

Review Article

Ximenia americana: Economic Importance, Medicinal Value, and Current Status in Ethiopia

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Ximenia americana is one of the most valuable wild edible plants in the world. In different countries, it is utilized as food, medicine, an essential oil source, and the industrial component to other products. In Ethiopia, it was one of the most known and very important plants for a long period of time. It was utilized as food, a medicinal plant, and animal feed. It was also one of the most economically important and culturally valuable plants. But nowadays, it is not adequately available in the country due to deforestation problem in the years. In addition, its economic importance, current status, and medicinal roles are not well documented and understood. As for research studies, it is concluded that unless a collective effort is taken, the existence of this plant is under severe threat and needs to have some measures. This review article is aimed at addressing the abovelined topics in detail and to pinpoint and explain the importance and status of *Ximenia americana*.

1. Introduction

The history of agriculture showed that the transition from food collection to food production requires the domestication of plants and rearing of animals. Although there is no precise evidence about the origin of agriculture, Childe [1] proposed that a second Neolithic revolution coinciding with the Bronze Age occurred between 6000 and 3000 BC; the change from villages to urban communities is the source for the development of settled agriculture.

Fruit culture, starting from its onset which is during the earliest periods of man settlement mostly up to its modern production with so many sophisticated equipment and technologies, passes through selection, vegetative propagation, irrigation, pruning, training, pollination, harvesting, and storage [2, 3]. Through those processes, human ancestors developed their association with the fruit growing, and they thrive with some of them as food, medicinal, and animal feed roles [4].

The selection process favors some fruits to be domesticated as well as utilized and some others to be used by

human beings as wild. Fewer than 20 plant species produce 90% of the food consumed by the global population [5]. Zemedu and Mesfin [6] by referring different authors to various sources reported that about 5% of the total plant species of the world which serve for human beings are domesticated, used as food, and another supplement. The remaining plant species are wild, and most of them are utilized as wild.

Wild edible fruits are important in the economy, medicine, and forage [7–9]. Not only are they important in these aspects, besides they have a role in preserving cultural heritages and maintaining ecological balance [10]. In Ethiopia, it is common to consume wild fruit crops mostly in rural areas. These wild plants are important as a food supplement, means of survival during drought periods, as medicine, a source of fuelwood, as animal feed, and to protect soil erosion [11].

The Ethiopian flora is estimated to contain between 6500 and 7000 species of higher plants of which about 12% is endemic [12]. Reports indicated that about 8% of the nearly 7000 higher plants of the country are edible. Of these, 203

wild and semiwild plant species are documented [13]. But there are many other wild edible plants that are not documented. More recently, some ethnobotanical studies were undertaken in some parts of the country [12, 13]. However, the majority of these studies have dealt with medicinal species, and little emphasis has been paid to wild edible fruit plants.

In Ethiopia, *Ximenia americana* (local name Inkoy) is one of the wild fruit plants which are given little emphasis on its general characteristics, food value, medicinal value, and its climatic and management requirements. Even if local people know the use and management of *X. americana*, only a few research studies have been performed by few researchers such as Bahiru et al. [14] and Debela et al. [15]. Therefore, the importance of this review is to pinpoint and to explain importance and status of *Ximenia americana* in Ethiopia.

2. Botany of *Ximenia americana*

Ximenia americana, which belongs to family *Olacaceae* with common names English (hog plum, wild plum, and false sandalwood), Amharic (inkoy and kol), Tigrigna (mlehtta and mullo), is a semiscandent bush-forming shrub or small tree 2–7 m high [13]. Mostly, its trunk diameter is not greater than 10 cm; the color of the bark is dark brown to pale grey and smooth to scaly. Its branchlets are purple-red with a waxy bloom, and the tree is usually armed with straight slender spines. Sometimes, there is semiparasitic nature with haustoria on the roots. Its leaves are alternate, lanceolate to elliptic, 3–8 to 1.5–4 cm, variable thickness (semisucculent to thin), obtuse or emarginate, 3–7 pairs of veins, inconspicuous. Petioles are short, slender up to 6 mm long, and canaliculated, and it has grey-green, hairless, and leathery or thin flesh. When crushed, the young leaves have the smell of bitter almonds [16].

