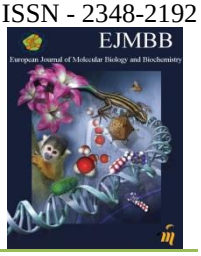
e - ISSN - 2348-2206
Print ISSN - 2348-2192

European Journal of Molecular Biology and Biochemistry

Journal homepage: www.mcmed.us/journal/ejmbb



A REVIEW ON MARTYNIA ANNUA, LANNEA COROMANDELICA, SWETENIA MAHAGONI ON ANTIBACTERIAL, ANTIFUNGAL, ALPHA GLUCOSIDASE AND IN VITRO ANTI-OXIDANT, ANTI-CYTOTOXIC ACTIVITIES

[1]Nomila Merlin J*, Bharathi M[2], Catherine J[2], Jamuna Rani A[2], Jasmine Sajini T[2], Jeevitha M[2], Shalini A[2]

[1]Assistant Professor, Department of Biochemistry, Chennai-600015, Tamilnadu, India.
[2]Department of Biochemistry, Chennai-600015, Tamilnadu, India.

Article Info
Received 23/12/2022
Revised 10/01/2023
Accepted 29/01/2023

Key words: -
Anti-oxidants, Anti-microbial, α-glucosidase activity, medicinal plants.

ABSTRACT
A variety of diseases have been treated with medicinal plants throughout history. It is estimated that 70 to 80% of the world's population uses either traditional or herbal medicine as part of their health care system. As a wild plant, Martynia annua Linn (Martyniaceae) is an important medicinal herbaceous annual plant that can be found in many parts of India as an herbaceous annual herb. The fruits, seeds, roots, and leaves are the most crucial parts of the plant that are utilized therapeutically, even though most of its parts are used in folklore and as kakanasika in Ayurveda. A medium-sized deciduous tree, L. coromandelica is native to the Mediterranean region. It is used for treating impetiginous eruptions, leprous ulcers, and obstinate ulcers as well as for treating sprains, bruises, skin eruptions, heart disease, dysentery, and mouth ulcers. Historically, Swietenia mahagoni has been used for its curative properties in diseases like malaria, diabetes, and diarrhea in India and some African countries. Additionally, it is used as an antipyretic, bitter tonic, and astringent. Research is being conducted on its pharmacological properties. The present study aims to review the plants (M. annua, L. coromandelica and Swietenia mahagoni) effective as anti-microbial, In-vitro anti-oxidant as well as anti-cytotoxic and alpha glycosidase inhibitory activity.

INTRODUCTION

A large number of modern drugs have been isolated from natural sources which have been used as medicinal plants for thousands of years. Throughout history, medicinal plants have been used in various parts of the world to treat a variety of diseases. In addition to being used as remedies, they have been used to prepare health care products [1]. 90% of these grow wild in climatic regions throughout the country. The traditional health care system and herbal medicines are mainly used by 70 to 80% of the people around the world [2].

Corresponding Author

Nomila Merlin J
Email: - nomilamerlin@gmail.com

It has long been recognized that therapeutically effective medicines can be derived from medicinal plants and their derivatives because secondary metabolites can be produced. Moreover, the extraction and development of several drugs and chemotherapeutics from these plants as well as traditional rural herbal remedies have increased the use of medicinal plants in industrialized countries. In the past twenty years, there has been at least one novel compound produced by higher plants marketed every 2.5 years. Researchers have been interested in the elucidation of natural compounds from plants belonging to different molecular families with intriguing biological activities, which will allow for breakthroughs in medicine through their discovery [3].

A wild herb known as Martynia annua is found throughout India. Natural products which are therapeutically important are discussed in depth in the Materia medica of India. It belongs to the Martyniaceae family and is often called kaakanassikaa in Ayurveda. According to Ayurveda, kakanasika is a herb that can prevent graying of hair, and its seeds may be taken for that purpose from the ayurvedic pharmacopoeia of India [4]. It has been found to possess anticonvulsant properties, anthelmintic properties, analgesic and antipyretic properties, antibacterial properties, antifertility properties, antinociceptive properties, antioxidant properties and wound healing properties [5, 6]. There are broad, ovate to deltoid leaves, 15 - 23 cm long, opposite and chordate, sinuately lobed and minutely dentate, covered by a gelatinous substance. Its flowers are foxglove shaped and have ill smelling racemes and are pink and dark purple blotched with yellow inside. Having hairy glands along the outer border of the corolla, the mouth lobes being oblique and unequal. Two recurved sharp hooks on the fruit make it hard, bilobed, woody, and yellow-brown [7]. Madhya Pradesh's tribal pockets administer root decoction to snakebites. For sore throat, epilepsy and tuberculosis, tribes use leaves juice in Marudhamalai hills. Tantriks also use the plant's stem in some places in India besides these uses [8].

