

Review Article

Aloes of Ethiopia: A Review on Uses and Importance of *Aloes* in Ethiopia

Bula Kere Oda and Baressa Anbessa Erena*

Department of Biology, Faculty of Natural and Computational Sciences, Bule Hora University, Ethiopia

*Corresponding author

Baressa Anbessa Erena, Department of Biology, Faculty of Natural and Computational Sciences, Bule Hora University, Bule Hora, Ethiopia, Tel: +251 91 2922336; P.O. Box: 144, Email: baressa.anbessa@gmail.com

Submitted: 03 February 2017

Accepted: 20 February 2017

Published: 22 February 2017

ISSN: 2333-6668

Copyright

© 2017 Erena et al.

OPEN ACCESS

Abstract

This review work tries to address on ethno botanical knowledge of *Aloe* plants in Ethiopia. There are 46 species of *Aloe* in Ethiopia in which about 66% of these *Aloe* species are endemic to the country. They are distributed in all floristic regions. *Aloes* are very important source of traditional medicine in Ethiopian communities to treat different ailments. In addition *Aloes* are used in soap production, jute sacks production, anti-microbial activities in cotton fabric, as thickening agent, degraded land rehabilitation and source of food for animals. Although there have been some attempts to conduct researches on Ethiopian *Aloe* species, the available information especially on commercial use, industrial use, propagation, germination and farming are insignificant and overlooked. As their distribution indicate *Aloes* are important component of Ethiopian dry-land ecosystem including pastoralist and agro-pastoralist area in which the amount of rain is low. In this area introducing *Aloe* farm system could be better alternative of poverty reduction and income generation. The presence of anthropogenic and environmental factors such as agricultural expansion into marginal lands, overgrazing, habitat destruction and restricted distribution may affect *Aloe* plants that could play great role in economic development for present and future generations of the country. As a result *Aloe* species need urgent conservation attention, effective documentation and further research.

Keywords

- *Aloes*
- Importance
- Diversity

INTRODUCTION

The *Aloes* are perennial plants that comprise herbs, shrubs and trees [1]. They are recognized by fleshy, strongly cuticularized leaves usually with spiny margins [2]. They are native to main land Africa south of Sahara except few species occurring in Arabian Peninsula and on small islands of the insular Africa. Hence, Sub-Saharan Africa, including the island of Madagascar accounts for over 90% of the 450 taxa (species, subspecies or varieties) of the genus *Aloe* known today. It has been suggested that the centre of origin for the genus is in the highlands of South East Africa [1,3], and the ancestral *Aloes* believed to spread during the Tertiary era. Although some species are very restricted in distribution, others are widespread and in the absence of competition, may become locally invasive. Southern Africa and Madagascar are particularly rich in endemic species [4].

Aloes are often thought to only grow in hot and dry climates but they actually grow in a variety of climates and ecosystems including desert, grassland, and coastal or even alpine areas. The genus occurs across a wide range of habitats, from dry forests to scrublands. The ecological range of *Aloes* generally excludes rain forest habitats, and except for species previously

grouped under the genus *Lomatophyllum*, which do not occur in lowland moist forests. The range of altitudes is wide, from 0 m (*Aloe massawana*) to over 2300 m for *Aloe juvenna*. The highest proportion of *Aloes* (32%) occurs between 100-1500 m above sea level. Higher altitudes have been reported from some species in Ethiopia (e.g. *A. ankoberansis*). *Aloe polyphylla*, can be found as high as 11,500 feet above sea level in the Drakens berg mountain of Lesotho [5]. *Aloes* usually grow in the open and rarely found among shrubs or trees. They are also adapted to arid habitats through their succulent habit [4].

Aloe species are adapted to highly disturbed areas and areas with extreme environmental conditions; and are found flourishing on nutrient deficient soils. In most cases *Aloes* are found growing in rocky or gravelly soils, but they will also grow in richer soils among grasses, out of cracks and crevasses in rocks, or in sand. *Aloe* plants growing in shade are generally more robust than those growing on exposed grounds. However, judged by their successful cultivation in different soil mixtures, *Aloes* are apparently tolerant to many soil types [6].

Aloes are successful because of several important adaptations to their environments. They use a special kind of photosynthesis

called CAM (Crassulacean Acid Metabolism) that minimizes water loss that would occur with standard photosynthesis in hot climates [7]. Another adaptation is an *Aloe's* ability to store relatively large amounts of water in the leaves; so in times of drought they will have a supply to draw upon [8]. A waxy coating on the surface of the leaves of *Aloes* also helps with moisture loss by minimizing evaporation of water from cells on the surface of the leaves and limiting water loss through the stomata. The wax can also reflect excess light away from the plant. This wax can be seen on the leaves of most *Aloes* as a bluish color cast [7].