The flower colors are mainly white, yellow-green, or pink which are developed in branched inflorescences. These inflorescences are borne on pedunculate axillary racemes or umbels which are on pedicels 3–7 mm long. The fruits are globose to ellipsoidal drupes about 3 cm long, 2.5 cm thick, glabrous, greenish when young, become yellowish (or rarely orange-red) when ripe, contain a juicy pulp, and 1 seed. Its seed is woody, light yellow, up to 1.5 cm long, 1.2 cm thick with a fatty kernel, and a brittle shell. The species flowers and their fruit ripen throughout the year; flowering and fruiting periods do not seem to be governed by climatic regimes. Fruits are dispersed by animals [17].

It is diversified in different locations such as countryside, savannah, forest lands, dry woodlands, and riverbanks. It is drought-resistant with an altitude requirement of 900–2,000 masl, mean annual temperature of 14–30°C, and mean annual rainfall of 300–1 250 mm. It prefers poor and dry soil, including clay, clay loam, loamy sand, sandy clay loam, and sand [17].

3. Importance of *Ximenia americana* in Different Parts of the World

Traditionally, *X. americana* fruits and leaves have several uses in medication as folks for humans and animals [18]. The leaves and twigs of the plant are used for fever, cold, as a solution for toothaches, as a laxative and eye lotion, and poison cure [19–21]. The root part of the plant is also used as a treatment for skin burns, leprosy, headaches, hemorrhoids, guinea worm attack, sleeping thickness, puffiness, and some sexually transmitted diseases [22]. The fruit is eaten in quantities to treat constipation by eating heavy foods and vermifuges. The bark is used to treat skin ulcers, after some local processing systems of drying, powder making, and applied to skin ulcers. The fruits are eaten in large quantities and act as a vermifuge [23, 24]. The leaves are used for headaches. It is also indicated that *Ximenia americana* has a wide role in controlling many more different humans as well as animal diseases [20, 25].

Ximenia americana bark contains approximately 17% oils; heartwood and flowers contain essential oils [26]. The seeds and fruit pulp reportedly contain a substantial amount of hydrocyanic acid. The processed and extracted oil which is mainly edible, nondrying, is also suitable for soap preparation, as lubrication, traditionally as body anointing, and as a cure for chapped and dry feet pulp [27].

Ximenia americana oil is reported to have a higher amount of saturated and monounsaturated fatty acids (about 99%), which gave it stability to oxidation. Experiments performed on the oil indicated that it is very useful to treat dry skin which is prone to early senescence and enhances the activities of the sebaceous tissues. Moisturizing, softening, and revitalizing of skin is the main importance of unsaturated fatty acids extracted from the fruit of the plant [28].

Orally took *Ximenia americana* as fresh or processed form also works well for treating skin wounds, hemorrhoids, and helps with looseness of the bowels. In addition, it is a decent pain-relieving agent that lowers fevers; at the same time, it additionally works well to fight off viral infections such as measles [29]. Some of the compounds in this plant help with insulin-resistant diabetes, and for treating Alzheimer's disease, improving memory, and lowering cholesterol.

The fruit and the stems have powerful compounds which are anticancer, antifungal, antiallergic, antiparasitic, antiviral, and antibacterial, and it is also a very good antioxidant [30–32]. It is also indicated that it is effective in healing arthritis. A higher amount of healthy fatty acids are available in seeds, and the antibacterial capacity of the leaf extract is reported to be equal to penicillin and is effective for killing gonorrhea and cancer cells [32].

Shagal et al. [33] concluded that phytochemical screening of three different plant parts using ethanol and water as solvent showed that tannins, saponins, flavonoids, phenols, and volatile oils were present, and ethanol extracts of the plant parts were found to have antimicrobial activity

on *S. aureus*. They also found that the water extract showed antimicrobial activity on *S. aureus* and *E. coli*.

