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REVIEW ON NOVEL PLANT *XIMENIA AMERICANA*

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ABSTRACT

Ximenia americana is the herbal plant belonging to family Olecaceae. It is commonly known as false sandalwood with different vernacular names like Nagari Gida (Kannada), chiru-illanthai (Tamil) and Bili nekkera (Telugu). It is native to tropical and subtropical regions across Africa, Asia, and the America. In Asia Young leaves were eaten as a vegetable, but because they contain cyanide, they must be cooked thoroughly and eaten in moderation. The study is aimed to explore the pharmacognostic characteristics, phytochemicals and pharmacological activities of *X. americana*. The plant is reputed as antidiabetic, anticancer, antifungal, antibacterial, gastro protective, analgesic, pesticidal and antioxidant effects. The different phytochemical compounds present in these plants make it a valuable source for novel drug development. This article discusses the plant potential in treating diseases including fever, leprosy, headache, constipation, wounds and skin infections and provides a scientific information. It exhibits unique where it can withstand drought conditions and thrive in poor soil conditions. It is considered as one of the most economical and culturally valuable plant.

INTRODUCTION

Ximenia americana is a medicinal plant. Medicinal plants are those that have a historical use as a treatment among a population or group and have the ability to treat or cure ailments. Its application is among the first methods for illness treatment, cure, and prevention [1]. Medicinal plants are also called as medicinal herbs. An herb generally refers to the leafy green or flowering parts of plants whose stems are soft and perishable. Herbal plant is a plant or plant part used for its flavour, scent or therapeutic properties. These therapeutic properties gave rise to herbal medicine. Herbal medicine is using a plant's seeds, roots, leaves, bark, flowers or fruits for medicinal purposes. Herbal medicine is also called as phytomedicine or botanical medicine. The medicinal plants have been used since the Vedic era which plays a vital role in human development [2]. The plants contain primary and secondary metabolites where the primary metabolites are responsible for growth and development. The secondary metabolites found In these plants are responsible for treating diseases and manufacturing medicines. These medicinal plants are the rich sources of both traditional and modern medicines [2]. Herbal medicine is referred as the important science bases for ancient and modern medicine system. Many developing countries are dependent on herbal medicines due to their wide range of advantages such as more acceptability and compatibility to humans and less adverse reactions [3]. For the purpose of maintaining health as well as preventing, diagnosing, improving, or treating physical and mental illnesses, traditional medicine is defined officially as "the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not" [4]. *Ximenia americana* a tree, which can grow up to 4.5 meters tall with prickly branches, is semi-parasitic on other trees' roots or self-paralytic.

It can be found in the dry forests of the Deccan Peninsula and on the rocky coasts of the Andaman Islands, reaching an altitude of 800 meters. It flourishes in regions with 300–1250 mm of rainfall and 14–300 c temperatures because it is drought tolerant [5].

Synonyms: Hog Plum, Sea lemon, Tallow wood, yellow plum etc.

Biological source: *Ximenia americana* is a shrub or small tree whose roots, stem, leaves and fruits contain various chemical constituents responsible for pharmacological actions. Family: Olacaceae

Chemical constituents: Alkaloids, Flavonoids, Polyphenols, Fatty acids, volatile oils, Glycosides, Tannins, Saponins, Glycerides and cyanide derivatives [6].

Uses: Leaves of *Ximenia americana* - show antibacterial activity, they are used in treatment of fever, tuberculosis, tooth decay and wounds. They are also used as laxatives and antidote for poison and used in eye lotion.

- Roots – used in treatment of leprosy, syphilis, dysentery and wounds. Also used in treating headache, hemorroids, Guinea worm attack and sexually transmitted diseases (STD's).
- Stem – exhibits anti trypanosomal activity and used for treating ulcers [7,8].
- Fruits – treat constipation and act as vermifuge (anthelmintic medicine) [8].
- Seeds – used in preparation of soap & prevention of dry and cracked feet [9].
- Bark – contains 17% of essential oils [10].

X. americana favors dry, poor soil, such as clay, loamy sand, sandy clay loam, and sand [11]. It is also stated that *Ximenia americana* is one of the plants that is in danger of going extinct. Clearing forests, grazing, extracting timber, producing charcoal, drought, bark, and root harvesting are the causes. The most concerning aspect of this plant is that, in comparison to other wild edible plants, its conservation status is extremely low [12].

