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# Ethno-Botanical Investigation of Traditional Medicinal Plants used to Protect Honey Bee Pests and Predators in Selected Districts of East Shewa and West Arsi Zones of Oromia, Ethiopia

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## Abstract

Ethiopia has rich flora with different plant species having use in the health care system based on local indigenous knowledge. In this study, plants of traditional medicinal use and indigenous knowledge associated to them in East Shewa and West Arsi were investigated. A total of 146 informants (age≥25) were selected to collect information on medicinal plant use from three sampled districts. Of these, 15 key informants were selected purposely based on recommendation by local elders and authorities. Ethno-botanical data were gathered using semi-structured questionnaires, field observations and group discussions with local traditional medicine practitioners. Data were analyzed using descriptive statistics. Moreover, Jaccard similarity index, informant consensus factor, fidelity level, preference ranking and direct matrix ranking were computed. Ethno- medicinal use of 34 plant species distributed in 21 genera and 16 families was documented. Highest number of species (3) was under family Asteraceae and myrtaceae. Habit wise, 50% were Trees followed by shrubs (29.4%), herbs (14.7%) and climbers (5.8%). The most widely used ways of applying plant materials to protect honey bee pests and predators were cutting the leaves and smearing around hive stand and hive entrance (47.6%), smoking (5.7%), cover hives standwith (7.6), put on hives (2.85) and planting around hives (4.76). Ants, lizards, beetles and snakes had the highest ICF value (> 90). Therefore, biochemical profiles of plant species used to protect pests and predators with high ICF should be investigated for screening of the active principles.

**Keywords**: Ethno-botany; Indigenous knowledge; Informant Consensus Factor; Honey bee

## Introduction

Ethno-botany is the study of how people of a particular culture and religion make use of indigenous plants. It accounts for the study of the relationship between people and plants for their use as medicines, food, shelter, clothing, fuel, fodder and other household purposes [1]. The current account of medicinal plants used in Ethiopia shows that about 887 plant species are reported to be utilized in the traditional medicine [2].

Due to ecological shifts and environmental perturbations, plant resources are dwindling at an alarming rate, suggesting the rapid loss of medicinal plants and their associated indigenous knowledge. Ethno-botanical studies are often significant in revealing locally important plant species especially for the discovery of new drugs [3]. Despite the agro-ecological and cultural diversity of the country, the documentation of medicinal plants and associated indigenous knowledge appears incomplete [4]. There is not much study in western part of Ethiopia, and particularly no documented study is found from West Arsi and East Shewa zones of Oromia. This suggests that there is still a gap in our knowledge about Ethno-botanical data on medicinal plants from various parts of Ethiopia, although we have rich and diverse ethnolinguistic groups throughout the country [5]. According to Pankhurst (2001), detailed information on the medicinal plant could only be obtained when studies are taking place in the various areas of the country to include places where little or no botanical and Ethno-botanical explorations have been made. Among rural communities of East Shewa and West Arsi zone as would be the case elsewhere, traditional medication is believed to be an important health care system, which mainly involves the use of locally available medicinal plants. However, such knowledge and practices, and plant resources may be threatened due to anthropogenic and other natural factors. Thus, concerted Ethno- botanical research plays a vital role to draw information on plants and related indigenous knowledge for conservation and sustainable utilization. Honey bee, Apismellifera L., is considered as an essential organism to the agricultural sector due to its role in pollination and alleviation of poverty in rural areas. Many pests and predators attack honey bee colonies causing severe damages and economic losses. These pests and predators include Ants, lizards, wax moths, small hive beetles, Snakes and parasitic flies. Using chemical methods to control these pests and Predators causes some negative effects on honey bees and contaminates their products, while using available indigenous knowledge and biological control agents is promising and has no serious hazards [6]. Decline of honeybee populations is of great concern around the world because of pests, predators and diseases (Panuwan, 2016). Traditional medicinal plants are used to protect Predators, insects and fungi (Jillian, 2015; Cobiac L, et al., 2006; Roy J, 2004). It is well knowing that in East Shewa and West Arsi, many pests and predators of honey bee colonies cause decreases in honey bee products and productivity. This study is, therefore, designed to collect, identify and document traditional medicinal plants that are used by local people for the protection of honey bees from pests and predators in the study area.

## Materials and Methods

### Survey and Selection of Study Sites

The study was conducted in selected districts of West Arsi and East Shewa zone. Based on beekeeping potential of the area, three districts, Kofale, Wando Genet and Dodola were selected from West Arsi zone. From East shewa zone, AdamiTuluJidoKombolcha district was selected. The districts were selected based on the availability of traditional medicine practitioners, traditional medicine use history, and altitudinal variation between districts.

