Ethnobotanical Study of Medicinal Plants Used for Human Health Care in Yem Culture, South Ethiopia

Gideon Woldemariam (gideongw2016@gmail.com)
WSU: Wolaita Sodo University https://orcid.org/0000-0002-2278-7006
Sebsebe Demissew
Addis Ababa University
Zemede Asfaw
Addis Ababa University

Research

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Abstract

Background

Indigenous or traditional herbal medicine has been widely regarded as a resource for strengthening the health care systems among communities of low income countries including Ethiopia. The Yem people in Ethiopia have deep-rooted and ancient traditional knowledge of managing human ailments and health conditions using medicinal plants (mps). On the other hand, mps and the associated indigenous knowledge are under erosion due to human-induced and natural factors. Therefore, documenting the plant biodiversity along with the associated indigenous knowledge is of urgent task for conservation.

Methods

This study was conducted in April, 2013, October, 2016 and July, 2016 with the objective of documenting traditional mps in different land uses that are used for treating human ailments. Ethnobotanical data were collected from 69 informants that were selected by stratified random sampling and purposive sampling. Vegetation data were obtained from 30, 30x30 m quadrats. Ethnobotanical data were analysed using paired ranking, Informant consensus factor and Fidelity Level index.

Results

About 213 medicinal plant species that are used for treating 117 human ailments were recorded. ICF calculated depicted a highest ICF value of 0.82 for Gastrointestinal & Visceral organs ailments. *Haplocarpha rueppellii*, *Carduus schimperi* and *Inula confortiflora* each 100%, *Maesa lanceolata* 80% and *Rumex abyssinicus* 75%. Vegetation analysis showed three plant communities.

Conclusion

The Yem people have rich traditional knowledge of utilising plants side by side with the mainstream biomedical system for maintaining human health care.

Introduction

Indigenous or traditional medicine has been widely regarded as a resource for strengthening the health care systems in low income countries [1-2]. Ethiopia is one of SubSaharan countries whose population is dependent on natural flora for health care and earning livelihood [3],[4]. The country has diversity ethnicities that have millennia old ethnobotanical knowledge beliefs, and practices about plant species growing in different vegetation and land use types. Traditional medicine has been normative and integral part of health care system in the country [5-7]. Estimates show that about 80% of human population health care in the country is based on TMps [8-9]. The diverse ethnicities of the country are believed to utilise about a third of the country's plant families in traditional medicine for maintaining their health care [10]. Among the ethnicities, Yem people who are inhabitants of Dry Afromontane Region in southern Ethiopia country have deep-rooted and ancient traditional knowledge of managing human ailments and

health conditions using plant biodiversity. Even though the mainstream biomedical system showed better coverage than before, Yem people still use plants and consult local herbal experts for a number of human ailments and health conditions due to their accessibility, millennia old experimentation on the efficacy of traditional herbal medicines that led to cultural trust in them. On the other hand, mps and the associated knowledge are being seriously eroded due to deforestation for agricultural expansion, fire wood and charcoal extraction, environmental degradation, modernisation and climate change that could ultimately undermine the primary healthcare services. Therefore, urgent ethnobotanical studies and subsequent conservation measures are needed to salvage the medicinal plants and the associated knowledge from further loss. The purpose of this study was to conduct ethnobotanical investigation and documentation of the remnant flora and associated indigenous knowledge of Yem ethnic group using qualitative and quantitative approaches as a step forward for suggesting conservation measures for medicinal plants and associated traditional knowledge.

Materials And Methods

Description of the study area

This study was conducted in four subdistricts of Yem Special District in the SNNPR namely, GoruminaHanigeri, Kesheli, ShemonaMetelo and SajaLafiten. The district is located in the north-western apex of Southern Ethiopia within coordinates of 7°37'N - 8°02' N and 37°40' E - 37°61' E (Fig. 1). Yem people speak Yemisa that is categorized in Omotic language group **[11]**. According to **[12]**, the total population of Yem was estimated to be 80,647 of which 50.3% were males and 49.7% females and the population density was 111.3 persons per sq. km. About 71.24% of the population said to practice Orthodox Christianity, 25.14% Muslim and 3.48% were Protestants **[12]**. The Yem practice enset-based subsistence crop cultivation and livestock rearing **[13]**. Metrological data received from Deri station in Yem showed that high rainfall is received between May to September where as low rainfall recorded from November to February reaching the lowest of 25 mm in December within 13 years (2000 - 2012) [14]**,** Similarly, the highest mean annual temperature was 21 ^{o}C recorded in May while the lowest mean annual temperature within 13 years was 7 ^{o}C recorded in December [14]. +

