (Or)	S	R	Both	Crushing and decoction[15,44]	Oral	Both	*SE (Benna Tsemay) SWE (Mana angetu)*	2
40.	*Euclea racemosa* Hiern	Ebenaceae	Dedaho (Am)	S	R	Wd	Boiling and crushing[37]	Oral	Both	*NWE (Gonder)*	1
41.	*Euphorbia abbyssinica* J.F. Gmel.	Euphorbiaceae	Adaamii (Or)	T	Sb	Wd	Decoction[31]	Oral	NS	*SWE (Gimbi)*	1
42.	*Euphorbia ampliphylla* Pax	Euphorbiaceae	Adamii (Or)	T	La	Both	Squeezing[33]	Oral	Fresh	*WE (Jima Rare)*	1
43.	*Euphorbia candelabrum* Kotschy	Euphorbiaceae	Adami (Or)	T	La	Wd	Squeezing[46, 47]	Dm	Fresh	*CE (in and around Finche) SWE (Gimbi)*	2
44.	*Euphorbia depauperata* A.Rich	Euphorbiaceae	Gurii (Or)	H	R	Wd	Crushing and decoction[48]	Oral	Fresh	*SEE (Bale)*	1
45.	*Euphorbia cactus* Boiss	Euphorbiaceae	Kolqual hamat (Tig)	S	La	Both	Squeezing[29]	Oral	Fresh	*NE (Seharti Samre)*	1
46.	*Euphorbia dumalis* S. Carter	Euphorbiaceae	Gurii(Or)	S	R and Sb	Both	Crushing and decoction[48]	Oral	Both	*SEE (Bale)*	1
47.	*Euphorbia lathyris* L.	Euphorbiaceae	Ambuluk (Or)	H	Se	Both	Crushing and powdering[48]	Oral	Both	*SEE (Bale)*	1
48.	*Euphorbia longituberculosa* Boiss.	Euphorbiaceae	Hokubkubii (Or)	H	St	Wd	Boiling[21]	Oral	NS	*SEE (Bale)*	1

(*Contd*.)