To deter herbivory by thirsty desert dwellers, *Aloes* have developed two important features. Most *Aloes* have *spines* along the margins of their leaves, and sometimes throughout the leaf surface, to prevent larger animals from chewing on the leaves. For smaller pests and those not deterred by spines, bitter exudates are produced just under the surface of the leaves. This is known as *Aloe* bitters, a substance that humans have been using for medicinal purposes for thousands of years [7]. The other important adaptation is the presences of brilliant flowers that have an excessive nectar production to attract pollinators, and winged seeds aid them for wind dispersal. These unique adaptations make the *Aloes* the important groups of plant in such environments in providing important source of shelter, nectar food, and moisture, especially to the avifauna [9,10].

Members of the genus *Aloe* has been known for their current and potential use in medicine, commerce and horticulture. They are said to be keystone species in ecological sense particularly in the dry-land ecosystem. *Aloe* species have been used for long time in folk medicine for treatment of constipation, burns, kill bacteria and dermatitis [11]. For instance, sap of *Aloe lateritia* is used in some communities of Kenya and Ethiopia for treatment of eye ailments [12]. *Aloes* are an important component of the dry-land ecosystems. They have great role in solving ecological problems. For example, *A. secundiflora* in Kenya have been used in fencing and hedging, soil conservation /compaction and ecosystem restoration (rehabilitation) [6].

According to Sebsebe Demissew and Nordal [10] and Sebsebe Demissew et al. [13], 46 species of *Aloes* are known from the flora area, out of which six have been described in the past seven years indicating active taxonomic research and targeted field surveys on the genus *Aloe* in the flora area. The six new species are all reported to be endemic (or, as in the case of *Aloe clarkei*, perhaps near endemic) to Ethiopia. This has raised degree of endemism of species of *Aloe* to 89%, indicating that the genus *Aloe* has high degree of endemism in the flora area. Very few, only five species are wide spread extending to East and West Africa. These are *A. laterita*, *A. macrocarpa*, *A. rivae*, *A. secundiflora* and *A. vituensis* of Ethiopia. It is also demonstrated that most endemic and near endemic species have very restricted distribution.

Though not yet investigated and exploited for their use as in other parts of Africa, *Aloes* in the flora of Ethiopia may have economic and ecological potential uses for current and future generation. As indicated by different researches *Aloes* of Ethiopia have different values such as: traditional medicines, soap production, manufacturing of soak for coffee export and degraded land rehabilitation. However, these important *Aloe* plants and their habitats are reported to be threatened in most parts of the

flora area. The reasons for threats might be two folds: linked to ecology of the species area distribution or to the biology of the species such as reproductive success, dispersal efficiencies and other population attributes. Habitat destructions for agricultural expansion, urbanization, development construction such as roads and overgrazing are worth mentioning. Hence, we found it is imperative to compile information on uses of *Aloes* of Ethiopia as a basis for future investigation of their traditional and modern uses.

ALOE PLANTS DIVERSITY AND DISTRIBUTION IN ETHIOPIA

Distributions of aloes in Ethiopia

The account of family *Aloaceae* of the Flora of Ethiopia recognized 46 species. They are distributed in all floristic region of the country including: Afar, Arsi, Bale, Gamo Gofa, Gojam, Gonder, Harerge, Kefa, Shewa, Sidamo, Tigray, Wellega and Welo floristic regions [10]. Accordingly, majority of *Aloe* spp. found in Sidamo floristic region (with 14 species) followed by Harerge, Bale, Shewa, Tigray and Welo floristic regions (with 10, 8, 8, 7 and 7 species respectively). Whereas few species found in Afar and Wellega floristic regions (each possess one *Aloe* species) and one *Aloe* species (*Aloe macrocarpa*) found in many floristic regions including Arsi floristic area (Figure 1).

Sebsebe Demissew et al. [14], analyzed the distribution of *Aloes* of Ethiopia in relation to vegetation types, and showed that the endemic and near-endemic species occurred predominantly in two vegetation types. These are: (1) dry montane evergreen forest (and associated montane evergreen scrub or montane grassland), and (2) Acacia-Commiphora woodland and bush-land. Some of the *Aloes* that occur in dry montane evergreen forest include *A. debrana*, *A. adigratana*, *A. percrassa*, *A. pulcherrima*, *A. elegans*, *A. camperi* and *A. yavellana*. Acacia-Commiphora woodland and bush-land also hosts *Aloe* species like *A. calidophila*, *A. ellenbeckii*, *A. gilbertii*, *A. friisii*, *A. retrospectiens*, *A. mcloughlinii*, *A. pirottae*, *A. otallensis* and *A. trichosantha*. Some of the *Aloe* species like *A. bertemariae* and *A. citrine* are reported from desert and semi-desert scrubland and *A. ankoberensis* is from Afro-alpine vegetation of Ethiopia [10]. The most surprising from ecological and phytogeographical points of view are *A.*