Data Collection

Collection of Ethnobotanical Data

For the ethnobotanical investigation and vegetation survey, four subdistricts that were selected purposively based on agroecological (climatic) barrier as used by [15]. General informants (lay) were selected using Stratified Random Sampling (SRS) following [16] while key (expert) informants were selected purposively following [17]. The sample size determined following Cochran's method [18] based on data obtained from [12] and offices of subdistrict administrations. The total number of informants sampled was 69. Out of this, 47 (68%) were general informants that were proportionally distributed to the subdistricts based on the number of households heads they contain while 22 (32%) were key informants.

Semi-structured interviews were conducted in 'Yemisa' and and Oromiffa' languages, and then translated by the help of guides. The interviews were conducted using 'interview guide' that was prepared priori as suggested by [17],[19]. Oral consent of informants was sought before interview administration.

Vegetation data were collected from 30, 30 m by 30 m quadrats that were laid in different land uses in April 2013; October, 2016; July, 2016 following preferential sampling as suggested by [20]. Percentage cover of species in the quadrats were taken and converted to cover/abundance values following [21]. Diversity of plant species sampled from quadrats laid in the study areas was computed using Shannon-Weiner's Index following [22]. Voucher specimens of medicinal species taken during interviews and vegetation study were brought to the National Herbarium (ETH), Addis Ababa University and processed using standard herbarium techniques for identification following [23].

Identification of the plant species specimens were made by the investigator in the National Herbarium of Ethiopia (ETH) using the published volumes Flora of Ethiopia and Eritrea Volumes 1- 8 [24].

Analysis of Ethnobotanical Data

Paired ranking

Paired comparison of highly cited medicinal plants was done with randomly selected key informants following [17]**.** Then, scores of each species were summed up and ranked based on the preference of the key informants against a given disease.

Informant Consensus Factor (ICF)

The ICF of Mps that had highest citations for treating human ailments were calculated to evaluate the level of homogeneity of information provided by different informants following [25]. The index was calculated as the number of use citations in each category minus the number of species used divided by the number of use citations in each category minus one. The formula of the index is; $$ICF = \frac{Nur - Nt}{Nur - 1}$$ where, Nur = number of use reports from informants for a particular plant-use category; Nt = number of taxa or species that are used for that plant use category for all informants. For the ICF analysis, ailments were grouped into nine categories as suggested by [26]. The ailment categories were blood vascular & infectious, dermatological, gastrointestinal & visceral organs, miscellaneous, musculoskeletal, respiratory system, psychospiritual & cultural, reproductive & urogenital ailments, and miscellaneous ailments (ailments whose sign and symptoms and specific body part could not be stated clearly).

Fidelity Level, FL (%) medicinal plants

Fidelity Level (FL%) of medicinal species used for human ailments was calculated to identify Mps with highest healing potential. This index is calculated as the ratio between the number of informants who suggested the use of a species for the same major purpose (I_p) and the total number of informants who

$$FL = \frac{I_p}{I_u}$$

mentioned the plant for any use (I_U) [27]. The formula for fidelity level (FL) is;

$$FL\ \% = \left(\frac{I_p}{I_u}\right) x\ 100$$

where I_p = the number of informants who suggested the use of a species for the same major purpose; I_U = the total number of informants who mentioned the plant for any use.

Analysis of vegetation data

Vegetation data was analysed using agglomerative hierarchical clustering method that employs average linkage and similarity ratio.

Statistical Analyses of Data

Both ethnobotanical data were entered and organized and analysed in excel spreadsheet [28]. The ethnobotanical data were analysed using MS excel and Statistical Package for Social Sciences (SPSS) version 20 [29]. For vegetation data classification of plant communities containing medicinal species was performed using agglomerative clustering method in R statistical software (version 3.5.2) [30].

Results

Ethnobotanical Data

About 213 medicinal plant species that are classified in 184 genera and 80 families were known to be used by Yem people (Appendix 1) for treating human ailments**.** Among ailments freelisted, abdominal pain was the highest cited, 130 (7.59%) followed by acute febrile illness 129 (7.53%) and feet swelling disease (‘dani furutu’/’awachifebe?u’) 69 (4.03%) were the highest cited ones (Table 2). Herbaceous life forms were the most cited i.e. 97 (45%) followed by shrubs 54 (25%) and trees 33 (15%). About 56 (70%) of the families treated a single ailment health condition while 24 (30%) of them treat more than a single ailment. Families that contain species that are used to treat multiple of human ailments include Asteraceae, Alliaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Rutaceae and Solanaceae. Asteraceae was the medicinal species richest family with 26 taxa followed by Lamiaceae 18, Fabaceae 19 and Euphorbiaceae 8. About 177 (83%) of medicinal species are known to be harvested from wild and 28 (15%) of them are cultivated. The medicinal species are known to be distributed in 13 different habitats. Forest constituted highest of 68 (32%) species followed by home garden 30 (14%) and living fence and fallow 24 (11%) (Fig. 2).

