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Phytochemicals, bioactivities of *Ximenia Americana*: A review

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Abstract

The genus Ximenia belongs to the Olacaceae and comprises about 8 species. *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. It is a plant that is used in traditional medicine for the treatment of malaria, leproutic ulcers and skin infections of mixed origin in Northern parts of Nigeria. *Ximenia Americana* is reputable for the treatment of various ailments in Nigeria. It has been alleged to have antineoplastic activities, antimicrobial, anticancer anti-inflammatory activities and lots more.

Keywords: *Ximenia americana*, chemical compounds, bioactivities.

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1. Introduction

Ximenia americana belongs to the family Olacaceae. The genus Ximenia has eight different species namely *Ximenia roiigi*, *Ximenia aegyptiaca*, *Ximenia parvifl* ora, *Ximenia coriaceae*, *Ximenia aculeate*, *Ximenia caffra*, *Ximenia americana* and *Ximenia aegyptica* [1]. It is commonly referred to as wild plum and tallow nut. It is a shrub or small tree that grows to about 7 m high, with zigzag branches. The bark is black or grey brown, smooth when young but becomes rough with age having stiff axillary spines. The leaves are alternate or clustered on spur shoots. The seed morphology is variable. Flowers are green white to greenish yellow, scented and 5-10 mm long in small branched inflorescences [2].

Native names in Nigeria: Hausa (Tsada), Fulani (Chabbull), Tiv (Anomadze), Yoruba (Igo) and Benin (Alimo-mamiwota) [3]. The methanolic extract of leaves of *Ximenia americana* has been proven to have anti-diabetic effect in rats [4]. The ethanolic extract of the bark of *X. americana* revealed the presence of the following metabolites; flavonoids, steroids, tannins, alkaloids, phenolic compounds, saponin, terpenoids, and glycosides. It also has activity against *Staphylococcus aureus* and low activity against *Pseudomonas aeruginosa*. Other investigations led to isolation of two compounds. The first one which is new is 3-methyl-1-oxoisochroman-8-carboxylic acid and the second compound which is a known steroid is ergosta-4,6,8,22-tetraen-3-one [5]. The plant has also been reported to have anti-HIV/AIDS related diseases effects such as abscesses, skin rashes, diarrhea and gonorrhea. The anti-HIV/AIDS effect of *Ximenia americana* is due to the fact that it contains oleic, ximenic (hexacos-17-enoic), linoleic, linoleric and stearic acids. Its oil consists of very long chain fatty acids with up to 40 carbon atoms used to manage STIs including gonorrhoea [6].

This review article is aimed at addressing the phytochemicals and bioactivities of *Ximenia Americana*. It has been alleged to have antineoplastic activities, antimicrobial and anti-inflammatory activities and lots more. The aqueous plant extract of the leaves is used in the treatment of cancer in African traditional medicine [7]. *X. Americana* has a wild varieties of phytochemical compounds which among them are the following secondary metabolites; saponins, flavonoids, tannins, terpenoids,

sterols, quinines, alkaloids, cyanogenetics glycosides, cardiac glycosides and carbohydrates in the form of sugars and soluble starch [8]. The essential oils of the leaves of *X. americana* using GC-MS and identified 33 components representing 98% of the total oil. The main constituents analysed are benzaldehyde 63.5%, hydroxybenzylcyanide 13%, isophorone 3.5%. The hydroxybenzylcyanide is known as a primary breakdown products of glucosinolates found mainly in the Brassicaceae family [9]. The fixed oil present in the seeds of *X. americana* [10].

2. Chemical compounds and Bioactivities

The stem ethanolic extract of the plant afforded steroids (stigmasterol and sitosterol), triterpenoids (betulinic acid, oleanolic acid, 28-O-(-D-glucopyranosyl) oleanolic acid, 3-oxo-oleanolic acid, 3β–hydroxycicloart-24(E)-ene-26-oic acid and sesquiterpenoids (furanoic and widdrane type). A large number of sesquiterpenes are constituents of essential oils of higher plants and seem to intervene in the pharmacological properties attributed to these volatile fractions [11]. It has been clarified that the biological activities of the liverworths are due to terpenoids and lipophilic aromatic compounds [12]. Steroids and triterpenes with therapeutic interest and manufacturing employment, are a group of secondary metabolites of outstanding importance [11]. Considerable recent work strongly indicates the great potential of the triterpenoids as source of use medicinal [13].