Pharmacognostic study: The study of macroscopical, microscopical, physical, chemical, biological and analytical parameters of medical plants is called pharmacognostic study. The WHO states that the first stage in determining the identity and level of purity of plant material is to examine the macroscopical and microscopical accounts of medicinal plants [14].

Macroscopic evaluation: The morphological description of plant parts. It is also called as organoleptic evaluation where the evaluation is carried out by sense organs [15].

- **Root**: Big bulgy root
- **Stem**: Trunk-Diameter greater than 10cm.Smooth, scaly and dark brown to pale grey. Branch-Spiny and they form circular or conical crown. Branchlets are purple red with straight spines.
- **Leaves**: Oval shaped bright green to pale yellowish colour. Obtuse or emarginate, with three to seven pairs of veins, the leaves are alternating, lanceolate to elliptic, measuring 3-8 to 1.5-4 cm and varying in thickness from semi-succulent to thin. Petioles are canaliculate, long, up to 6 mm, and thin. thin, leathery, green, and hairless flesh. Young leaves smell like bitter almonds when crushed [5,16]
- **Flowers**: The fragrant inflorescences of white, yellow-green, or pink flowers are borne in branched arrangements on short, pedunculate axillary racemes or umbels; the pedicles are glabrous and range in length from 3 to 7 mm.
- **Fruits**: A single seed and a juicy pulp are found within the fruit globose to ellipsoidal drupes, which are glabrous, greenish when young and turn yellowish or, rarely, orange-red, when ripe. They are around 3 cm long and 2.5 cm thick. With a fatty kernel and a bristle, the woody, pale yellow seed can grow up to 1.5 cm long and 1.2 cm thick [5].

Microscopic evaluation*: Microscopic* study—which is the anatomical study—is carried out by selecting the relevant sections of the plant parts under investigation where every characteristic that sets them apart can be recorded [15].

I) **Midrib**: *Ximenia americana* midrib. Consists of a flat adaxial side and a broad "v"-shaped abaxial half; the midrib measures 650 µm and 700 µm in the vertical plane. The ground tissue of the midrib is differentiated into outer three or four layers of compact angular collenchyma cells in the transverse plane. The epidermis of the

midrib is single-layered, and the epidermal cells are tiny, cubical, thick-walled, and with a conspicuous cuticle. The adaxial side of the midrib has xylem elements, whereas the abaxial section has phloem.

II) Lamina: The cuticle covering on the lamina is conspicuous, mesomorphic, dorsiventral, and hypostomatic. The epidermis is single layered, and the epidermal cells are square to rectangular in shape. The lamina's palisade mesophyll cells are single-layered, but the spongy mesophyll has three or four layers.

III) Petiole: The petiole has a roughly round shape. The petiole's epidermis is a single layer that is followed by six layers of angular, thick-walled collenchyma cells. The inner area consists of compact, circular, or tangentially oblong parenchymatous ground tissue with thin walls. Phloem surrounds the dense, continuous, closed cylinder of xylem elements that make up the petiole's vascular strand. The xylem elements are thick-walled, thin, and arranged in radial files, while the phloem elements are a narrow band that surrounds the xylem cylinder.

IV) Stomata: The abaxial epidermis contains stomata. The stomata may be paracytic or cyclocytic [16].

V) Vein termination: The vein islets are thick, wide, and rectangular. The vein terminations exhibit dichotomous branching, with branches dispersing throughout the islet. Dextrinoid outline formation [16].

Chemical evaluation:

Chemical evaluation is used to analyze the crude powder and/or crude medicines extracted in different solvents for the presence of various phytoconstituents [17, 18]. Alkaloids, flavonoids, tannins, phenols, cardiac glycosides, triterpenes, steroids, and saponins are typically tested for in them [15]. *X. americana* showed presence of alkaloids, steroids, sugars, saponins, tannins and terpenoids in methanol extract. In aqueous and ethanol extract terpenoids were absent [5].

Biological evaluation:

The pharmacological and other positive benefits of antinutritional substances i.e. secondary metabolites in plants were evaluated this is called biological evaluation. The different ways that plants are used in traditional medicine are likely due to the presence of these secondary metabolites in plants [19].