Human ailments freelisted

There were about 117 ailments freelisted during interview with informants. The top 10 ailments with informant consensus are given in Table 2. Abdominal pain was the highest cited ailment with 130 (7.59%) followed by acute febrile illness 129 (7.53%) and anthrax 69 (4.03%)

Table 2. Top ten most cited human ailments in Yem

Ailment	Yem name	no. of citations	%
Abdominal pain	konu sato	130	7.59
Acute Febrile illness	nekelebe?u	129	7.53
Anthrax	kemar	69	4.03
Earth breath disease	awachife be?u	65	3.79
Hepatitis	amshisho	58	3.39
Gonorrhea	ameba	53	3.09
Amoebiasis	ameba	45	2.63
Diarrhea	kenicha	44	2.57
Fresh wound	adis maza	44	2.57
Malaria	koksa	41	2.39

Parts, methods of preparation, routes and mode of application of medicinal plants

The results showed that leaf was the highest cited part for 197 (45%) preparations followed by root 83 (19%). About 10 different methods of preparation of plant remedies were reported among which maceration was the most used method with 201 (46%) remedies followed by

decoction 85 (19%) and infusion 64 (15%). About 296 (68%) remedies were taken via oral route followed by 71 (16%) dermal and 20 (5%) nasal. Drink was the most cited mode of application for the highest of 310 (71%) remedies followed by paint 26 (6%), inhale 25 (6%) and chew & swallow 20 (5%).

Informant Consensus Factor (ICF)

The results of ICF calculated depicted largest ICF value of 0.82 (Table 4) for Gastrointestinal & Visceral organs ailments category (GIV) (being treated with 91 species, 506 use reports). The GIV was also highest with regard to number of taxa used treat and number of uses reported. This category contained 15 ailments such as abdominal pain (treated by 14 species), amoebiasis (by 13 species), child diarrhea & hepatitis (treated by 10 species each), nephritis (by 8 species), diarrhea (by 7 species), hemorrhoids (by 5 species), taeniasis (by 4 species), ascariasis (by 3 species), dysentery, dyspepsia, constipation, poor appetite, vomiting and sudden abdominal pain each treated by a single medicinal species.

Table 4. ICF values of Mps for human uses

(UR = no. of use reports, spp.= # of species used for treating ailments, BVI = Blood Vascular & Infectious, DR = Dermatological ailments, GIV = Gastrointestinal & Visceral organs ailments, MISc = Miscellaneous

ailments, MSK= Musculoskeletal ailments, RS = Respiratory System ailments, PS = Psychospiritual & cultural ailments, RUG = Reproductive & Urogenital ailments, SH = Sensorial ailments & Headache)

Category	UR	Spp.	ICF
BVI	211	70	0.67
DR	207	59	0.72
GIV	506	91	0.82
MISc	277	54	0.81
MSK	114	31	0.73
PS	67	18	0.74
RUG	97	32	0.68
RS	143	30	0.80
SH	106	28	0.74

Table 5. Species with large FL(%) values

Species	ailment	Ip	Iu	FL(%)
Haplocarpha rueppellii	abdominal pain	40	40	100
Carduus schimperi	acute febrile illness	25	25	100
Inula confortiflora	sudden ailment	17	17	100
Maesa lanceolata	abdominal worms	13	16	80
Embelia schimperi	abdominal worms	12	16	75
Rumex abyssinicus	hepatitis	24	32	75
Verbena officinalis	child diarrhea	12	18	65
Brucea antidysentrica	sudden abdominal pain	9	14	64
Hagenia abyssinica	taeniasis	17	28	60

Fidelity level, FL(%) of selected medicinal species

Species that scored large FL values include *Haplocarpha rueppellii* (for abdominal pain) 100%, *Carduus schimperi* (for acute febrile illness) and *Inula confortiflora* (for sudden ailment) each 100%, *Maesa lanceolata* (for abdominal worms) 80%, *Rumex abyssinicus* (for hepatitis) 75%, *Verbena officinalis* (for child diarrhea) 65%, *Brucea antidysenterica* (for abdominal pain & diarrhea) 65% and *Hagenia abyssinica* (for taeniasis) 60% (Table 5).