### Ethno-botanical Data Collection

Prior to Ethno-botanical data collection, respondents were selected from the selected districts. Totally, 146 respondents (aged ≥25) and 5 key informants (traditional healers) were selected from each district. The key informants were selected by purposive sampling based on the information gathered from the local people while other respondents were randomly selected. Data collection was undertaken using interviews, group discussions and field observations being guided by key informants. Voucher specimens were collected, pressed, and dried for identification. For some species, preliminary identification was done in the field using keys and illustrations. In addition, further identification of all specimens was done by comparison with authentic specimens, illustrations and taxonomic keys from Flora of Ethiopia and Eritrea.

Data collected during the study include the local names of the plants they use to treat pests and predators, pests and predators treated, part(s) of plants used, methods of gathering, methods of preparation of remedies, route of administration of remedies, application of the remedies, dosage and side effects of the treatment, use of the plants other than medicine, types of threat and conservation problems and plant habit and habitat.

## Data Analysis

The collected data were analyzed by using descriptive statistical, Jaccard's similarity index (JI), Informant consensus factor (ICF), Fidelity level (FL), preference ranking and direct matrix ranking. Percentage and frequency were used to summarize ethno-botanical data.

### Jaccard's similarity index (JI)

Jaccard's similarity index was calculated to compare similarity between districts of different altitudewith regard to knowledge on medicinal plants. For this, presence of a given plant species and its utility as medicine or its absence/ not considered as medicine are used as data sets.

$$JI = c / a + b + c$$

Where, JI is the Jaccard similarity index, 'c' is the number of species shared by the study sites, 'a' is the number of species in study site A only and, 'b' is the number of species in study site B only. The JI values range between 0 and 1, where a value of 1 indicates complete similarity.

### Informant consensus factor (ICF)

Informant consensus factor was calculated for categories of ailments to identify the agreements of the informants on the reported cures using the formula used by (Rodrigo et al., 2005). ICF was calculated as follows: number of use citations for each ailment (nur) minus the number of species used (nt) for that ailment, divided by the number of use citations for each ailment minus one.

$$ICF = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

### Fidelity level(FL)

The fidelity level, the percentage of informants claiming the use of a certain plant for the same major purpose, iscalculated for the most frequently reported ailments using the following equation (Teklehaymanot,2007).

$$FL(\%) = \frac{NP}{N} \times 100$$

Where, Np is the number of informants that claim the use of a plant species to treat a particular pests and predators, and N is the number of informants that use the plants as a medicine to treat any given pests and predators.

### Preference ranking

Preference ranking is used to compare the most effective medicinal plants used by the community to treat the particular disease, pests and predators. Preference ranking was conducted following Martin (1995) and Cotton (1996) for six most important medicinal plants. For this, five informants were selected from each district to identify the best preferred medicinal plant species for treatment of the honey bee pests and predators. Each informant was provided with six medicinal plant used being paper tagged. Then they were asked to assign the highest value (6) for the most preferred species against the illness and the lowest value (1) for the least preferred plant and in accordance of their order for the remaining ones.

### Direct Matrix Ranking

Direct matrix ranking exercise was done following Martin (1995) and Cotton (1996) to compare multipurpose use of a given species and to relate this to the extent of its utilization versus its dominance. Based on information gathered from informants, multipurpose tree species were selected out of the total medicinal plants and use diversities of these plants were listed for the selected key informants to assign use value to each species. Each key informant was asked to assign use values (5=best, 4=very good, 3=good, 2=- less used, 1= least used, and 0=not used). Accordingly, each key informant uses values for the selected multipurpose medicinal plant species, average value of each use diversity for a species was taken and the values of each species were summed up and ranked.

## Results and Discussions

### Socio-demographic of the respondents

Based on the degree of responsibilities to care for honey bee health and assumed accumulation of traditional knowledge of the community, respondents were categorized into four age classes. Age distribution of the informants showed that the majority (61.6%) are between 45 and 60 years of age followed by 31-45 (21.9%), 18-30(6.2%) and >60 (10.3%). Marriage wise,

95.9% of the respondents were married, whereas 4.2% of them were unmarried. The majority (44.6%) of respondents had no formal education, whereas 32.2, 6.2 and 1.4% of them had elementary school, high school and college level educations, respectively. Majority of the respondents 98.6% were males and only 1.4% were females. From the participants 69.9% were Muslims and 29.4% Christians.