In general, the compounds found in *X. americana* were saponins, glicosydes, flavonoids, tannins, phenolics, alkaloids, quinones and terpenoids types. In addition, the plant is potentially rich in fatty acids and glycerides and the seeds contain derivatives cyanide. The identified compounds did not demonstrate a representative pattern of each class. For example, the sesquiterpene were furanoic and widdrane while, triterpenes exhibited oleanane and cycloartane skeletal type. Concerning the fatty acids, in addition to common C_{16}, C_{18} and C_{22}, a distinctive feature is the presence of acetylenic, as well as, very long chain fatty acids.

2.1 Antimicrobial and antifungal potentials

The MeOH extract from leaves of *X. americana* inhibited or retarded growth of *Neisseria gonorrhea* organism at dilution as low as 250 µg/ml. This same extract showed antifungal effect against *Candida albicans* and *Cryptococus neoformans* in concentration of 4000 µg/ml. Chemical screening conducted on the extract showed the presence of several secondary metabolites as tannins, sterols, terpenoids, flavonoids and saponins [14].

2.2 Analgesic activity

The aqueous extract of stem bark of *X. american* has analgesic properties that justify its use popular in countries such as Tanzania, Senegal, Zimbawe and Nigeria. The extract of *X. americana* in doses containing 10 to 100 mg/kg P.C, inhibits contractions of the abdomen with analgesic effects comparable to those of phenylbutazone. In fact, at doses of 100 mg / kg P.C, phenylbutazone causes an inhibition of pain in 45.2±2%. The percentage of inhibition by extract of *X. ameriacana* is 61.1±% in the same concentration. These properties are probably due to the presence of flavonoids and saponins, detected in the extract.

The analgesic activity of the methanol extract of *X. americana* leaf was investigated in chemical models of nociception in mice. The extract at doses of 200, 400 and 600 mg/kg i.p. produced an inhibition of 54.13, 63.74, and 66.4% respectively, of the abdominal writhes induced by acetic acid in mice. In the formalin test, the administration of 200, 400 and 600 mg/kg i.p. had no effects in the first phase (0 to 5 min) but produced a dose dependent analgesic effect on the second phase (15 to 40 min) with inhibitions of the licking time of 29.3, 47.8 and 59.8%, respectively. These observations suggested that methanol extract of *X. americana* leaf possesses analgesic activity [15].

2.3 Antipyretic activity

The bark of stem of *X. americana* has been used in West Africa for the treatment of pain and fever. To verify this second property, the treatment of rats in hyperthermia with *Ximenia americana* stem bark aqueous and with beer yeast was compared to those obtained with lysine acetylsalicylate (Aspegic). The study showed an antipyretic action of the extract. Moreover, the toxicological study of the stem extract indicated a LD_{50} of 237.5 mg/kg P.C according to the classification of Diezi this plant is relatively toxic. The experiments show that the properties of *X. americana* could due to the presence of saponosides, as show by screening tests performed in this study. These results justified the use of *X. americana* in traditional cure of fever treatment [16].

2.4 Antitrypanosomal potential

The *in vitro* antitrypanosomal activity of methanolic and aqueous extracts of stem bark of *Ximenia americana* was evaluated on Trypanosoma congolense. Blood obtained from high infected mice with T. congolense was incubated with methanolic and aqueous extracts at 20, 10 and 5 mg/ml and Diminal(R) (diminazene aceturate) at 200, 100 and 50 µg/ml in a 96 micro plate. The results revealed that methanol and aqueous extracts had activity at 20 and 40 mg/ml however, the methanolic extracts were more active than aqueous extracts at 10 and 5 mg/ml. Phytochemical screening of the methanolic and aqueous extracts of the bark showed that they both had flavonoids, anthraquinones, saponins, terpenes and tannins. The aqueous and methanolic extract appears to show some potential activity against *T. congolense* [17].