Indigenous medicinal plant knowledge (mpk) and socio-economic variables

The proportion of informants based on socio-economic (predictor variables)are given in (Table 7). Accordingly, based on gender, about 38 (55%) of the informants were males and 31 (45%) females; agewise 38 (55%) were old agers, 19 (28%) middle agers and 12 (17%) young agers; by religion 53 (77%) of them were Christians and 16 (23%) Muslims; by level of education 36 (52%) were uneducated, 28 (41%) elementary and 5 (7%) high school and above, and 47 (68%) general informants and 22 (32%) key informants.

Table 7. Proportion of informants by socioeconomic variables

Variable	Category	no.	%
Gender	male	38	55
	female	31	45
Age	young (18-35)	12	17
	middle (36-50)	19	28
	old (>50)	38	55
Religion	Orthodox	51	74
	Muslim	16	23
Education	noneducated	36	52
	elementary (1-8)	28	41
	highschool & above	5	7
Informant proficiency	general	47	68
	key	22	32

Analysis of multiple linear regression showed that 31.10% of the variance was explained by the model (Table 8) with modest correlation of 0.56 between the outcome and predictor variables. The model was a significant predictor of medicinal plant knowledge, $F(5,63) = 5.69$, $p < 0.001$(Table 9). Only, gender ($B = -6.13$, $p = 0.025$) and informant proficiency ($B = 10.08$, $p < 0.001$) significantly contributed to the model while age ($B = -0.28$, $p = 0.88$), religion ($B = -4.50$, $p = 0.09$) and education ($B = -0.36$, $p = 0.87$) did not (Table 10). Based on the model, there was a modest positive correlation between informant proficiency $r = .46$ ($p < 0.001$), and a modest negative correlation between gender and mpk, $r = -.36$ ($p=0.001$).

Table 8. Model Summary of regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.558[a]	.311	.257	10.259
a. Predictors: (Constant), informant, religion, education, gender, age				

Table 9. ANOVA of Regression model

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2997.071	5	599.414	5.696	.000[b]
	Residual	6630.176	63	105.241		
	Total	9627.246	68			
a. Dependent Variable: mpk						
b. Predictors: (Constant), informant, religion, education, gender, age						

Table 10. Regression model coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	21.240	10.58		2.006	.049
	gender	-6.131	2.670	-.258	-2.296	.025
	age	-.279	1.790	-.018	-.156	.877
	religion	-4.500	2.648	-.179	-1.699	.094
	education	-.363	2.233	-.019	-.163	.871
	Informant proficiency	10.078	2.764	.398	3.646	.001
a. Dependent Variable: mpk						

The regression model was:
Medicinal plant knowledge (mpk) = 21.24 - 6.13*gender - 0.28*age - 4.50*religion - 0.36*education + 10.07*informant proficiency.

Diversity, abundance and richness of medicinal plants in the plant communities studied

Three plant communities identified in Yem are highlighted in Table 11. The synoptic values of dominant species are given in Appendix 3. The proportion of Mps that were enlisted during interview and encountered in the study quadrats were highest 113 (47%) species. The analysis diversity of Mps in study quadrats showed diversity and evenness of 2.11 and 0.45, respectively (Table 11).

Table 11. Shannon's diversity, evenness and quantitative information of community clusters (*H'* = Shannon's Diversity index, *J'* = Shannon's evenness index, A = community no., B = quadrat no., C = altitude range, D = overall species richness)

A	B	C	D	H'	J'
1	1,2,11 - 17	2485-2559	161	4.56	0.89
2	3-10	2505-2554	151	4.56	0.91
3	18 - 30	1677-1881	184	4.89	0.94

Community 1. *Juniperus procera-Syzygiumguineens*e subsp. *guineense-Podocarpus falcatus* type

This community consisted of 9 quadrats and its elevation range was between 2485 - 2559 m. Its overall species richness, Shannon's diversity (*H'*) and evenness (*J*) were 161, 4.56 and 0.89, respectively (Table 11). This community is rich with 37 mps. The medicinal species with the highest synoptic values under this community in descending order are *Juniperus procera (*6.22), *Syzygium guineense* subsp. *guineense* (4.00), *Podocarpus falcatus* (3.44), *Osyris quadripartita* (2.44), *Olinia rochetiana* (2.22), *Myrsine africana* (2.11) and *Ilex mitis* (2.00).