## Ethnomedicinal plant species used by people of the study areas

From the study region, a total of 34 kinds of medicinal plants used to combat various honey bee predators and pests were collected. These plants are from 16 families and 21 genera. Out of these plants, 17 species (50%) were utilized to control ants, spiders, snakes, lizards, and beetles, whereas 14 species (41.1%) and 3 species (8.82%) were noted to treat only ants and honey badger, respectively. This implies that localcommunities in the districts of Kofale, Adami Tulu JidoKombolcha, Wando, and Dodola use traditional medicine derived from plants. Asteraceae and Myrtaceae were two families with three species each. Other families each have a single or double species (Table 1). When comparing the number of reported medicinal plant species throughout the investigated districts, Jaccard's Similarity Index (JI) was computed to determine how similar they were. In accordance with the findings, respondents from Kofale (2450 masl) and Dodola (1950 masl) reported the same two species (Hagenica abyssinica and Syzygiumguineense) with a JI value of 0.25. The same two species, with a JI value of 0.25, were reported by respondents from Adami Tulu (1558 masl) and Wando (1750 masl). The discrepancy between these two districts may be the result of environmental variations. For instance, the altitudes of Kofale (2450 masl) and Dodola (1950 masl) differ from one another, and the way that information about medicinal plants was shared between residents of the two districts varied. In other words, there may not be much environmental overlap between these two districts, and communication concerning medicinal plants between them has been scarce.

The majority of medicinal plant species (35.2%) were harvested from the wild, followed by home gardens (26.4%), highways (14.7%), agricultural fields (11.7%), and live fences (11.7%). The fact that so many different species of medicinal plants were found growing wild suggests that conserving medicinal plants in the research region should be possible Various districts of the study area reported using specific plants more frequently than others as medicinal plants to ward against various honey bee pests and predators. Syzygiumguineense, according to 55% of respondents, is used to defend honeybee colonies against ants, spiders, lizards, and snakes. Eucalyptus globules, Hageniaabyssinicaand Rutachalepensis are employed against ants by 50% of respondents. Similarly, 53% of respondents said Acacia bussei LandCroton macrostachyus help to keep out lizards, snakes, and ants. On the other side, according to 40% of respondents, Vernoniaamygdalinais used to prevent ants, while 29% of respondents stated Ziziphusmucronata protects honeybee colonies from ants, spiders, and beetles, and 30% of respondents said Dovyalisabyssinica avoids honey badgers.

Among the 34 therapeutic plants discovered, trees make up the majority, followed by shrubs, herbs, and climbers (Figure 2). This demonstrates that in the study region, trees and shrubs are the most commonly used medicinal plants. This could be as a result of these trees and shrubs being more prevalent in the research areas than herbs and climbers. Alemayehu (2015), who did research on the medicinal plants of the Ada'a District, east Shoa zone, also reported the relatively high number of trees and shrubs used for medicinal purposes.

**Table 1:** Some of the medicinal plants cited most by informants

| Botanical Name of Medicinal Plants | No. of Informants | Percentage | Districts |
|---|---|---|---|
| Syzygiumguineense | 55 | 55.0 | Kofale |
| Acacia Bussei | 53 | 53.0 | Kofale |
| Eucalyptus globulusLabill | 50 | 50.0 | kofale |
| Enseteventricosum(Welw) | 45 | 45.0 | kofale |
| Hageniaabyssinica | 42 | 42.0 | Dodola |
| Eucalyptus camaldulensis | 45 | 40.0 | Dodola |
| Vernoniaamygdalina Dell | 40 | 40.0 | Dodola |
| Oleaeuropia L. | 37 | 37.0 | Dodola |
| Cpsicumannuum L. | 34 | 34.0 | Dodola |
| Vernoniaauriculifera | 31 | 31.0 | Dodola |
| Ziziphusmucronata | 29 | 29.0 | Dodola |
| Dovyalisabyssinica(A.Rich)Warb | 30 | 30.0 | Dodola |
| Schinusmolle L. | 50 | 50 | wando |
| Rutachalepensis L. | 45 | 45 | Wando |
| Aloe macrocarpaTod | 35 | 35.0 | A/Tulu |
| Croton macrostachyus L. | 30 | 30.0 | A/Tulu |
| Justice schimperiana (Hochst. | 25 | 25.0 | A/Tulu |