2.5 Anticancer activity

Two sesquiterpenes isolated from the EtOH extract of the stems of *X. americana* did not inhibit the growth of HL-60 (human leukemia), HTC-8 (human colon) and MDA-MB-435 (human breast cancer) cell lines. The antineoplastic activity in vitro of various extracts from *Ximenia americana*, plant used in African traditional medicine for the treating cancer, was investigated [18]. The most active, aqueous extract was subjected to a detailed investigation in a panel of 17 tumor cell lines originating from human (16 lines) and rat (1 line), showing an average IC_{50} of 49 mg raw powder/ml medium. The majority of cell lines (11 out of 17) were classified as sensitive (the sensitivity varied from 1.7 mg/ml in MCF7 breast cancer cells to 170 mg/ml in AR230 chronic-myeloid leukemia cells) and three of these (MCF7 breast cancer, BV173 CML and CC531 rat colon carcinoma) showed a particularly high sensitivity, with ratios lower than 0.1 of the average IC50. The *in vivo* antitumor activity was determined in the CC531 coloretal rat model and significant anticancer activity was found following per oral administration, indicating a 95% reduced activity [18].

2.6 Antiviral effect

The stem bark MeOH extract of *X. americana* as well as several others plant species used by the Maasai pastoralis of East Africa showed antiviral effect against measles virus in vitro by plaque reduction neutralization assay. Potentially active constituents from extracts of all the plants include polyphenols, alkaloids, tannins, sterols, terpenes, saponins and glycosides, between others [19].

2.7 Hepatic and heamatological effects

A study was conducted from the leaves, stem bark and root aqueous extract of *X. americana* with albino rats. The results of this work shows that the extracts significantly ($P<0.05$) increasing the level of serum alanine transaminase (ALT) and aspartate transaminase (AST), results indicative of hepatocellular damage. The result also shows that the root has the ability to impair albumin synthesis as observed by the decrease of level of serum albumin. The weight of the animal showed a significant ($P<0.05$) reduction on administering the leaves extract as compared to the control and the others extracts. This reduction might be due to poor intake and utilization of food by the animals in the leaves extract group. The significantly ($P<0.05$) higher content of hydrogen cyanide, saponins, and oxalates in the root extracts indicates that the root extracts may be more toxic. Hydrogen cyanide is known to cause gastrointestinal inflammation and inhibition of cellular respiration. Saponins are known to have haemolytic properties and the ability to reduce body cholesterol by preventing its reabsorption. The high saponin content in the root may lead to gastroenteritis manifested by diarrhea. Oxalates have been known to cause irreversible oxalate nefrosis when ingested in large doses. Thus, there is need to isolate the specific component(s) responsible for the toxicity in the root extract in order to standardized the preparation for maximum therapeutic benefit [20].

2.8 Food composition and cosmetic use

Glyceride blends containing ximenynic acid (found in *X. americana*) are useful for the preparation of food compositions or food supplements, including margarine, chocolate, ice cream, mayonnaises, cheese, dry soups, drinks, cereal bars and sauces and snack bars. The blend provides a composition providing health benefits consisting of insulin resistance, or related disorders such as diabetes, delaying the onset of symptoms related to development of Alzheimer's disease, improving memory function, lowering blood lipid levels, anticancer effects or skin antiageing effects. Foods X. americana flowers are a replacement for orange blossoms with similar fragrance and soothing cosmetic properties [21].

3. Conclusion

Ximenia americana has several medicinal uses as anticancer. antioxidant, antimicrobial and others. The plant could be a veritable and cheaper substitute for conventional drugs since the plant is easily obtainable and the extract can easily be made via a simple process of maceration or infusion.

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