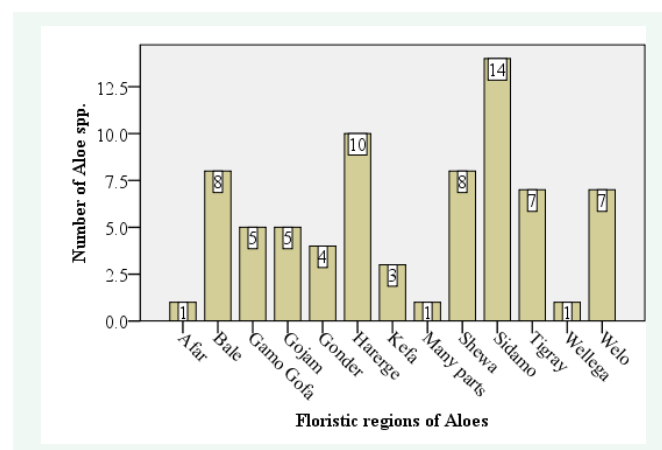


Figure 1 Distribution of Aloes in various floristic regions of Ethiopia.

benishangulana and *A. ghibensis* that seem to belong to a hitherto unrecognized western group mostly associated with fire-susceptible Combretum-Terminalia woodlands [13].

Habitats of *aloes* in Ethiopia

Aloes are available in variety of vegetation types at various altitudes in the country. Thus most *Aloes* (about 48%) are found at elevation ranges of 1500-2500 m in middle altitude area. Some *Aloes* (about 34%) are found at altitudes of 500-1500 m in semi-arid climate while other species of *Aloe* (about 14%) could be live between altitudes of 2500-3200 m in high altitude area. However, few *Aloes* (about 2%) survive at elevation ranges above 3200 m in alpine area whereas the other few *Aloe* species (about 2%) may live at altitudes below 500 m in arid climate (Table 1). Here, the alpine *Aloes* are found in Shewa floristic region and they are adapted to cold climatic conditions. Besides, the arid area *Aloes* are found in Harerge floristic region and adapted to survive in the hot arid climates.

Endemicity of *Aloes* in Ethiopia

The genus *Aloe* has high degree of endemism (89%) in Flora of Ethiopia. The high degree of endemism is incomparable with any other genus in the flora area that has similar species diversity [13]. Furthermore, out of the total species and subspecies of *Aloe* plants in Ethiopia, about 66% are endemic or near endemic to the country while about 34% are not endemic (Figure 2). These endemic *Aloes* are crucial for economic benefits of local communities and development of the country. Therefore, these plants require urgent conservation for sustainable usage in the future.

Most of endemic *Aloe* species have very restricted distribution area. According to Sebsebe Demissew and Nordal [10], four centers of endemism have been recognized in the flora area: 1) Northern and central highlands, north and west of the Rift Valley that comprises 16 endemic species (e.g. *A. adigratana*, *A. camperi*, *A. sinana*, *A. pulcherima*, and *A. debrana*); 2) Eastern and south east highlands and lowlands that includes 9 species restricted to the eastern highlands (e.g. *A. elkerriana*, *A. harlana*, *A. mcloughlinii*

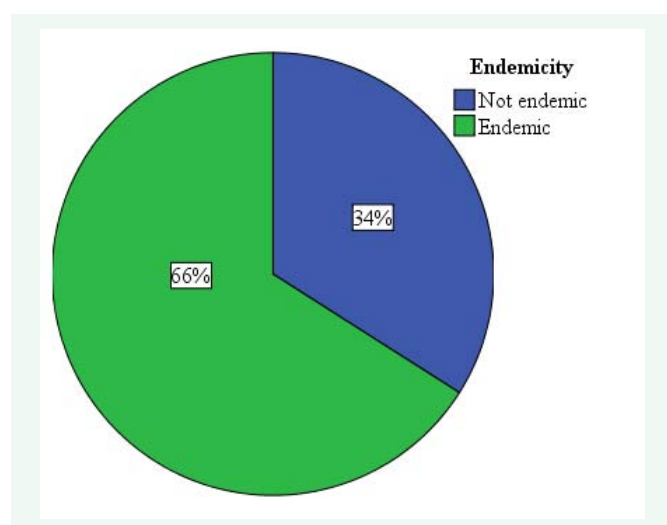


Figure 2 Endemicity of *Aloe* plants in Ethiopia.