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S. No	Scientific Name	Family	LN	Ha	PU	Hb	Method of preparation	RD	CoU	Floristic areas (districts)	Freq.
49.	*Euphorbia piscidermis* M.Gilbert	Euphorbiaceae	Kolkol (Or)	H	RSe	Wd	Crushing and boiling[15]	Oral	Fresh	*SWE (Mana Angetu)*	1
50.	*Euphorbia schimperiana* Scheele	Euphorbiaceae	Robe (Or)	H	R	Both	Crushing and boiling[15]	Oral	Both	*SWE (Mana Angetu)*	1
51.	*Fagaropsis angolensis* (Engl.) Dale	Rubiaceae	NS	T	Le	Wd	Decoction[38]	Oral	NS	*SE: Kochere*	1
52.	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae	Akuku (Or)	S	Rb	Wd	Grinding[47]	Oral	NS	*SWE (Gimbi)*	1
53.	*Foeniculum vulgare* Mill.	Apiaceae	Ensilal (Am); Kemona (So)	H	LRS	Hg	Concoction, crushing, and decoction [48]; pounding[20]; boiling [22, 27]	Oral	Both	*SEE (Bale); NWE (Shinasha and Agew- Awi); EE (Diredawa); SE (Hawassa) SWE (Gummer)*	5
54.	*Gladiolus dalenii* Van Geel	Iridaceae	Kelede (Or)	H	R	Wd	Crushing[48]	Oral	Both	*SEE (Bale)*	1
55.	*Gnidia stenophylla* Gilg /	Thymelaeaceae	Harmala Tiqishu (Or)	H	R	Wd	Crushing and boiling[15]	Oral	Both	*SWE (Mana angetu)*	1
56.	*Gomphocarpus integer* (N.E. Br.) Bullock /	Asclepiadaceae	Harmala (Or); Chifrig (Am)	S	R	Wd	Crushing and extract[15]; pasting [19]	Oral; Dm	Both	*SWE (Mana angetu) NWE (Bahirdar Zuria)*	2
57.	*Grewia villosa* Willd.	Malvaceae	Bururi (Kr)	S	Le	Wd	powdering[13]	Oral	Dry	*SE (Amaro)*	1
58.	*Impatiens aethiopica* Gray-Wilson	Balsaminaceae	Anshoshila (Or)	H	R	Hg	Crushing[48]	Dm	Fresh	*SEE (Bale)*	1
59.	*Ipomea cicatricosa* (Bark.) Hall. F.	Convolulaceae	Dhamaee (Or)	H	R	Both	Boiling[21]; crushing[49]	Oral	NS	*SEE (Bale, Dawa Kechene)*	2
60.	*Justicia schimperiana* (Hochst. ex Nees) T. Anders.	Acanthaceae	Sensel (Am); Dhumuga(Or); Tumuniga (Hd)	S	LR	Hg	Crushing[50]; pounding[33]; crushing[27]	Oral	Fresh	*WE (Jima Rare, (Gindeberet); SE (Hadiya) SE (Hawassa)*	4
61.	*Kalanchoe densiflora* Rolfe	Crassulaceae	Endahula (Am)	H	Le	Wd	Concoction, crushing and powdering[48]	Oral	Both	*SEE (Bale)*	1
62.	*Kniphofia isoetifoli* Steud. ex Hochst.	Asphodelaceae	Shinshile (Or)	H	R	Wd	Concoction, crushing and powdering[48]	Oral	Both	*SEE (Bale)*	1
63.	*Lagenaria siceraria* (Molina) Standl	Cucurbitaceae	Botto (Gd); Buqqe- sexana (Or)	H	FS	Wd	Soaking [52]	Oral	NS	*SE (Wango) SE: Abaya (Borana)*	2
64.	*Lantana camara* L.	Verbenaceae	NS	S	R	Wd	Crushing and boiling[15]	Oral	Both	*SWE (Mana Angetu)*	1
65.	*Lantana trifolia* L.	Verbenaceae	Medandubra (Or)	S	R	Wd	Crushing and boiling[15]	Oral	Both	*SWE (Mana Angetu)*	1
66.	*Leptadenia sp*.	Asclepiadaceae	Dunkel (So)	H	R	Wd	Crushing and boiling[20]	Oral	Fresh	*EE: Diredawa*	1
67.	*Lepidium sativum* L.	Brassicaceae	Fetto (Am)	H	Le	Hg	Filtration[55]	Oral	NS	*SEE (Minjar-Shenkora)*	1
68.	*Lycopersicon esculentum* (L.)Mill	Solanaceae	Timatimo (Or)	H	Le	Hg	Concoction, crushing, and decoction [1]	Oral	Both	*SEE (Bale)*	1
69.	*Marantochloa leucantha* (K.Schum.) Milne-Redh.,	Marantaceae	Zuka (Shk)	H	LR	Wd	Crushing[56]	Oral	NS	*SWE (Sheko)*	1
70.	*Momordica boivinii* Baill.	Cucurbitaceae	Kiree (Sd)	Cl	R	Wd	Chewing[17]	Oral	Fresh	*SE (Wondogenet)*	1
71.	*Momordica foetida* Schumach.	Cucurbitaceae	Hidda Boffaa/ Buqee (Ym); Yekurahareg/Kuramechat (Or)	H	LR	Wd	Crushing and squeezing[42]; Pounding and squeezing[45]	Intve ; Oral	Fresh	*SWE (Sekoru); NWE (Gonder)*	2

(*Contd*.)

Table 2 — Medicinal plant species, families, local name, habit, parts used, habitat, method of preparation and route of administration used for the treatment of Gonorrhea in Ethiopia