Analytical evaluation: When the active principles are extracted from the plants, they are purified for therapeutic utility for their pharmacological activity this is called analytical evaluation. Various parameters such as adulteration, substandard herbs are evaluated [20]. Different methods for analytical evaluation are:

- Chromatography
- Thin layer chromatography
- High performance thin layer chromatography
- High performance liquid chromatography-
- Gas chromatography
- Mass spectrometry
- Ultraviolet and visible spectroscopy
- IR spectroscopy
- Atomic absorption spectroscopy etc. [21]

PHARMACOLOGICAL ACTIONS OF *XIMENIA AMERICANA:*

1. **Antidiabetic activity**: The Gas chromatography-Mass spectroscopy profile of *Ximenia americana* is evidence which is scientifically proven that the leaves of this plant show antidiabetic activity. The leaf extracts show presence of many phytochemicals. In chloroform extract oleic acid, n-hexadecanoic acid, non-decanoic acid and octadecatrienoic acid were found. The aqueous extract showed presence of 9,12-Octadecadionoic acid. Other phytochemicals were found in ethanol and ethyl acetate extracts [7]. The 9,12-Octadecadionoic of aq. extract decrease the activity of digestive enzymes like **α-Amylase** which leads in delaying the digestion of starch and oligosaccharides. This results in reduced absorption of glucose and decrease blood glucose levels [22]. The antidiabetic activity is also shown by root extract of *X. americana* which reduces serum lipid peroxide levels and increase insulin absorption [23].

Table1: Taxonomy [13]

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Santalales
Family	Olacaceae
Genus	Ximenia
Species	americana

Fig. 1: Fruits of *X. americana*

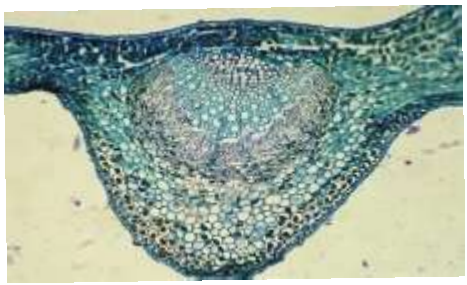

Fig. 2: T.S of Midrib of *X. americana*

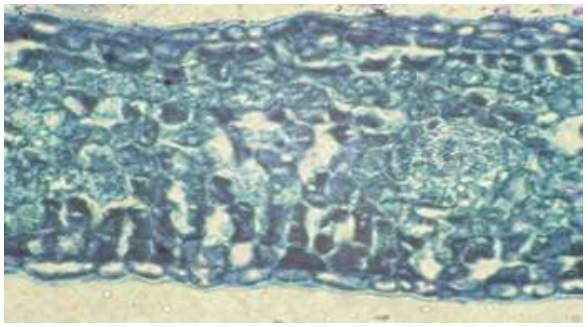

Fig. 3: T.S of lamina

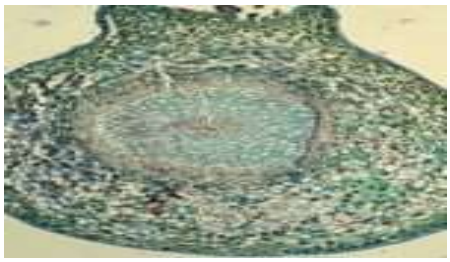

Fig. 4: T.S of Petiole

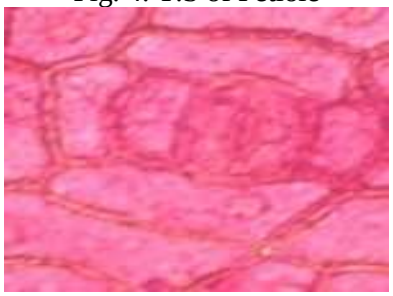

Fig. 5: T.S of stomata

Table 2: Quantitative values [5]

Stomatal number: Lower epidermis Upper epidermis	 6-7-9/sq mm^2 4-5-7/sq mm^2
Stomatal index: Lower epidermis Upper epidermis	 13.31-14.21-15.35/sq mm^2 5.25-6.35-7.35/sq mm^2

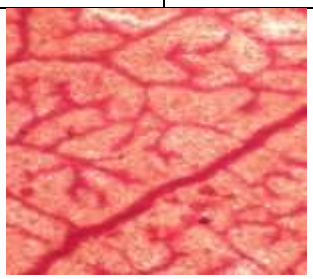

Fig. 6: Vein termination

Table 2: Physical parameter values [5]