Table 1: The habitat elevations of *Aloe* plants in Ethiopia.

Altitude range	Frequency	Percent	Valid Percent
> 3200 m	1	2.0	2.0
2500-3200 m	7	14.0	14.0
1500-2500 m	24	48.0	48.0
500-1500 m	17	34.0	34.0
< 500 m	1	2.0	2.0
Total	50	100.0	100.0

and *A. welmelensis*); 3) Southern part of Ethiopia that contains 6 endemic taxa (e.g. *A. gilbertii*, *A. otallensis*, and *A. friisii*); and 4) Western parts of Ethiopia that includes 4 species (*A. clarkei* and *A. kefaensis*, and the newly described *A. benishangulana* and *A. ghibensis*)

APPLICATIONS OF ALOES IN ETHIOPIA

Medicinal values of *Aloe* species

Most *Aloes* produce a bitter exudate just under the surface of the leaves. This *Aloe* bitter is a substance that humans have been using for medicinal purposes for thousands of years [7]. Members of the genus *Aloe* has been known for their current and potential use in medicine, commerce and horticulture. *Aloe* species have been used for long time in folk medicine for treatment of constipation, burns; kill bacteria, dermatitis, diseases connected with the digestive system; wounds and skin problems [11,15]. The medicinal role of *Aloe* specie believed to be due to the synergistic action of different compounds constituent. These chemical compounds include inorganic minerals like ions of calcium, magnesium, zinc, iron, copper etc., saccharides namely arabinose, galactose, glucose, mannose and xylose, some twenty amino acids, vitamins B₁, B₂, B₆, B₁₂ and C. etc. and enzymes such as amylase, lipase, folic acid, etc. [16].

In Ethiopia, *Aloe* spp. such as *Aloe trichosantha* Berger, *Aloe pubescens* Burger, *Aloe citrina* Carter & Brandham, *Aloe bertemariae* Sebsebe & Dioli, *Aloe eumassawana* Carter, Gilbert & Sebsebe and *Aloe schoelleri* Schweinfurth "have been used in a wide range of skin and hair care products; also they form the basis of health drinks and tonics" [17]. In rural parts of the country, its mucilaginous fluid applied to cuts and wounds in order to prevent infections and bring about healing [18]. Recent ethnobotanical studies have been reported the use of various *Aloe* species as traditional medicines in our country (Table 2).

Commercial values of *Aloe* species

Different products can be extracted from various parts of *Aloe* plants which include flowers, leaves, stems and roots. *Aloe calidophilla* is identified to be one of the commercially important species [6]. In the Borana community, the sap/exudate from the most popular *Aloe calidophilla*, *Aloe Scandiflora* and *Aloe Scabrifolia* processed for their soap. Roots of *Aloe secundiflora* are used in fermentation process [36]. Moreover, *Aloe vera*, *Aloe ferox* Mill. (Found in South Africa), *Aloe arborescens* Mill. (South Africa, Malawi, Mozambique and Zimbabwe) and *A. marlothii* Berger (South Africa) have been of commercial interest. For instance, *Aloe vera* is added to commercial creams and lotions to soften

Table 2: Use of *Aloe* species as traditional medicine in Ethiopia.

<i>Aloe</i> species used as medicine	Disease treated	Remedy part	Reference
<i>Aloe macrocarpa</i> Tod.	Impotency in men	Root	[19]
	Malaria	Latex	[20]
	Ticks	Latex	[21]
	Bloat and fire burn	Fresh leaf	[22]
<i>Aloe percrassa</i> Tod.	Caught	Root	[23]
<i>Aloe trichosantha</i> Berger	Malaria, Stomach ache, Gonorrhoea, Impotency in men	Latex	[24]
<i>Aloe citrina</i> Carter & Brandham	Swollen foot	Latex	[24]
<i>Aloe barbadensis</i>	Strain, Ascariasis	Latex	[25 - 26]
<i>Aloe pubescens</i> Reynolds	Anthrax, internal parasite	Root	[27]
<i>Aloe debrana</i> Christian	Wounds, to stop breast feeding	Sap	[28]
<i>Aloe pulcherrima</i> M.G. Gilbert & Sebsebe	Asthma	Sap	[28]
	Psychiatric disease	Sap mixed with other medicinal plants	[28]
<i>Aloe vera</i> (L) Burm.f.	Sprain	Root,	[29]
	Diabetes	Fresh sap	[30]
<i>Aloe pirottae</i> A.Berger	Wounds	Leaf latex	[31]
<i>Aloe monticola</i> Reynolds	Liver disease	Root	[32]
<i>Aloe gilbertii</i> Reynolds	Malaria and wounds in humans	Leaves gel, roots and exudates	[33]
<i>Aloe lateritia</i> Engl.	Eye ailments	Exudates	[12]
<i>Aloe secundiflora</i> Engl.	Medicinal use not specified	-	[4]
<i>Aloe ruspoliana</i> Baker	Used as a poison	-	[4]
<i>Aloe rivae</i> Baker	Medicinal use not specified	-	[4]
<i>Aloe camperi</i> Schweinf.	Medicinal use not specified	-	[4]
<i>Aloe calidophila</i> Reynolds	Medicinal use not specified	-	[4]
<i>Aloe</i> spp.	Malaria, abdominal cramp, pasterlosis, black leg, tuberculosis	Leaf	[34]
	Anti worms and impotency	Latex	[22]
	Cold	Leaf	[35]
	Burn	Latex	[28]