Community 2. *Ficus sur-Hagenia abyssinicaVernonia myriantha* type

This community had 8 quadrats and its altitudinal range varied between 2545 - 2555 m and its overall species richness, Shannon's diversity (*H'*) and evenness (*J'*) were 151, 4.56 and 0.91, respectively (Table 11). This community had 33 mps. The medicinal species that highest synoptic values of this community were *Ficus sur* and *Hagenia abyssinica* each (2.75), *Vernonia myriantha* (2.63), *Erythrina brucei* (2.50), *Croton macrostachyus* (2.25) and *Arundinaria alpina* (2.13).

Community 3. *Combretum molle -Acanthus polystachius-Sapium ellipticum* type

This community included 13 quadrats and its altitudinal range varied between 1677-1881 m along Gibe River valley. Its overall species richness, Shannon's diversity (*H'*) and evenness (*J'*) were 184, 4.89 and 0.94, respectively (Table 11). The community consisted of MP richness of 35 species. The medicinal species with the highest synoptic values in this community were *Combretum molle* (2.33), *Acanthus polystachius* (2.15), *Syzygium guineense* subsp. *guineense* (2.08) and *Sapium ellipticum* (1.92). HH H hhhhhhhkkkllllll

Discussion

Diversity, abundance and habit of mps reported for human ailments

The findings showed that the Yem have rich traditional knowledge and use of mps for human health care and use them side by side with the biomedical health system. This is due to long experience and trial & error that led to discovery of efficacious taxa by the society, the accessibility of Mps, cultural acceptance, and the cost of the biomedical health care. The diversity medicinal plants inventoried in the present study conforms with other cultures in Ethiopia and overseas that used Mps to treat human ailments [31-38]. Few medicinal families such as Asteraceae, Alliaceae Euphorbiaceae, Fabaceae, Lamiaceae, Rutaceae and Solanaceae were reported used to treat more than a single ailment which might be attributed the popularity of the taxa in the families among the community for treating multiple of ailments. Asteraceae was found to treat the highest number of health problems which might attributed big number of medicinal taxa to it contains. Reports indicate that a big number of taxa of this family are known to possess rich secondary metabolites such as steroids, terpenes and alkaloids that are used as antiinflammatory, analgesic anantipyretic and antioxidant agents as proven in research works [39-40]. The predominant use of herbs for human ailments might be attributed to their wider distribution and accessibility. The fact that most medicinal species obtained from wild sources mainly from forest habitat might pose use pressure as they are not managed. Studies indicate that wild harvested taxa are threatened due to overexploitation and poor management practices [41-43].

Diversity and abundance of mps in the plant communities

The medicinal species in the quadrats of Yem had higher diversity and evenness. The three plant communities identified had almost close MP richness which might be due to closer number of sample quadrats they contain and similar topographic and climatic factors. [32] similarly reported variation in diversity and evenness of Mps from southwest Ethiopia.

Parts used and methods of preparation plant remedies

The finding that leaf was the most used part might be with a thought that it contains healing bioactive substances, its ease for collection and its availability for most seasons of the year. Other studies similarly reported predominant use of leaf [43-47]. Maceration was the highest cited method of plant remedy preparation. With maceration, the mixture of the damp solid material is pressed then is strained, and the combined liquids are clarified by decantation or filtration after standing [48]. Other studies also reported maceration as a method of remedy preparation [49-50].

Paired Ranking, Informant Consensus Factor and Fidelity Level of medicinal species

These tools showed that Yem area has high diversity of species that have popularity and cultural agreement among the communities to be candidates for further phytochemical analyses and clinical trials for standardising their employment in health system and development of drugs when possible. *Rumex abyssinicus* was the most preferred remedy for hepatitis. The Yem do not visit modern medical

practitioners for this ailment, rather they use widely this species. The highest ICF values obtained gastrointestinal & visceral organs ailments category indicates the highest prevalence of the ailments mentioned in this category. The high prevalence of ailments in this category might be attributed to poor hygienic living conditions such as absence of enough water and sanitizing agents for washing topical body parts, lack of sanitation and living along with domestic animals, consuming of raw/uncooked meat, lack of sanitation of dishes and improper management of prepared food, local climate favouring vectors such as flies, lack of balanced diet, lack of awareness and poverty. According to [51], the ailments associated with poor sanitation are particularly correlated with poverty and infancy which accounts for about 10% of the global burden of disease. The high ICF score further indicates high dependence of local people on the plants that are available in the local flora and used for selection of specific plants for further search of bioactive compounds [52-54].