Researchers around the world reported that the orange shaped fruit that tastes a little bit like almonds is pack full of vitamin C (vitamin C is a great antioxidant that helps to prevent cardiovascular disease, strokes, and cancer). *Ximenia* fruit reportedly contains an ample amount of vitamin E, minerals fiber, carbs, starches, and higher content protein as well. It also has nonessential proteins, and the stem, bark, and leaves of the tree also contain lots of natural steroids that may be used in the future for treating diseases such as cardiovascular disease and strokes [34–36].

This implies that the plant has a lot of benefits on the environment, food security, and medicinal value, input for industries, and if properly handled as well as invested on, it may be a source of income for developing countries such as Ethiopia.

4. Importance of *Ximenia americana* in Ethiopia

4.1. Local Medicine. In Ethiopia, the impact of traditional medicine on the health and wellbeing of the people is significantly high. Nearly 80% of the people are dependent on traditional medicine to treat different human and animal diseases. This could be due to the cost and nonavailability of modern drugs, lack of extended healthcare services, and higher acceptability of traditional medicines [37].

Ethnobotanical and ethnomedicinal studies in different parts of Ethiopia indicated that *Ximenia americana* plants have diverse use in the country. Culturally, the plant is utilized as a medicine for various animal and plant diseases. It is reported to give relief to stomach complaints, placenta expulsion [38], internal parasitism, worm infestations [39], treatment of hepatitis, and malaria (Table 1) [42].

It was also indicated that the local people of Dak Island use the bark of the plant as a medicine for rabies diseases. The process of utilization is by soaking the bark in the water and the water is taken orally [43]. The oils extracted from fruit kernel are also utilized as oil flesh wounds to prevent infections [44].

The screening of *Ximenia americana* extracts was tested for its antiviral activity for its inhibitory effects on the in vitro replication of HIV-1 and HIV-2. The results indicated that lower antiviral activity was recorded than the level necessary to produce cytotoxicity (CC50: 37.7 mg/mL). However, the result warrants further investigation because of the selectivity shown by the plant extract against HIV-1 and HIV-2 strains tested [45].

4.2. Food and Feed Value of *Ximenia americana* in Ethiopia. It is indicated that the plant is one of the main wild edible plants which is eaten during famine periods in most parts of the country. This indicated the availability of the plant while there is a drought for other plants [46]. It is also reported

that *Ximenia americana* plant is one of the wild edible plants that could enhance food security in different parts of Ethiopia [47–49].

It is one of the most utilized fruits by livestock herders, children, women, and the poorest families. Its main utilization is as a food and some amount sold in the roads and local markets [17]. In different parts of Ethiopia, the leaf is highly important as a feed for cattle, goats, and sheep. The plant is available in all months of the year as it is not a deciduous plant. Hence, its leaf is available in all months of the year as a feed for animals [50]. In Tsemay and Benna ethnic groups of the country, the plant is reported to have a supplementary role as a household food security [51].

Shred of evidences also suggest that the plant is used as one of the many wild edible plants utilized as an emergency, supplementary, or seasonal food sources to avert food insecurity in rural households of Ethiopia [52].

The fruit of these plants is also reported to have an ample amount of protein, fiber, vitamins, lipids, and amino acids. Furthermore, it also contains the main essential minerals such as calcium, magnesium, potassium, sodium, iron, and manganese. The plant seeds also have low antinutrient content which could make them a good dietary supplement for both human and animal feeds formulation [53] (Table 2). Hence, consumption of this fruit in wild in the country could supplement and enhance the food consumption habit of the country.

4.3. Economic Value. The use of wild edible plants and their products in human life has grown from ancestral practices [53, 55, 56]. This could enhance household food security in wild plants consuming territories, especially in rural areas [54]. In Ethiopia, many wild edible plants have been consumed wild which enhances the food security status of households throughout the year. Especially, in the rural areas, there is a culture of consuming wild plants in pastoral, agropastoral, nomadic, and rural areas [56, 57].