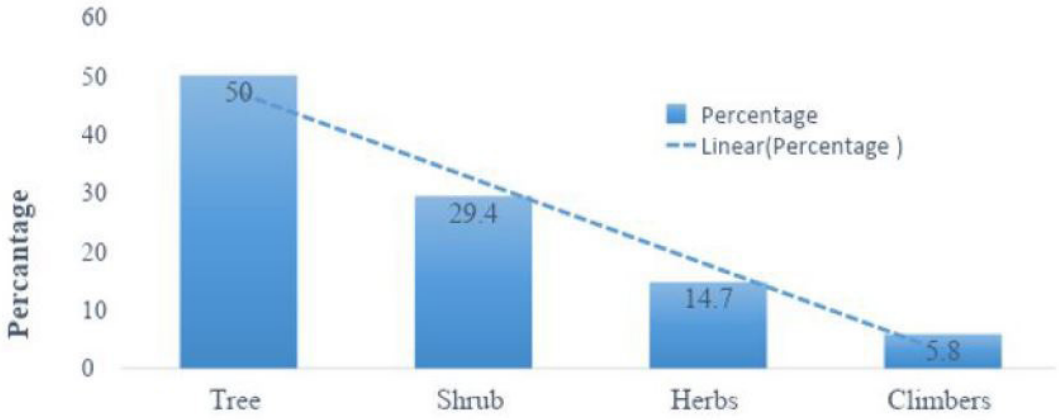


**Figure 1:** Growth forms of medicinal plants used to protect honey bee pests and predators

## Plant Parts Used to Protects Honey bee pests and Predators, Methodsof Preparationand Conditions

Despite reports of many plant parts, the leaf, followed by the stem, the whole portion, the seed, and the root, werethe most frequently used plant components for remedy concoctions (Table 2). There were additional reports of other plant components, such as berries and bulbs (Table 2). This outcome is in line with some earlier research works carried out across the nation (Mirutse, 1999; Endalew, 2007; Jarrso, 2016, Mekonen 2013; Mulugeta, 2014).

**Table 2:** Plant parts used for traditional medicine preparations

| Plant parts | Total responses | % of total |
|---|---|---|
| Leaf Stem | 75 25 | 51.3 17.12 |
| Whole parts Root Seed Fruit | 20 11 65 | 13.67.534.103.42 |
| Bulb | 4 | 2.73 |
| **Total** | **146** | **100** |
| | | |

## Ways of Applying Plant Remedies

The prepared traditional medicines are applied in a number of methods among which cutting the leaves (47.6%), put the leaves in front of hives (19.04%), cover hive stands with (7.60%), smoking (5.7%), Cleaning by fresh leaves smear by fresh leaves parts of the hives (6.6%), cover hive stands (7.6), planting around hives as fence (3.80%) and put on the hives (2.85%) were mentioned. In this study, cutting the leaves and smearing the hive stands and hive entrance accounts for the largest percentage (Table.3).

**Table 3:** Ways of applying the plant remedies used to protect honey bee pests and predators.

| No. | Ways of Applying plant materials | Total Responses | Percentage (% ) |
|---|---|---|---|
| 123 | Cutting the leaves & smear hive stand &hive entrance Put the leaves in front of hives Cutting the stem & put in the hive | 50202 | 47.6 19.04 1.90 |
| 4 | Planting around hives | 5 | 4.76 |
| 5 | Put on | 3 | 2.85 |
| 6 | Smoking | 6 | 5.73.8 |
| 7 | Planting around hives as fence | 4 | 3.8 |
| 8 | Cleaning by fresh leaves smear by fresh leaves parts of the hives | 7 | 6.6 |
| 9 | Cover hive stands | 8 | 7.6 |
| | **Total** | **105** | **100** |

## Informant Consensus Factor (ICF) and Fidelity Level

The pests and predators of the study area have been grouped into different categories based on the site of incidence of the pests and predators, condition of the pests and predators as well as treatment resemblance of the disease by the local people. Analysis of ICF showed that values ranged from 0.85 to 0.98 for the pests and predators categories (Table.4). Of the pests and predators categories, ants, beetles and honey badger had the highest ICF value suggesting the common occurrence of these problems and agreement of the people on their remedy. It has been shown that medicinal plants that are effective in repelling certain pests and predators and well known by the community members have higher ICF values.