The high fidelity level values closer to 100% in this finding show that almost all use-mentions refer to the same purpose, that is the plants (and their use for a particular purpose) are most preferred as indicated by [27]. Generally, species with the highest fidelity level values are known to possess highest healing potential of ailments and they are considered as model plants that can be employed for further phyotochemical investigation [25], [52],[55].

Effects of socio-economic variables on mpk

The significant difference in mpk and gender, males being more knowledgeable than females might mainly be attributed to difference in occupation [56-57]. The significant difference among key and general informants, that the key informants knew more than the general informants might be attributed to specialisation in herbal knowledge [57]**.** [38] similarly reported that medicinal experts could list more treatments than lay informants. The absence significant variation among religious groups in our finding might due to the fact both Christian and Muslim religions permit the use of medicinal plants to cure illnesses besides their belief in faith healing depending on doctrine of their religion. Similar findings are also reported by [44],[58].

The negative coefficients of gender, age, religion and education in the equation suggest negative correlation; as the values of these variables increase, the mpk decreases. But the later three were not significant. The positive coefficient in informant proficiency indicates positive correlation and increase of mpk with informant proficiency. The finding that age and education were not significant predictors mpk might be attributed to that mpk is commonly a public domain that might be related the fact that the Yem have a yearly mass mps gathering event from Bori mountain in which all age and education groups participate share the mpk openly (Woldemariam, in press). This finding is in disagreement with some studies that reported that age is a of predictor of mpk, and older people are more knowledgeable and youngsters who distrust traditional medicine [56-57]. Our finding with regard to education agrees with [59] who reported that mpk is not affected by level of education.

Conclusion

The number of mps recorded in the current study is one of highest inventories indicating that the Yem community have deeprooted traditional knowledge of using plants for managing human health care. The mps are the available health care inputs for the Yem who utilise them side by side with the mainstream biomedical system. Conducting phytochemical screening and clinical trials of the mps with high informant consensus and FL including *Carduus schimperi, Haplocarpha rueppellii, Inula confortiflora*, *Maesa lanceolata* and *Rumex abyssinicus* is suggested in the first priority line for their efficacy, safety and standard uses in primary health care. Gender and proficiency in mps were found to be predictors of mpk among Yem. The different land use systems were known to be still reservoirs for medicinal and useful plants. The Ethiopian Biodiversity Institute needs to work with local community for promoting and conserving the knowledge the biota and indigenous knowledge.

Declarations

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Availability of data and materials

Most of data collected and analyzed and presented in Figures and Tables in the text, and Appendix is included as additional file.

Authors' contributions

Woldemariam collected, analyzed the data and written the manuscript, and was the major contributor of the study. Demissew and Asfaw advised, reviewed and approved the final manuscript.

Availability of data and materials

All data collected and analyzed in this paper are included within the article and attached in the form of "Appendix" as additional file.

Ethics approval and consent to participate

A letter of cooperation for conducting the research was written on the behalf the corresponding author from Department of Plant Biology and Biodiversity Management, Addis Ababa University to Yem Special District Administration. The local authorities acknowledged the letter and gave permission to conduct the research, gather data from informants and field and take plant samples from field. Additionally, informants were asked about their view if their name is openly accessed, and they have agreed to have their names and personal data to be published. Then, Addis Ababa University approved the research finding after it was presented for the thesis defense.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