Loss on drying	3.30 %
Total ash	9.00 %
Acid insoluble ash	1.15 %
Alcohol soluble extractive value	15.00 %
Water soluble extractive value	27.90 %

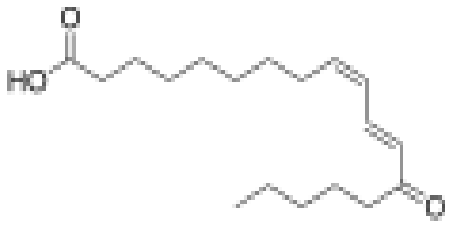

Fig. 7: 9,12- Octadecadionoic acid

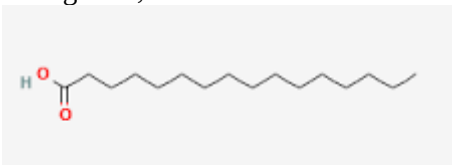

Fig. 8: n-Hexadecanoic acid

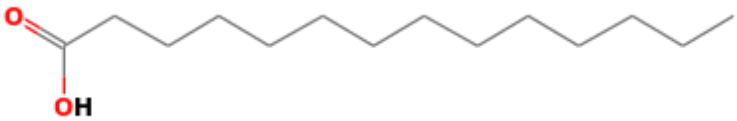

Fig. 9: Tetradecanoic acid

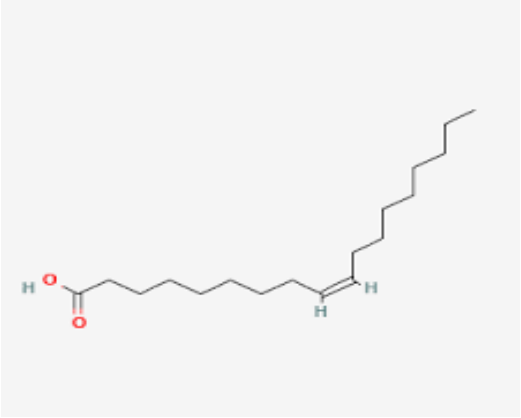

Fig. 10: Oleic acid

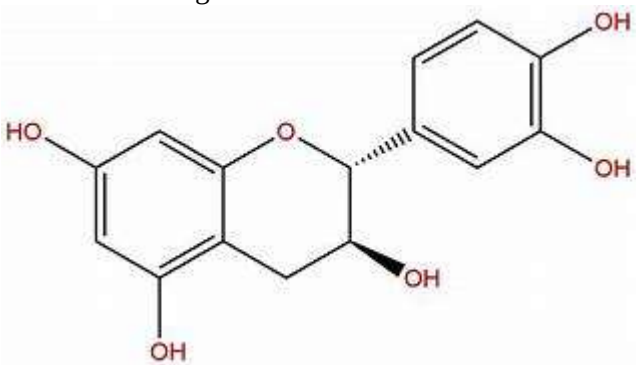

Fig. 11: Catechin

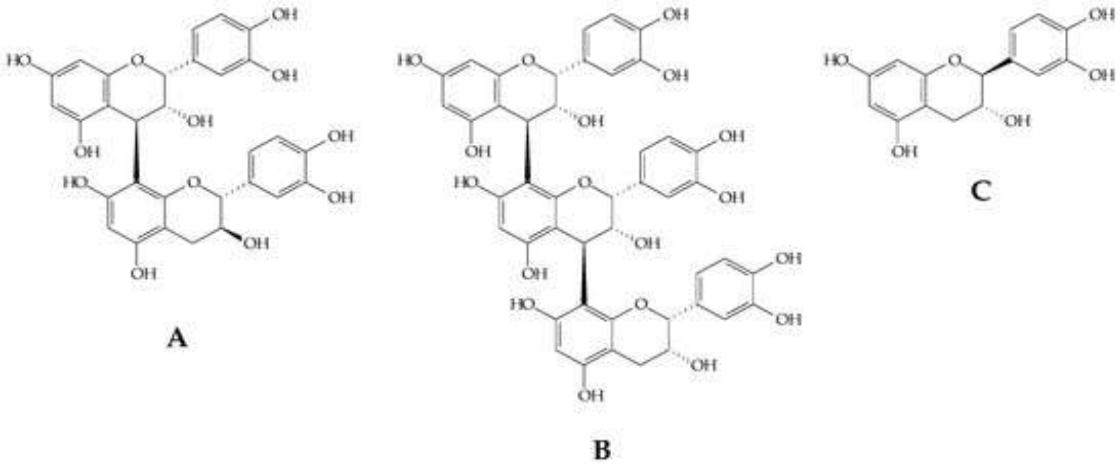

Fig. 12: A) Procyanidin B; B) Procyanidin C; C) Catechin.