**Table 4:** Informant Consensus Factor (ICF)

| Disease categories | Nt | Nur | ICF |
|---|---|---|---|
| Ants | 8 | 98 | 0.92 |
| Lizards | 11 | 95 | 0.89 |
| Beetles | 2 | 20 | 0.94 |
| Spiders | 9 | 90 | 0.91 |
| Snakes | 10 | 65 | 0.85 |
| Honey badger | 2 | 16 | 0.93 |

Fidelity level (FL) is an index which shows the specificity of a given plant to effectively treat a particular pests and predators of honey bees. Fidelity level was then calculated for some commonly used medicinal plants to treat pests and predators/ailments. Result showed that Schinusmolle L. Eucalyptus globules,Rutachalepensis Croton macrostachyushad the highest FL followed by Acacia bussei,Hageniaabyssinica,OleaeuropeaVernoniaamygdalina& Aloe macrocarpa (Table 5). The medicinal plants that are widely used by the local people to treat one or very few cases have higher FL values than those that are less popular (Tilahun and Mirutse 2007; Mulugeta, 2014). High FL could also be an indication of efficiency of the reported plant to treat specific pests and predators.

**Table 5:** Fidelity index of some medicinal plants

| Botanical Name of Medicinal Plants | Examples of Pests treated | Np | N | FL | FL% |
|---|---|---|---|---|---|
| Schinusmolle L. Eucalyptus globulus Croton macrostachyus | Ants | 46 | 50 | 0.92 | 92 |
| Acacia bussei, Hageniaabyssinica,oleaeuropea | Lizards | 41 | 45 | 0.91 | 91 |
| Syzigiumguineense | Spiders | 40 | 45 | 0.88 | 88 |
| Vernoniaamygdalina& Aloe macrocarpa | Snakes | 35 | 41 | 0.62 | 85 |
| Anoonuu&Hageniaabyssinica | Beetles | 22 | 35 | 0.81 | 81 |
| Dovyalisabyssinica | Honey badger | 20 | 30 | 0.66 | 66 |

Where,Np is the number of informants that claim the use of a plant species to treat a particular pests and predators, and N is the number of informants that use the plants as a medicine to treat any given disease.

## Preference Ranking and Direct Matrix Ranking

When there are different species prescribed for the same health problem, people show preference of one over the other Preference ranking of six medicinal plants that were reported for protecting ants was conducted after selecting ten key informants. The informants were asked to compare the given medicinal plants based on their efficacy and to give the highest number (6) for the medicinal plant which they think is most effective in protecting ants and the lowest number (1) for the least effective plant in ants. Rutachalepensis scored 46 and ranked first indicating that it is the most effective in treating pests and predators followed by Eucalyptus globulus and the least effective was Syzigiumguineense (Table 6)

**Table 6:** Preference ranking of medicinal plants used for protecting ants

| List of medicinal Plants | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | Total | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rutachalepensis | 4 | 6 | 5 | 2 | 4 | 5 | 4 | 6 | 4 | 6 | 46 | 1st |
| Eucalyptus globulus | 6 | 5 | 4 | 5 | 5 | 4 | 4 | 3 | 4 | 4 | 44 | 2nd |
| Croton macrostachyus | 5 | 4 | 6 | 3 | 7 | 2 | 6 | 3 | 3 | 1 | 40 | 3rd |
| Hageniaabyssinica | 6 | 2 | 2 | 3 | 5 | 4 | 6 | 3 | 5 | 1 | 37 | 4th |
| Eucalyptus camudelencis | 3 | 3 | 3 | 8 | 2 | 3 | 1 | 2 | 3 | 3 | 31 | 5th |
| Syzigiumguineense | 2 | 2 | 4 | 2 | 1 | 4 | 4 | 2 | 1 | 3 | 25 | 6th |

**Table 7:** Direct Matrix ranking for the ten Selected Multipurpose Plant Species. Ranking was done based on the use criteria rated as 5 = best; 4 = Very good; 3 = good; 2 = less used; 1 = least used and 0 = no value)