There are some medicinal plants, such as Lannea coromandelica (Jhika or Indian ash tree), which belongs to the Anacardiaceae family, and has long been used by indigenous people in Bangladesh. [9] It is known that *Lannea coromandelica* has anti-inflammatory, antihypertensive, and wound healing properties. [10]

In this tree, the leaves are imparipinnate, 25-45 cm long, crowded at the ends of branches, leaflets are 3-7 pairs, elliptic oblong or ovate-elliptic, with gray or white bark, which exfoliates irregularly with rounded plates when the leaves are bare, yellowish green, crowded with cymose fascicles, and fruit is drupe, reniform, and red when ripe. The seeds are solitary, compressed, and exude a yellowish white mucilagenous gum, called Jihingan gum, when they are fresh. Furthermore, elephantiasis, eruptions, snakebite, stomach ache, and vaginal disorders were also relieved by the plant. It is also useful for ulcerative stomatitis, dyspepsia, general debility, gout, cholera, diarrhea, and dysentery. [11]

A limited number of scientific studies have been conducted on L coromandelica, but it is generally used as a traditional medicine. The presence of bioactive compounds makes this plant a potentially valuable source of antibacterial herbal raw materials.

In the west Indies, Swietenia mahagoni (Linn.) Jacq. grows to a tremendous size and is a very important timber tree. In tropical zones like India, Malaysia, and Southern China, this tree is primarily cultivated for its timber. One of the most popular traditional medicines in Africa is the Swietenia mahagoni tree, which belongs to the African genus Khaya. About 6 to 10 cm long, the fruit is brown, egg- to pear-shaped. Upon reaching full ripeness, the woody shell splits into five sections and falls off of the fruit.

The decoction of the stem bark is applied to cuts and wounds as an antiseptic; the seeds are used to treat hypertension, diabetes, malaria, cancer, coughs, and intestinal parasites [12]. Moreover, seed extracts of S mahagoni have been reported to possess antimicrobial properties [13] and used in Indonesia and Amazonia for leishmaniasis and abortion medicine. Approximately 1290 cm high, 915 to 1524 cm in diameter, the plant reaches a height of 1 290 cm. Each individual has a more or less identical crown form with a symmetrical canopy and regular outline. There are alternate, pinnately compound leaves bearing a dark green color. A lanceolate or ovate leaflet is shaped. Approximately every two years, the plant produces inconspicuous green flowers.

Fruits are woody capsules, brown in color and oval to pear in shape, ranging from 8-16 cm in length, and do not attract wildlife. A tree grows and its branches droop. Besides curing diabetes, seeds possess anti-inflammatory, anti-mutagenic, and anti-tumor properties.

As an alternative treatment for skin cuts, itching, and wounds, the seed oil is being used in African countries to alleviate the healing process.

In addition to their valuable therapeutic properties, secondary metabolites of the plant can be used to manufacture natural antibiotics [14].

There are many different types of chemical compounds present in Meliaceae species, including triterpenoids (limonoids). The genus Swietenia has produced more than 300 limonoids, making it the family with the most limonoids. S mahagoni seeds have been extracted methanolically and found to contain seven limonoids [15].

1. Anti-microbial, anti-fungal and anti-bacterial activity

a. *Martynia annua*

There are several properties of the plant: anti-pyretic and analgesic abilities, anti-bacterial, anti-convulsant, anti-nociceptive properties. It also showed anthelmintic, anti-fertility ability. Many reports showed it has anti-oxidant and would healing properties. It acts against diabetic, and fungal diseases. As well as it had gastro protective property.