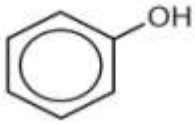

Fig. 13: Phenol

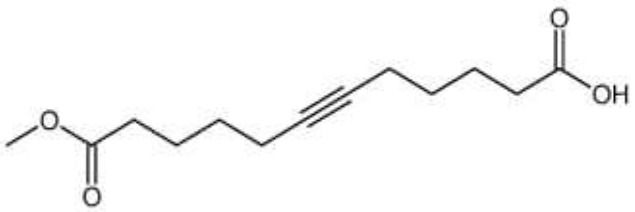

Fig. 14: Tariric acid

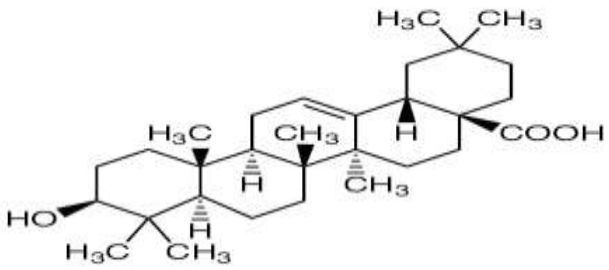

Fig. 15: Oleanolic acid

2) Anticancer activity: Proteins with a galactose affinity are the active anti-tumor component(s) of the plant *X. americana*, according to physicochemical characterization. Furthermore, one of these proteins was found to have a stretch of 11 amino acids that was exactly like a tryptic peptide from the ribosome-inactivating protein ricin using mass spectrometry [24]. Preliminary anticancer studies *of X. americana* indicated 100% of plant extract had LC50 value 86.57(microgram/ml) which implies the plant is used in reducing the risk of tumor causing diseases [25]. n-Hexadecanoic acid is the chemical constituent which shows cancer prevention property [26].

3) Antifungal and antibacterial activity: The main phytoconstituent responsible for antibacterial and antifungal is Tetra decanoic

acid [27]. Oleic acid and 9, 12-Octadecandionoic acid were also found to show antibacterial activity [28, 29]. The methanol extract of bark powder of *X. americana* shows antimicrobial activity against *Bacillus subtilis, S. aureus, P. aeruginosa* and *E. coli* [30].

4) Anti-inflammatory activity: Methanol extract of plant shows more anti-inflammatory activity [31]. XM catechin isolated from ethyl acetate extract of stem bark possesses anti-inflammatory activity [32]. Aqueous ethanol extract of root bark of *X. americana* show anti-inflammatory activity by reducing edema [33].

5) Analgesic activity: *X. americana* may extract enough opioid-like substances from the plant, which are in charge of the plant's analgesic effects [34]. It might possibly have something to do with the existence of steroids, which have been demonstrated to have analgesic properties [35*]. Ximenia americana* water extract mostly exerts a peripheral analgesic effect [36].

6) Gastroprotective activity: *Ximenia americana* stem and bark extract is used for mucosal and skin ulceration, gastritis. It is also used in treating cramps [37]. The two main components of basal gastric secretion—the volume and overall acidity of gastric juice-were both lowered by americana stem bark. Considering that one of the mechanisms of action linked to catechins is suppression of the proton pump. By inhibiting stomach H+, K+-ATPase, catechin and its derivatives function as gastroprotective agents [38]. By lowering gastrin and histamine levels, catechin also showed an endocrine-based gastroprotective mechanism [39]. The main constituents found in *X. americana* extract were Procyanidin B, Procyanidin C, Catechin / Epicatechin [40].