S. No	Scientific Name	Family	LN	Ha	PU	Hb	Method of preparation	RD	CoU	Floristic areas (districts)	Freq.
72.	*Nicotiana tabacum* L.	Solanaceae	Tombowae (Kr)	H	LR	Hg	Crushing, decoction, and concoction and powdering[13]	Oral	Fresh	*SE (Amaro)*	1
73.	*Olea europaea* subspecies *caspidata*	Oleaceae	Ejersa (Or)	T	Sb	Both	pounding[26]	Oral	NS	*WE (Tulu Korma)*	1
74.	*Oreosyce africana* Hook.f./	Cucurbitaceae	Hiddii (Ym)	Cl	R	Wd	Crushing and squeezing[42]	Oral	Fresh	*SWE (Sekoru)*	1
75.	*Ozoroa insignis* Del.	Anacardiaceae	Dheri (Or)	T	Le	Wd	Crushing and boiling [15]	Oral	Both	*SWE (Mana Angetu)*	1
76.	*Periploca linearifolia* Quartin Dill.& A.Rich:	Asclepiadaceae	Annannoo (Or)	Cl	La	Wd	Squeezing[33]	Oral	NS	*WE (Jima Rare);*	1
77.	*Phytolacca dodecandra* L'.Herit.	Phytolacaceae	Andode (Or); Endode (Am); Shebti (Tig)	S	L R	Hg	Crushing and boiling[15]; Powdering[41]; pounding[26]; Squeezing[25]; powdering[32,33]; Grinding and powdering[29]; Chewing[27]; Pounding and concoction[57]	Oral	Both	*SWE (Mana Angetu)* *WE (Tulu Korma, Ejaji Area, Jima Rare, Wayu Tuka) SWE (Goma, Seka);* *SE (Hawassa);* *NE (Seharti Samre)*	9
78.	*Plumbago zeylanica* L.	Plumbaginaceae	Mexres (So); Mertes (Or)	S	LR	Wd	Crushing[20]; powdering[13]	Oral	Fresh	*EE (Diredawa);* *WE (Nekemete)*	2
79.	*Prunus africana* (Hook.f.) Kalkam	Rosaceae	T/Kaka (Gd); 'Sukke' (Or)	T	R	Both	Concoction[52, 53]; Crushing[49]	Oral	Both	*SE (Wanago)* *SE: Abaya (Borana) NEE (Awash Park)*	3
80.	*Ricinus communis* L.	Euphorbiaceae	NS	H	R	Both	Crushing and extract[15]	Oral	Fresh	*SWE (Mana angetu)*	1
81.	*Rubia cordifolia* L.	Rubiaceae	Lalessa (Or)	H	R	Wd	Crushing and boiling[15]	Oral	Both	*SWE (Mana angetu)*	1
82.	*Rubus steudneri* Schweinf.	Rosaceae	Goora (Or)	S	Le	Wd	Crushing and boiling[15]	Oral	Both	*SWE (Mana angetu)*	1
83.	*Rumex abyssinicus* Jacq.	Polygonaceae	Dhangago (Or)	H	R	Wd	Powdering[18]	Oral	NS	*WE (Nekemte)*	1
84.	*Rumex nepalensis* Spreng.	Polygonaceae	NS	H	R	Both	Crushing[38]	Oral	NS	*SE (Kochere)*	1
85.	*Ruta chalepensis* L.	Rutaceae	Sunkuruut (Sd)	H	Le	Hg	Grinding[27]	Oral	Fresh	*SE (Hawassa)*	1
86.	*Securidaca longepedunculata* Fresen.	Polygalaceae	Amera (Or); Etse Mehane (Am)	S	Wp	Wd	Boiling[47]; decoction[18]	Oral	NS	*SWE (Gimbi);* *WE (Nekemete)*	2
87.	*Senna occidentalis* (L.) Link	Fabaceae	Assenmeka (Gd); Hawacho (Or)	H	R	Wd	Powdering[52,53]; crushing and boiling[15]	Oral	Both	*SE (Wanago)* *SE: Abaya (Borana)* *SWE (Mana Angetu)*	3
88.	*Solanum americanum* Miller	Solanaceae	YaitAwut (Am)	H	LR	Both	Decoction [14]; infusion[58]	Oral	Fresh	*CE (Fiche town market, in and Around Fiche District)*	2
89.	*Solanum anguivi* Lam	Solanaceae	Zirit Embuay (Am)	S	R	Wd	Chewing [14]; infusion[58]	Oral	Both	*CE (Fiche town market, in and around Fiche District)*	2
90.	*Solanum dasyphyllum* Schumach.	Solanaceae	Ankwa (Gu)	H	R	Wd	Crushing and squeezing[34]	Oral	Fresh	*WE (Mandura)*	1
91.	*Solanum incanum* L.	Solanaceae	Embuaty (Kr); Hiddi (Or); Neshtey engule (Tig)	S	R; Fl	Wd	Powdering [13]; crushing and Extract [15]; grinding, powdering and pasting [29]	Oral	Dry	*SWE (Mana angetu)* *SE (Amaro); NE (Seharti Samre)*	4
92.	*Solanecio gigas* (Vatke) C. Jeffrey, /	Asteraceae	Yeshekoko Gomen (Am)	S	R	Wd	Decoction [14]	Oral	Fresh	*CE (in and around Fiche district)*	1

(*Contd*.)