Ximenia americana is one of the known fruits which is consumed in different parts of the country. It was indicated that the average production of a single *Ximenia americana* plant is near to 50.33 kg wet fruits, which can create an income amount of 2516.50 Ethiopian Birr which can be sufficient enough to buy main staple foods for a given household [58, 59]. Being one of the major plants in local medicine for humans and animals, it plays a significant role in reducing household expenditure in medicine costs [60].

The house making, fuelwood (charcoal and firewood), and in-house materials all over the country are still greatly dependent on forest and forest tree products. Different plants are selected for different purposes. *Ximenia americana* is one of the plants which is utilized as a source of firewood, fencing, and in preparing the housing products [17, 61].

The plant is economically important in other parts of the world. It is valuable in producing soup, oils, cosmetics, skin cream, medicinal tablets production, and as food [4, 24, 35].

TABLE 1: Traditional medicinal uses and parts used of *Ximenia americana* in Ethiopia.

Use	Part of plant used	Ways of preparation	Authors
Lung abscess	Root and bark	Crushed, homogenized in water, and drunk	[40]
Muscle cramp	Root and bark	Crushed, homogenized in water, and drunk	[40]
Wounds	Root and bark	Crushed, homogenized in water, and drunk	[40]
Hepatitis	Seed and leaf	Crushed, homogenized in water, and drunk	[38]
Kidney problem	Fruit and leaf		[41]
Abdominal pain	Stem and bark	Crushed, homogenized in water, and drunk	[38]
Antivomit, leech infestation, and tonsillitis	Leaf		[17]

TABLE 2: Physicochemical properties of the oil extracted from *X. americana* pulp and seed.

Parameter	Pulp	Seed
Acid value	0.29 ± 0.15	0.56 ± 0.15
Saponification value (mgKOH/g oil)	178.12 ± 0.02	179.94 ± 1.69
Peroxide value (mEq O ₂ /kg)	27.80 ± 0.11	30.06 ± 0.12
Iodine value (g I ₂ /100 g)	43.17 ± 0.25	40.61 ± 0.10
FFA (%)	0.15 ± 0.10	0.29 ± 0.15
Refractive index	1.4330 ± 00	1.4130 ± 00
Specific gravity	0.8980 ± 00	0.9493 ± 00
Viscosity (25°C) (g/cm ³ s ⁻¹)	46.99 ± 0.15	48.00 ± 0.01
Color	Light brown	Light brown

Source: Tanko et al., [54].

But in Ethiopia, there is no company involved in the processing and producing *Ximenia americana* products. Therefore, except for consumption and local medicine use by local people, it is not yet under the industrial system.

5. Current Status of *Ximenia americana* in Ethiopia

In Ethiopia, this plant has been used by the rural people for a long time as a source of fresh fruit, as a medicine, and as a supplement for firewood. But there are few ethnobotanical studies and are limited on knowing its existence and thereby with few explanations about its importance [37].

Ximenia americana is also reported as one of the plants which face threats of extinction. The factors responsible as a cause are forest clearing, grazing, timber harvesting, charcoal making, drought and bark, and root harvesting. The most fearful thing about this plant is also the conservation status is very low as compared to other wild edible plants [46]. Previously, the plant was widely available in different parts of the country. But, nowadays due to its huge depletion and threat of extinction, it is not accessible even for local medicine purposes [37]. It could be associated with the climate change and other factors associated [15].

It is indicated that some national parks such as Awash National Park played a significant role in conserving wild edible fruits. *Ximenia americana* is one of the wild edible fruits which is available inside the park and scarce outside

it [17]. This showed that even if the plant is not available in normal forest lands and faced extinction, its availability in national parks will be hope in future conservation practices.

Dejene et al. [46] reported that the plant faces threats such as fire, clearing, grazing, timber harvesting, leaf harvesting, fruit harvesting, flower harvesting, root harvesting, bark harvesting, charcoal making, pest infestation, drought, and others. Whereas, the regenerative capacity of the plant is promising. The result indicated that the plant is among one having higher regenerative capacity among wild edible plants (Figure 1).