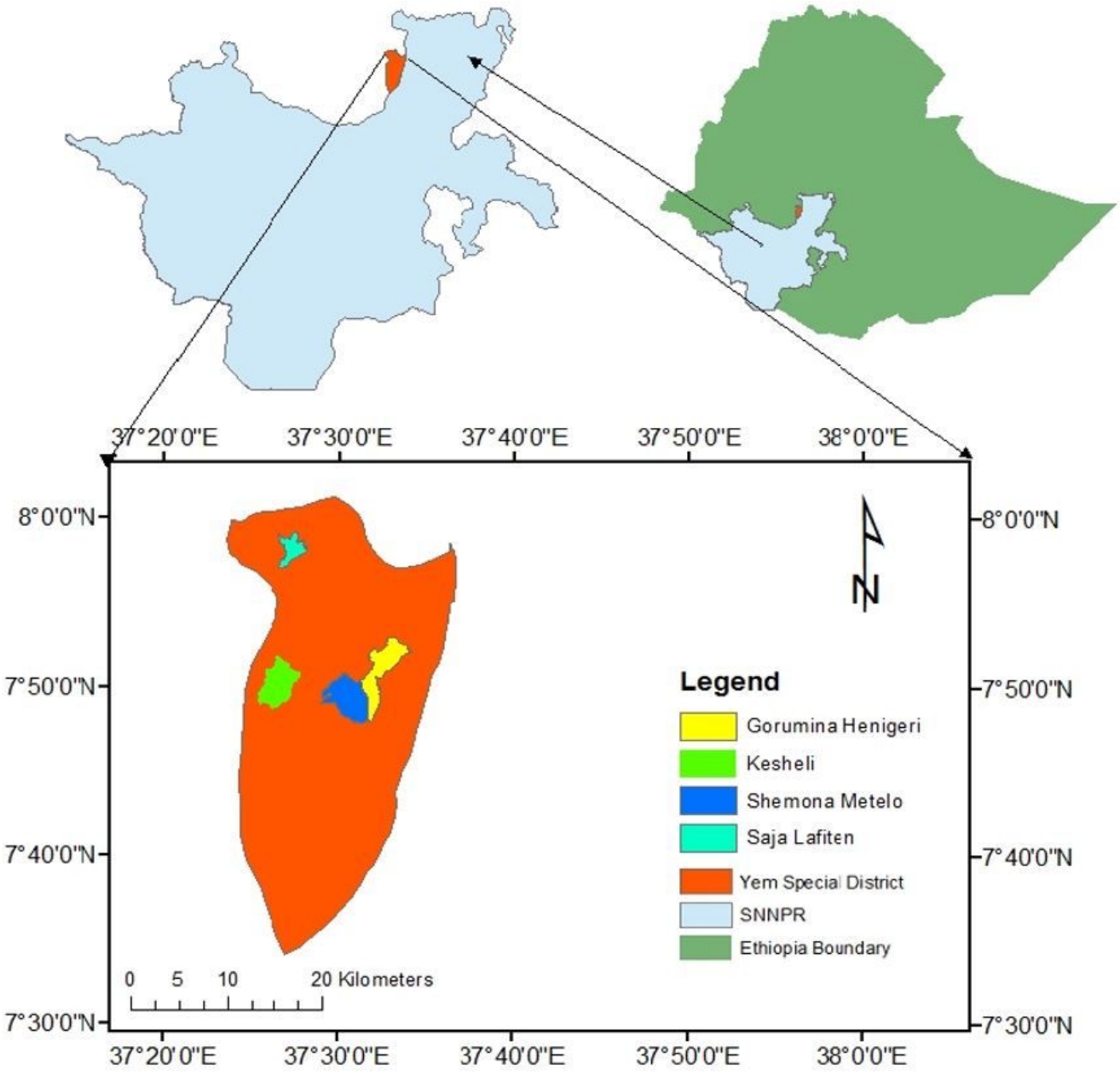
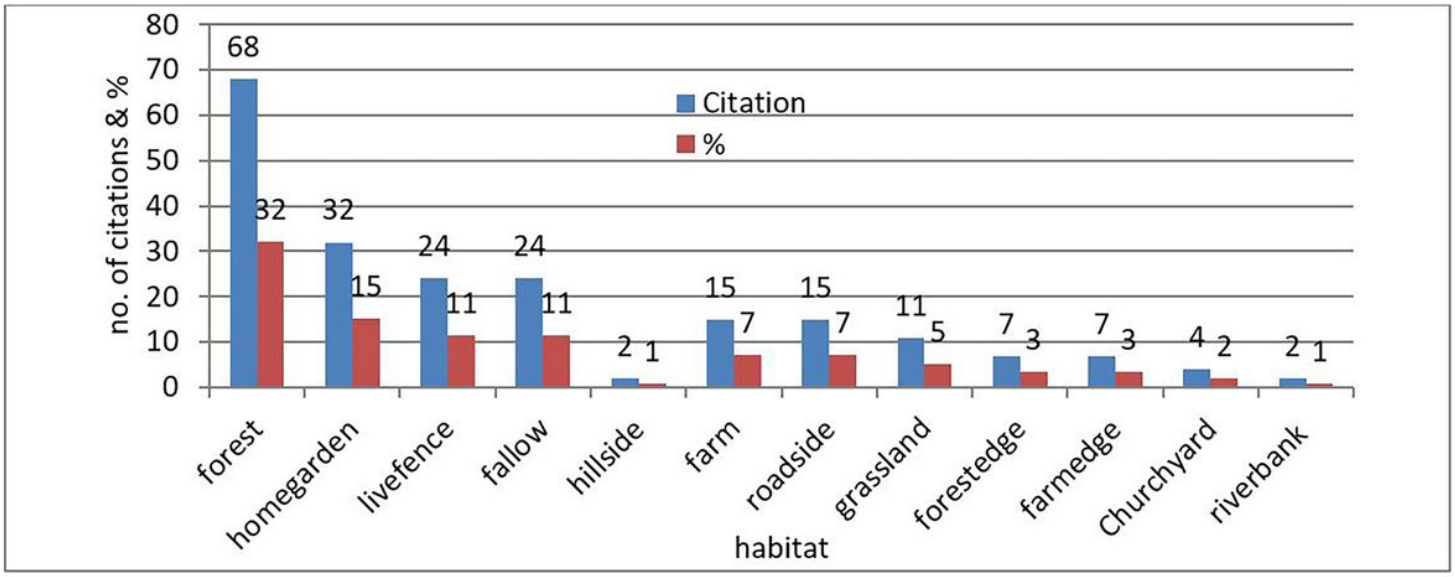