and moisturize skin and to other products for a variety of reasons [18].

In Ethiopia, especially in Southern Ethiopia, including parts of Somali Region and Oromia region (Borana and Guji Zones), wild *Aloe* species grow over vast areas. However, there is very little awareness of the commercialization of this ample resource by residents and transient communities. Currently there is no commercial harvesting, production, handling and processing of

indigenous *Aloe* species. But a few Bio-enterprise developments in sustainable wild harvest and domestication of indigenous *Aloe* species were established by the help of Oxfam Canada in Borana Zone. This is aimed to contribute the poverty reduction, economic empowerment and social wellbeing of pastoralists, particularly women. They domesticate *Aloe* for healthcare and body care products. Nowadays three villages in the zone engaged in harvesting *Aloe* jell, producing soap from *Aloe* and marketing *Aloe* soap. In this areas about three species of *Aloe* are identified, which have been found to have compounds similar to those in *Aloe vera*, and have comparable leaf sizes making them good candidates for commercial exploitation. These *Aloe* species are *Aloe yavellana*, *Aloe turkanensis* and *Aloe secundiflora*. They are found in abundance and being used only by bio-enterprise [37].

Aloe plants in industry

The extract oils of different *Aloe* species found in Central Highland of Ethiopia like *Aloe sinana*, *Aloe trichosantha*, *Aloe ankobernsis*, *Aloe debrana*, *Aloe pulcherrima*, *Aloe schelpei*, *Aloe camperi* and *Aloe weloensis* were checked and identified for production of jute sacks. But only *Aloe debrana* and *Aloe trichosantha* plants allowed for the company by Ethiopian Biodiversity Institute, because others are rare. The natural oil of these two *Aloe* species is currently used in production of jute sacks for packing coffee, cereals and oil seeds. The use of batching oils on raw fibers which contain certain amount of hydrocarbon minerals become a problem in fiber producing company. This is due to the use of mineral oil based batching in the process of manufacturing jute bags used for packaging of food grade materials had been a matter of concern for the final consumers because of alleged and possible hydrocarbon contamination of the bags. As a result, currently the fiber company started using naturally earned oils from *Aloes*, especially, in manufacturing of soak for coffee export [38].

Recent researches indicate that extracts of *Aloes* can be used in different industries and can contribute for the future development of various industrial developments in the country. Some *Aloes* of Ethiopia are tested for different industry inputs in the future: for example, the extract of *Aloe barbadensis* for anti-microbial activity in cotton fabric, i.e., controlling *Staphylococcus aureus* [39], the in-vivo anti-malarial activities of *Aloe debrana* was test and it showed positive results [40], *Aloe debrana* was also examined as good thickening agent for printing polyester and cotton with disperse dyes [41].

Ecological uses of *Aloe* species

Nowadays, *Aloes* are recognized as an important component of the dry-land ecosystems where they are associated with species such as *Acacia*, *Kleinia*, *Cissus* and *Euphorbia*. It has been suggested that *Aloes* may be primary colonizers of habitats that enable later habitation by other less resilient plants. Areas which experience prolonged drought can benefit from the planting of *Aloe* [42]. Observations made on *A. secundiflora* have shown that vegetation diversity, litter cover, soil retention and soil seed bank are greatly enhanced in the immediate vicinity of the plants [6,43].

Aloe shrubs increase the survival and growth rate of newly planted *Cenchrus ciliaris* grasses. This native species has

already proved invaluable in saving rangeland in Kenya and Southern Ethiopia [42]. The presence of *A. secundiflora* creates microhabitats for associated plants and animals probably due to the physical protection, shade and perennial ground cover. *Aloe* shrubs are also known to improve soil conditions around them and to encourage the range of other plant species in the local area [6,43]. Furthermore, because of their demonstrable efficacy in rangelands rehabilitation, the *Aloe* plants benefit the environment in other ways [42].