Table 2 — Medicinal plant species, families, local name, habit, parts used, habitat, method of preparation and route of administration used for the treatment of Gonorrhea in Ethiopia

S. No	Scientific Name	Family	LN	Ha	PU	Hb	Method of preparation	RD	CoU	Floristic areas (districts)	Freq.
93.	*Stephania abyssinica* (Dillon & A.Rich.)	Menispermaceae	Kalala (Or)	H	R	Both	Crushing and decoction[48]	Oral	Fresh	*SEE (Bale)*	1
94.	*Suregada procera* (Prain) Croizat	Euphorbiaceae	Xillo (Or)	T	R	Wd	Crushing and boiling[15]	Oral	Dry	*SWE (Mana angetu)*	1
95.	*Trichilia dregeana* Sond.	Meliaceae	Menisa (Or)	T	R	Wd	Crushing and boiling[15]	Oral	Dry	*SWE (Mana angetu)*	1
96.	*Urtica dioica* L.	Urticaceae	Lalesa (Sd)	H	Wp	Both	Crushing, pounding and decoction[17]	Oral	Fresh	*SE (Wondogenet)*	1
97.	*Urtica simensis* Steudel	Urticaceae	Sama (Am); Dobii(Or)	H	LR	Wd	Powdering and filtration[55]; Crushing[22]; infusion[59]	Oral	NS	*SEE (Minjar-Shenkora); SWE (Gummer); SEE (Ada'a)*	3
98.	*Verbena officinalis* L.	Verbenaceae	Dargu (Am)	H	R	Wd	Chewing[13]	Oral	Fresh	*SE (Amaro)*	1
99.	*Vernonia hymenolepis* A. Rich	Asteraceae	Sooyyoma (Or)	S	Le	Wd	Pounding[1]	Oral	NS	*WE (Ejaji area)*	1
100.	*Syzygium guineense* (Willd.) DC.	Myrtaceae	Duwancho (Kr)	T	RSL	Wd	Squeezing[13]	Oral	Fresh	*SE (Amaro)*	1

Key Word: LN: Local Name (Am = Amaharic, Or = Afaan Oromo, Ym = Yemegna, Hd: Hadiyegna Sd = Sidama , Dw = Dawuro, Gd= Gedeo, Tig=Tigrigna, So= Somali, Kr=Koorete, Af= Afar, Gu= Gumuz, Shk=Sheko, Shn=Shinasha, Ku= Kunama, Kw= Kwego, Ka=Kara, Ke=Kembatissa ; Ha: Habit; T: Tree; S: Shrub ; NS= Not Specified; H: Herb; Cl: Climber PU: Parts Used; Fr: Fruit; Se: Seed; R: Root; Le: Leaves; Fl: Flower La: Latex; St: Stem; SL: Stem and Leaves; RSe: Root and Seed; RF: Root and Fruit; LF: Leaf and Fruit; LR: Leaf and Root; FS: Fruit and Seed; LSe: Leave and seed; RSL: Root, Stem and Leaves; Wp: Whole plant Part; Sb: Stem bark; Rb: Root bark Hb: Habitat; Wd: Wild; Hg: Homegarden; RD: Route of administration; CoU: Conditioned Used; Intve: Intravenous; Dm: Dermal; NEE:North East Ethiopia, CE: Central Ethiopia, NWE: North West Ethiopia, NE: Northern Ethiopia, WE: West Ethiopia, EE: Eastern Ethiopia, SE: Southern Ethiopia, SWE: South West Ethiopia, SEE: South East Ethiopia, Freq.= Frequency.

Root were the most commonly used parts of medicinal plant for treatment of gonorrhea infections of human accounts (42 %) followed by leaves (9 %), Latex (5 %) and stem (3 %). Moreover, other medicinal parts such as flower, root bark, stem bark, fruits, seed or a combination of two or more of these parts were also reported for the treatment of gonorrhea in Ethiopia[13-61]. This indicates that the different cultural groups in Ethiopia make use of diverse medicinal plant parts used as treatment of gonorrhea. The reported anti-gonorrhea results showed that 39 % of the plant medicines were prepared from fresh plant parts, 9 % from dried and 26 % from both fresh and dried parts, 26 % did not have specific condition used[13-61].