| **Plant Species** | **Use Categories** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Charcoal** | **Constrc-tion** | **Fencing** | **Fire wood** | **Food** | **Forage** | **Furinu-ture** | **Medicine** | **Total** | **Rank** |
| Acacia bussei | 5 | 4 | 4 | 4 | 2 | 4 | 2 | 4 | 30 | 1st |
| Eucalyptus glob-ulus | 3 | 5 | 4 | 5 | 2 | 3 | 3 | 3 | 28 | 2nd |
| Eucalypcamaldu-lensis | 5 | 4 | 4 | 3 | 1 | 0 | 5 | 3 | 25 | 3rd |
| syzygiumguineense | 3 | 4 | 2 | 2 | 2 | 1 | 5 | 4 | 23 | 4th |
| Croton macro-stachyus | 4 | 4 | 3 | 3 | 0 | 0 | 3 | 4 | 21 | 5th |
| Vernoniaamygdali-naDovyalis | 2 | 2 | 2 | 4 | 0 | 4 | 1 | 4 | 19 | 6th |
| abyssinica | 1 | 0 | 5 | 3 | 1 | 2 | 1 | 3 | 16 | 8th |
| Enseteventricosum | 2 | 3 | 3 | 4 | 0 | 5 | 2 | 2 | 21 | 7th |
| Schinusmolle | 0 | 0 | 1 | 0 | 4 | 5 | 0 | 5 | 15 | 9th |
| Oleaeuropea | 0 | 5 | 2 | 3 | 0 | 5 | 1 | 5 | 21 | 7th |

In the study area, many medicinal plants were found to have different uses other than medicinal purpose. The major uses of plants reported were for firewood, charcoal making, construction, fencing, food, forage, furniture and medicine. The direct matrix ranking result showed that Acacia busseiranked first followed by Eucalyptus (Table 7).This result indicates that Eucalyptus globules and Eucalypcamaldulensis appear to have more demand than the others as they are used for more diverse purposes. The direct matrix ranking result also shows that the local people harvest the 10 multipurpose plant species mainly for firewood followed by charcoal, fencing, medicinal purpose, furniture, construction, forage and food (Table 7).

Threats to medicinal plants Rural people need plants for their livelihood in different aspects. In this study several factors both human and natural were found to contribute to the threats that affect survival of medicinal plants species in the study area. From the interview with informants, various factors were recorded as the main threats to medicinal plants in all Districts of study area. Agricultural encroachment, firewood collection, charcoal production, plant use for house and fence construction, overgrazing and urbanization were reported to be factors for the dwindling of natural vegetation in general and medicinal plants in particular. As a result, according to the respondents, the accessi bility of medicinal plants has become less when compared to the previous times.

### Transfer of knowledge on the use of medicinal plants

Traditional healers also keep their knowledge on medicinal plants for the sake of securing means of income and a cultural belief that telling information may make plants ineffective to cure the pests and predators/ailments. Similar findings were reported elsewhere (Abebe, 2017; Fassil, 2001; Mirutse and Gobena, 2003). However, it was recognized that Ethno-botanical knowledge on uses of some medicinal plants is transmitted orally to one or few family members to use in secrecy. They disclose their knowledge on medicinal plants at old age by the time when they most probably die before teaching the details of medicinal plants or when they are too old to walk to the field to show the plants in their habitats

## Conclusions and Recommendations

This study was conducted in Adami Tulu JidoKombolcha, Dodola, Kofale,Wando and Dugda Districts, with the objective of documenting ethno medicinal plants and indigenous knowledge on their use for medicine. 146 respondents have participated in this study as respondents. Data on medicinal plants use were collected through semistructured interviews, field observation, and group discussion and guided field walk. Totally 34 medicinal plant species used to protect honey bee pest and predators were documented. The majority of medicinal plant species (35.2%) were harvested from the wild, home gardens (26.4%), highway (14.7%), agricultural fields (11.7%), and live fences (11.7%). Syzygiumguineense, according to 55% of respondents, is used to defend honeybee colonies against ants, spiders, lizards, and snakes. Eucalyptus globules, Hageniaabyssinica and Rutachalepensisare used against ants by 50% of respondents. Similarly, 53% of respondents said Acacia bussei L and Croton macrostachyus help to keep out lizards, snakes, and ants.

The prepared traditional medicines are applied in a number of methods, among which cutting the leaves smearing in front of honey bee entrance (47.6%) and putting the leaves in front of hives (19.04%) are the major ones. The major threats to medicinal plants and the associated knowledge in the study area are firewood collection, charcoal production, agricultural expansion, uses of plants for construction and using plants for fencing and furniture. Based on the finding of the study, the following recommendations are forwarded:1) In order to conserve medicinal plants and preserve indigenous knowledge, local people should be aware of cultivating medicinal plants in their home gardens mixing with crops and as live fences,2) Encourage the local herbal medicine practitioners to enhance the use of traditional medicine through licensing and other incentives, 3)Attention should be given to standardization of measurement and hygiene of the medicines made from plants by training both the healers and other members of the local community, 4) Biochemical profiles of plant species used for diseases categories of high ICF should be investigated for screening of the active principles.

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