Aloes are an important component of the dry-land ecosystems of Ethiopia. They have great role in solving ecological problems. For, example, *A. gilbertii* plant and its parts for various purposes among others, its uses in the rehabilitation of degraded land and soil conservation efforts were widely mentioned. The whole individuals were transplanted by local community to the areas surrounding their farm lands, range lands and home gardens for the purpose of demarcation and protection in the form of area enclosure, in hedging and fencing. It was also widely observed that individuals of *A. gilbertii* are planted along slopes in bund, terracing or ditch formation against soil erosion and for soil retention during erosion [33]. The existence of *Aloe macrocarpa* is used as a fence for home, farm land and range land [21]. *Aloe debrana* plants are also very important in soil and water conservation [38].

Aloe as a food of animals

Aloe species are important source food for animals and various birds. *Aloes* produce large amounts of nectar. They have long tubular, most often red to yellow flowers, producing considerable amounts of nectar, all traits indicating typical adaptations to bird pollination. The different *Aloe* species have different flowering periods; some flower over an extended period, thereby offering a continuous food supply for nectar feeding birds. Accordingly, the *Aloes* make an important contribution to the bird biodiversity of Ethiopia, especially for the sunbirds. At the same time, the birds are vital for the pollination of the flowers and seed set [10]. In relation to honeybees, the presence of flowering *Aloes* has been observed to enhance the quantity and quality of honey output over the seasons [6]. This indicates the importance of *Aloes* as honey bee forages.

THREATS TO AND CONSERVATION OF ALOES

Many species of *Aloe* are threatened for various reasons. These include habitat destruction caused by urban and regional development constructions, and over collection for their use in pharmaceutical and cosmetic industries. Another important concern is that many species have very restricted areas of distribution and occur only in small populations. The *Aloes* may also be a target for succulent enthusiasts in their quest for rarities [10]. Moreover, out of 46 *Aloe* plants of Ethiopia, 18 species are listed as threatened species [4]. These threatened species require urgent conservation in order to transmit them for next generations. Therefore, wisely use of these plants will be advisable during harvesting for medicine, cosmetics, soap, fibers, food, etc. in order to use sustainably in the future.

CONCLUSION AND RECOMMENDATION

Conclusion

Despite the large abundance of *Aloes* in Ethiopia both in terms of distribution and species number, information on their

uses and research are very limited. The available research information in Ethiopian societies is insignificant and indicates the need for further investigation in all regions of the country. In addition, taking further study on economic use, commercial use, industrial use, conservation, farming and domestication of *Aloes* is very important issues for future uses of *Aloes* in economic development of the country.

Ethiopia is one the developing countries, in which many people get low income per capital. Since *Aloes* are abundant and available in different part of the country, they may serve as good source of income like *Aloe vera* in other countries. Therefore, *Aloes* could be potential resource in local uses and as export commodity to generate income. Although Ethiopian *Aloes* have different importance, they are threatened by many anthropogenic and environmental factors like habitat loss and degradation; hence urgent conservation attention is needed to conserve Ethiopian *Aloes* for sustainable usage in the future.

Recommendation

Although Ethiopia is rich in medicinal, commercial and ecologically important *Aloe* species, there is no widely use of these plants in modern way. However, modern drugs, cosmetics, soap, fibers and food can be manufactured from *Aloe* species industrially. Therefore, the practice of manufacturing *Aloe* products should be developed through further experimental investigations on medicinal, cosmetic, nutritional and other uses of *Aloe* species in our country.

In addition, even if *Aloe* species are such crucial in our country, some species are threatened due to lack of awareness, urban expansion, agricultural practices and uses as traditional medicinal plants. Also they are not well conserved and have not got more emphasis by local communities. Therefore, the local people should participate actively in conservation and protection of *Aloe* species in their local area.

REFERENCES

1. Newton LE. Illustrated handbook of succulent plants: Monocotyledons. *Aloe*. In: Egli, U. (ed.), Springer Verlag, Berlin, Heidelberg, and New York. 2001; 102-137.
2. Smith GF, Steyn EMA. Taxonomy of Aloaceae. In: Reynolds, T. (ed.), *Aloes: The genus Aloe*. CRC Press. Boca Raton, London, New York, and Washington, D.C. 2004; 15-30.
3. Newton DJ, Vaughan H. South Africa's *Aloe ferox* plant, parts and derivatives Industry. TRAFFIC East / Southern Africa, Johannesburg. 1996.
4. Oldfield S. Review of Significant Trade East African Aloes. CITES. PC14 Do.9.2.2 Annex 4. 2003.
5. Human H. Evaluation of the Floral Rewards of *Aloe Greatheadii* var *Davyana* (Asphodelaceae), the Most Important Indigenous South African Bee Plant. University of Pretoria, Pretoria. 2006.
6. Wabuye E, Keyalo S. Sustainable use of Eastern African Aloes: The Case of Commercial Aloes in Kenya. 2008.
7. University of California Davis Botanical Conservatory (UCDAVIS). Botanical Notes. The Genus *Aloe*. Volume I, issue 1.0. University of California Davis. USA. 2009.
8. Willert DJ, Von Eller BM, Werger MJA, Brinckmann E, Ihnlenfeldt HD. Life Strategies of Sullulents in Deserts with special reference to the