Figure 1

Location map of Yem Special District and subdistricts under study in Ethiopia. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.



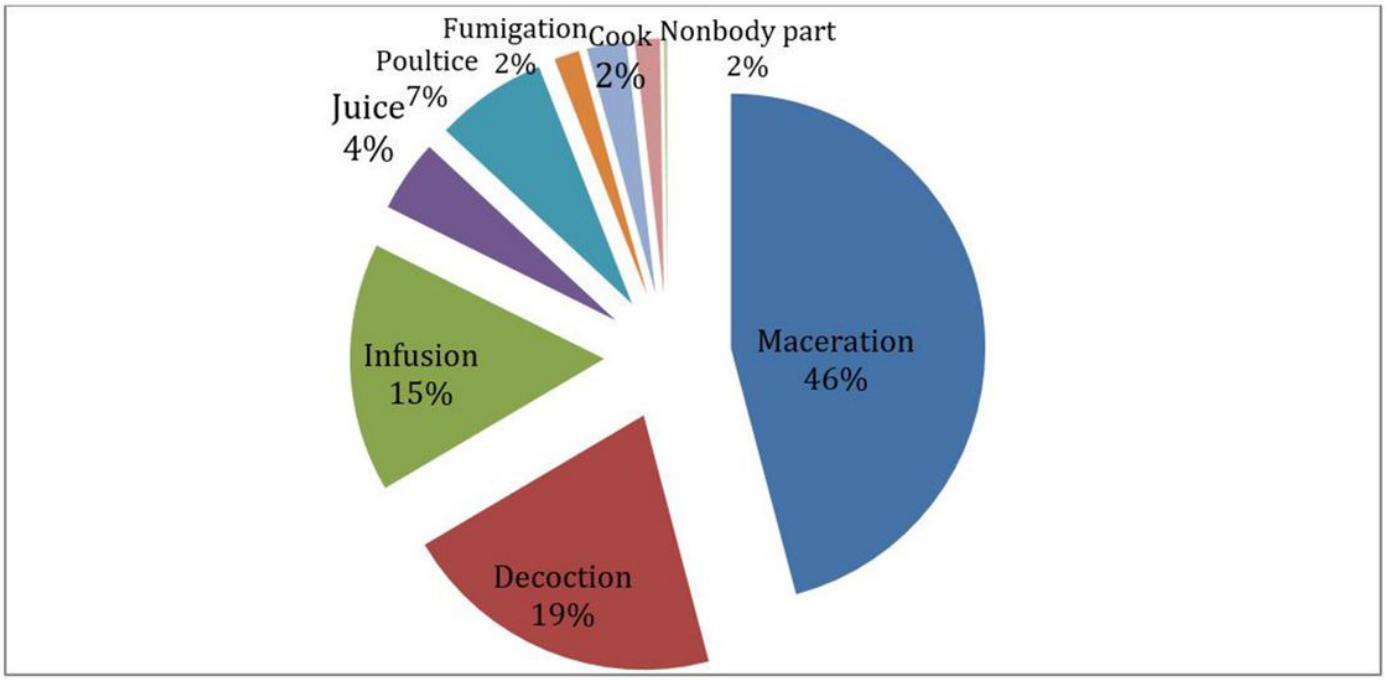


Figure 2

Habitat of Mps used for human ailments . Methods of remedy preparation

Supplementary Files

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