According to Debela et al. [15], unless the situation is reversed by a collective effort, there is a fear of extinction of this wild edible fruit in the near future particularly from the rate of deforestation, selective removal, and indiscriminate degradation of local habitat and expansion of grazing and farmlands. This report also sets the most important conservation options which can reverse the problem are sustaining multipurpose uses, rehabilitating, improving the ecosystem and enhancing its services, enhance resilience to climate change, promoting indigenous knowledge, diversify food sources, and biocultural heritage.

Yadev [44] also reported that wild edible fruits and other vegetative resources of the country are dwindling due to exploitation. To conserve these resources, systems such as medicinal gardens, proper handling practices, and scientific development are needed to be implemented.

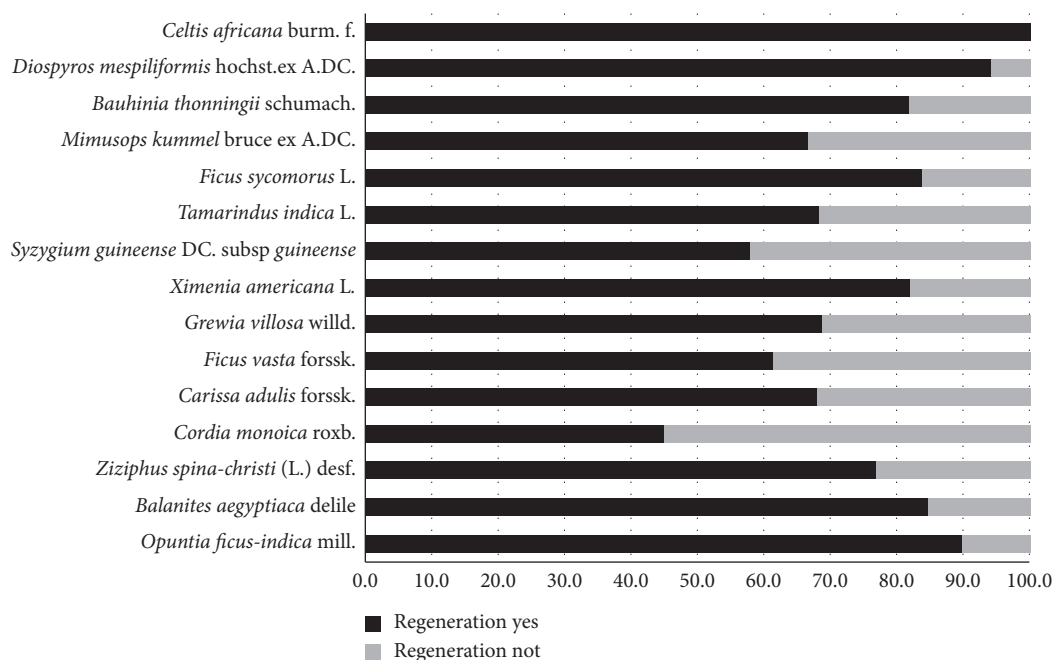


FIGURE 1: Regeneration status of *Ximenia americana* in low lands of Ethiopia. Source: Dejene et al. [46].

6. Conclusion

Ximenia americana plants have economic, medicinal, and forage values; in addition, they preserve cultural heritages and maintain ecological balance by providing various ecosystem services. However, the plant faced threats of extinction due to forest clearing, grazing, timber harvesting, charcoal making, drought, and bark and root harvesting. And also, the conservation status is very low as compared to other wild edible fruit plants. Hence, the most important conservation options which can reverse the problem are sustaining multipurpose uses, rehabilitating, improving the ecosystem and enhancing its services, enhance resilience to climate change, promoting indigenous knowledge, and diversify food sources and bio-cultural heritage. In addition, to conserve this resource, systems such as medicinal gardens, proper handling practices, and scientific development are needed to be implemented.

Data Availability

No primary data were used to support this study.

Disclosure

The authors confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

GAK is the first author of the review article, whereas the co-authors have contributed equally for the literature collection,

manuscript documentation, and its revision. All authors read and approved the final manuscript.

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