- Namib Desert. Cambridge: Cambridge University Press. 1992; 340.
9. Oldfield S. Status survey and conservation action plan. Cactus and succulent plants. 10: 214, IUCN, Gland. 1997.
 10. Sebsebe Demissew, Nordal I. *Aloes and Lilies of Ethiopia and Eritrea*. Colophon Page. Addis Ababa University and University of Oslo. Shama Books Addis Ababa. 2010; 42-109.
 11. Grace OM, Simmonds MSJ, Smith GF, Van Wyk AE. Documented Utility and Biocultural Value of Aloe L. (Asphodelaceae): A Review. *Economic Botany*. 2009; 63: 167-178.
 12. Wabayele E. A systematic assessment of the relationship between Aloe macrocarpa and Aloe lateritia (Aloaceae). Msc thesis, Addis Ababa University, Ethiopia. 2000.
 13. Sebsebe Demissew, Friis I, Tesfaye A, Wilkin P, Weber O, Bachman S, et al. Four new species of Aloe (Aloaceae) from Ethiopia, with notes on the ethics of describing new taxa from foreign countries. *Kew Bull*. 2011; 66: 111-121.
 14. Sebsebe Demissew, Nordal I, Stabbetorp OE. Endemism and patterns of distribution of the genus Aloe (Aloaceae) in the flora of Ethiopia and Eritrea. *Biol Skr*. 2001; 54: 194-203.
 15. Rajeswari R, Umadevi M, Sharmila Rahale C, Pushpa R, Selvavenkadesh S, Sampath Kumar KP, et al. Aloe vera: The Miracle Plant Its Medicinal and Traditional Uses in India. *J Pharma Phytochem*. 2012; 1: 118-124.
 16. Ermias Dagne, Daniel Bisrat, Viljoen A, Van Wyk BE. Chemistry of Aloe Species. *Current Organic Chemistry*. 2000; 4: 1055-1078.
 17. Sebsebe Demissew, Nordal I, Stabbetorp OE. *Flowers of Ethiopia and Eritrea: Aloes and other lilies*. Shama Books, Addis Ababa, Ethiopia. 2003.
 18. Mesfin Tadesse, Brook Mesfin. A review of selected plants used in the maintenance of health and wellness in Ethiopia. *Ee-JRIF*. 2010; 2: 85-102.
 19. Getnet Chekole. An Ethnobotanical Study of Plants Used in Traditional Medicine and as Wild Foods in and Around Tara Gedam and Amba Remnant Forests in Libo Kemkem Wereda, South Gondar Zone, Amhara Region, Ethiopia. MSc. Thesis, Addis Ababa University, Addis Ababa, Ethiopia. 2011.
 20. Reta Regassa. Assessment of Indigenous Knowledge of Medicinal Plant Practice and Mode of Service Delivery in Hawassa City, Southern Ethiopia. *J Med Plant Res*. 2013; 7: 517-535.
 21. Assegid Assefa, Tesfaye Abebe. Ethnobotanical Study of Wild Medicinal Trees and Shrubs in Benna Tsemay District, Southern Ethiopia. *J Sci and Dev*. 2014; 2: 17-33.
 22. Mengistu Gebrehiwot. An Ethnobotanical Study of Medicinal Plants in Seru Woreda, Arsi Zone of Oromia Region, Ethiopia. M.Sc. Thesis Addis Ababa University, Ethiopia. 2010.
 23. Eskedar Abebe. Ethnobotanical Study on Medicinal Plants Used by Local Communities of Debark Wereda, North Gondar Zone, Amhara Regional State, Ethiopia. MSc. Thesis, Addis Ababa University, Addis Ababa, Ethiopia. 2011.
 24. Negusse Tadesse. Ecology and Plant Use Diversity in Sof Umer Area of Bale, Southeastern Ethiopia. MSc. Thesis, Addis Ababa University, Addis Ababa, Ethiopia. 2006.
 25. Gidey Yirga. Assessment of Traditional Medicinal Plants in Endrta District South-Eastern Tigray, Northern Ethiopia. *Afr J Plant Sci*. 2010; 4: 255-260.
 26. Gidey Yirga. Use of Traditional Medicinal Plants by Indigenous People in Mekel Town, Capital of Tigray Regional State of Ethiopia. *J Med Plant Res*. 2010; 4: 1799-1804.