7) Antioxidant activity: The fruits of *X. americana* have demonstrated notable antioxidant properties and are rich in phenols and flavonoids [41]. Because of their natural antioxidant capacity, using polyphenolic chemicals, which are present in many medicinal plants *X. americana* can reduce the risk of various diseases [42]. Extract's chelating and antiradical properties are because of its polyphenol concentration, which may scavenge free radicals, limit their creation, or chelate metals like copper, iron, and zinc that are involved in the development of free radicals [43,44]. In the presence of a chelator, competition inhibits the formation of the complex (ferrozine-Fe2+) between ferrous ions and free ferrozine. The complex formation of *X. americana* stem bark is inhibited in a concentration-dependent manner by hydro-ethanolic extract.

8) Pesticidal activity: Acetylenic lipids and unsaturated fatty acids are abundant in oleaceous seed oils [46]. Acetylenic metabolites exhibit a variety of biological properties, such as insecticidal action [47]. A record of *X. americana* indicated include icosenoic-triacontenoic acids and octadec-11-en-9-ynoic acid, also known as ximenynic acid [48].

9) Anti trypanosomal activity: Terpenes, tannins, saponins, and flavonoids are examples of secondary metabolites found in the plant *X. americana* root bark. *Trypanosoma brucei* was inhibited by methanol extract of this root bark [49].

Current status of *X. americana* in different parts of world: Traditional medicine is used by about 80% of the population to treat a variety of human and animal illnesses. *X. americana* is stated as one of the most prized edible wild plants in the world. There are several uses for *Ximenia americana* plants in Ethiopia, according to ethnobotanical and ethnomedical research conducted in various regions of the nation [50, 51]. It is used as food, medicine, a source of essential oils, and an industrial component of other products in several nations. For a very long time, it was one of the most well-known and significant plants in Ethiopia. It was used as animal fodder, a medicinal herb, and food. It was also among the most valued plants in terms of culture and economy [8]. It is widely dispersed throughout many areas. Its origins are in the following places: Bahar Ghazal, Upper Nile, Kordofan (Nuba Mountains, Nuhud), Red Sea Hills (Erkwit), Darfur (Jabal Marra, Radom); Blue Nile (Ingessena Hills); and Equatoria (Torit) [52]. The analysis revealed that about 169,399 km2 corresponding to 62% of Burkina Faso's total area is currently suitable for the conservation of *X. americana*, whereas 38% (105,001 km2) is unsuitable. It is stated that *Ximenia americana* is one of the plants that is in

danger of going extinct. Clearing forests, grazing, extracting timber, producing charcoal, drought, bark, and root harvesting are the causes. The most concerning aspect of this plant is that, in comparison to other edible wild plants, its conservation status is quite low. In the past, the plant was readily accessible across the nation. The study revealed that the environmental variables used for the distribution of *X. americana* in Burkina are mainly climatic variables (Annual precipitation, mean temperature of the coldest quarter, minimum temperature of the coldest month, mean temperature of the driest quarter, precipitation of the warmest quarter and precipitation of the driest month) [53,54]. Currently herb, *X. americana* is used in countries like Burkina Faso traditional medicine to treat a variety of conditions, including constipation, diarrhea, fever, jaundice, arterial hypertension, and female sterility. It has antibacterial, antitrypanosomal, mollucicidal, and analgesic properties. *X. americana* is used to treat cancer. Fruits of *X. americana* contain coumarins and flavonoid aglycones, as demonstrated by Kabran (2012). Tannic acid is abundant in the bark, while cyanogenic glycosides of saponosides are present in the leaves. The presence of flavonoids and saponins in the aqueous extract of X. americana stem bark was detected by phytochemical screening, which may be the source of the plant's anti-inflammatory qualities [55].

CONCLUSION

From this review we can conclude that the plant *Ximenia americana* is a useful medicinal plant which is found mostly in some countries of Africa. It contains many active principles i.e. secondary metabolites like alkaloids, steroids, glycosides, fatty acids, flavonoids, tannins, volatile oils, saponins and cyanide derivatives. The different parts of plant containing these active principles show various pharmacological activities which are used in treating diseases. This review also explains the pharmacognostic characteristics of plant which includes macroscopic, microscopic, physical, chemical, biological and analytical evaluation. With the help of this study, we came to know a total description of plant *Ximenia americana*. It is a traditional herb which has been used widely but it is in threat of extinction due to many factors. Ximenia americana demonstrates promising pharmacological activities.

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