Method of remedy preparation, routes of administration and dosage of herbal remedies

Anti-gonorrhea plant remedies are prepared using crushing, squeezing, pounding, powdering, decoction, and infusion etc., the plant parts either individually or in some cases by the combination of two or more medicinal plants. Water is the major medium in which the decoctions are made. Sometimes, other additives like honey, milk, butter and salt mixed while preparing plant remedies[13-31, 32 -61].

Most of the traditional medicines were taken orally accounts (95 %) of the total medicinal plants, followed by dermal (2 %), intravenous (1 %) and combination of two types of route of administration such as oral with dermal and intravenous (1 % each)[13-61]. Some of the anti-gonorrhea herbal preparations were prepared from mixtures of two or more different medicinal plant species reported from different parts of Ethiopia using various parts of the plants[18,26-29,32,33, 36-38,47,50-52]

Discussion

In 2008, the World Health Organization (WHO) estimated that about 106.1 million new cases of gonococcal infections occurred globally and about 21.1 million in Africa, making it the second most common sexually transmitted bacterial infection worldwide[7]. Moreover, the global prevalence of *N. gonorrhoeae* in adults between the ages of 15 and 49 years was estimated to be 36.4 million in 2008. Meanwhile in Africa, the prevalence in these age groups was estimated to be 8.2 million[7]. Some of the recent studies in Africa showed that the prevalence of the disease in STI suspected patients' ranges from 2.7 to 8.2 % in various target groups[11,59,62].

In the present review, one hundred medicinal plants used for treatment of Gonorrhea have been recorded and documented from published and unpublished journals in Ethiopia. From which, a few of medicinal plant species used for the treatment of gonorrhea diseases in the country have similar report in other

parts of the world[61,63]. The medicinal uses of (6 %) are supported by reports have similar uses in the other parts of the world. Anti-gonorrhea plant species such as *Allium sativium*, *Achyranthes aspera, Foeniculum vulgare, Trichilia dregeana, Plumbago zeylanica* and *Securidaca longepedunculata* were reported in other part of the world[6,11,31,61]. However, around 94 medicinal plant species (94 %) recorded from different parts of Ethiopia practiced in various ethnic groups and cultures to treat gonorrhea infection were prominent in the country only. These plants are not approved and widely practiced in the other parts of the world. This needs to do more on the phytochemical extraction in the near future to promote the indigenous knowledge of the community in each ethnic group.

This review of ethnobotanical plant uses in Ethiopia show the importance of documentation of anti-gonorrhea plant species and their associated indigenous knowledge was impressive for future conservation of the practice. The more frequently cited plant species by different authors were *Croton macrostachyus, Phytolacca dodecandra*, *Acokanthera schimperi, Foeniculum vulgare*, *Catha edulis*, *Carissa spinarum, Justicia schimperiana* and *Solanum incanum* reported different regions of Ethiopia were more prominent in the community to go further clinical tests by giving priority. Therefore, these anti-gonorrhea plant species targeted for phytochemical and pharmacological studies with the aim of identifying bioactive ingredients contained by such plants resulting in them having unique therapeutic uses.

Conclusion

This review literature reveal that medicinal plants used for the treatment of gonorrhea in Ethiopia is intended to document the indigenous practice and serve as scientific baseline information for future pharmacological studies. At the present moment, phytochemical and pharmacological analysis of traditional medicines occupies a key position in medicinal plant research and indigenous knowledge system conservations. Sharing of such knowledge is crucial for maintaining options for the use of traditional medicines, particularly as use of alternative medicine is growing because of its low costs, accessibility and biomedical importance. The significant levels of global pharmaceuticals knowledge originated from indigenous knowledge. Though most of these medicinal plants are widely utilized in different parts of the country, only safety and efficacy information of some of them such as *Allium sativium*, *Achyranthes aspera, Foeniculum vulgare* and *Trichilia dregeana* were scientifically tested in vivo experiment. Thus, it is relevant for recent and future researchers in the field to study of the remaining 94 anti-gonorrhea plant species and generate the pharmacological information to protect the public health of the communities particularly gonorrhea in the country.

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Conflict of Interest

The authors have not declared any conflict of interests.

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