 27. Endalew Amenu. Use and Management of Medicinal Plants by Indigenous People of Ejaji Area (Chelya Woreda) West Shoa, Ethiopia. M.Sc. Thesis Addis Ababa University, Ethiopia. 2007.
 28. d'Avigdor E, Muth HW, Zemeda A, Tesfaye A. The Current Status of Knowledge of Herbal Medicine and Medicinal Plants in Fiche, Ethiopia. *J Ethnobiology Ethnomed*. 2014; 10: 1-32.
 29. Zenebe G, Zerihun M, Solomon Z. An Ethnobotanical Study of Medicinal Plants in Asgede Tsimbila District, North-Western Tigray, Northern Ethiopia. *J Plants, People and App Res, Ethn Res App*. 2012; 10: 305-320.
 30. Kalayu Mesfin, Gebru Tekle, Teklemichael Tesfaye. An Ethnobotanical Study of Traditional Medicinal Plants Used by Indigenous of Gemed District, Northern Ethiopia. *J Med Plants Stud*. 2013; 1: 32-37.
 31. Beentje HJ, Hilton-Taylor C. 2000 The IUCN Red List of Threatened Species: Aloe pirottae. 2013; 1-7.
 32. Marsha Ashagre. Ethnobotanical Study of Medicinal Plants In Guji Agro-pastoralists, Bule Hora District of Borana Zone, Oromia Region, Ethiopia. M.Sc. Thesis Addis Ababa University, Ethiopia. 2011.
 33. Fikre Dessalegn (2013). Study on the Populations of an Endemic Aloe Species (Aloe gilbertii Reynolds) in Ethiopia. *Engineering Science and Technology: An International Journal (ESTIJ)*. 2013; 3: 562-576.
 34. Tesfaye Seifu. Ethnobotanical and Ethnopharmaceutical Studies on Medicinal Plants of Chifra District, Afar Region, of North-Eastern Ethiopia. M.Sc. Thesis Addis Ababa University, Ethiopia. 2004.
 35. Melesse Maryo, Sileshi Nemomissa, Tamirat Bekele. An Ethnobotanical Study of Medicinal Plants of the Kembatta ethnic Group in Ense-based Agricultural Landscape of kembatta Tembaro (KT) Zone, Southern Ethiopia. *Asian J Plant Sci Res*. 2015; 5: 42-61.
 36. Teshome Dega. Aloe Soap Value Chain Initiative and Its Effect On Livelihood Diversification Strategy: The Case of Pastoralists and Agro-Pastoralists of Borana, Southern Ethiopia. *JAD*. 4: 87-136.
 37. Wren S, Getachew Mamo. Summaries Report on the Potential for Plant Based Rangeland Enterprises in the Dry Lands of Ethiopia, the Case of Borana and Guji Zones. 2009.
 38. Tesfaye Awas. Assess and Benefit Sharing Initiative in Ethiopia: The Case Of Aloe. Ethiopia Biodiversity Institute Addis Ababa. 2009.
 39. Jothi D. Experimental Study on Antimicrobial activity of Cotton Fabric Treated with Aloe Gel extract from Aloe vera Plant for Controlling the Staphylococcus aureus (Bacterium). *Afr J Micro Imb Res*. 2009; 3: 228-232.
 40. Tekalign Deressa, Yalemtehay Mekonnen, Abebe Animut. In Vivo Anti-malarial Activities of Clerodendrum myricoides, Dodonea angustifolia, and Aloe debrana Against Plasmodium berghei. *Ethiop. J Health Dev*. 2010; 24: 25-29.
 41. Sisay Awoke, Yirga Adugna, Redwan Jihadnand Habtam Getaneh. The Importance of Aloe Debrana Plants as a Thickening Agent for Disperse Printing of Polyester and Cotton in Textile Industry. *J Textile Sci Eng*. 2013; 4: 1-4.
 42. J. Ecological Importance of Aloe. (Accessed October 2016). 2010.
 43. King EG, Stanton ML. Facilitative Effects of Aloe Shrubs on Grass Establishment, Growth, and Reproduction in Degraded Kenyan Rangelands: Implications for Restoration. *Restoration Ecology*. 2008; 16: 464-474.

Cite this article

Oda BK, Erena BA (2017) Aloes of Ethiopia: A Review on Uses and Importance of Aloes in Ethiopia. *Int J Plant Biol Res* 5(1): 1059.