A study reported that the antibacterial effect was observed on gram-positive and gram-negative bacteria when chloroform, ethyl acetate, and methanol extracts were prepared from *M. annua* L leaves. A variety of bacteria are susceptible to the antibacterial action of the solvent extracts. *B. subtilis*, *P. vulgaris*, and *B. thuringiensis* were all more susceptible to chloroform extracts. A potential anti-bacterial effect of ethyl acetate extract was demonstrated against Salmonella A, Salmonella B, *P. mirabilis*, and P. vulgaris, whereas the methanol extract was more effective against *P. vulgaris*, *B. subtilis, S paratyphi* B, and *P. aeruginosa*. We used the

Disc Diffusion method to measure anti-bacterial activity [16].

Another study revealed that the anti-bacterial assay done by Agar well diffusion method using microorganisms cell suspension whose concentration was equilibrated to 0.5 McFarland standards. The antibacterial activity was tested against leaf extracts of *Martynia annua*. As a result, bacterial growth was significantly reduced. When leaf extract concentrations increase, the zone of inhibition also increases, indicating dose-dependent activity. *Martynia annua* leaves at 100 g/mL showed a maximum growth inhibition (30 mm) against Staphylococcus aureus. There were also 29 mm of Klebsiella pneumonia, 28 mm of Bacillus subtilis, and 28 mm of Proteus mirabilis. Acetate, aqueous, and petroleum ether extracts inhibited growth in Staphylococcus aureus, Bacillus subtilis, and Proteus mirabilis at a concentration of 100 g/mL, followed by Klebsiella pneumonia (28 g). As a result of significant zone of inhibition (23 - 27 mm) of ethanol extract at 25,50,75 g/mL, all the tested organisms were found to be susceptible to the ethanol extract. All of the tested microorganisms were moderately inhibited by acetone, petroleum ether, and aqueous extracts of *Martynia annua* leaf.

Using CSDPs belonging to nine families from Arnala and Kalamb beaches, *Martynia annua* L was investigated for its antifungal activity. According to the results obtained, 90% colonization was discovered in C. rotundus, 90% in *E zeylanica*, 90% in *L procumbens* (Kalamb beach), 90% in Martynia annua, 90% in *P punctatum*, and 90% in *S orientale* [17].

b. *Lannea coromandelica*

A research work has done on *L. coromandelica* against MRSA strains. Five MRSA isolates were inactivated by extracts of all types (methanolic, ethanolic, and aqueous). The disk diffusion of extracts of *L. coromandelica* (methanolic, ethanolic, and aqueous) showed an increasing inhibition zone with increasing concentrations of extracts. Methanolic extract 100 mg/ml produced the highest zone of inhibition of 14 mm. Maximum extracts' MIC and MBC were 3.125 mg/ml and 6.25 mg/ml, respectively [18].

Another study showed the presence of a clear zone around the well indicated antibacterial activity of various concentrations of *L. coromandelica* extract. Bacteria cannot grow in the clear zone surrounding the well because the extract is diffused there. A comparison of the results revealed that KJBEA extract had the highest antibacterial activity. This was due to the presence of phenolic compounds within KJBEA extract that interfered with bacterial metabolism, inhibiting bacterial growth [19].

Disk diffusion was used for the antimicrobial assay. A dried sample extract was tested for antimicrobial activity against thirteen microorganisms. A sterile loop was used for immediately transferring the inoculated organisms to a petri dish from the previously sterilized nutrient agar media under aseptic conditions. A Petri dish was filled with the prepared sample and standard solution. At 37°C, the plates were incubated overnight. In order to determine the antimicrobial activity of the extracts, the area of inhibition was measured and compared to the standard antibiotic cephradin disc expressed in millimeters (mm). Furthermore, antifungal activity against two fungi was assessed and compared with that of nystatin.

Based on agar well diffusion testing, aqueous and ethanol extracts were found to have antibacterial and antifungal activity in vitro. For this method, pure isolates of each microbe were subcultured at 35-37°C for 25 h on the recommended C media for that microbe. As a standard for antibacterial activity, ciprofloxacin was used (stock 10 micrograms/ml) and amphotericin B was used for antifungal activity (stock 10 micrograms/ml).

It is evident that ethanolic extract is more effective against Staphylococcus aureus. In the concentrations of one hundred percent, 75%, and 50%, the zone of inhibition (ZI) is 19.21 mm, 18.45 mm, 16.41 mm, with a mean diameter of 12.49 percent, 119.98 percent, and 106.72%, respectively, as compared with the control drug i.e., 100% (Ciprofloxacin, zone of inhibition 15.37 mm), whereas the aqueous extract only has higher activity when concentrated at 100%, i.e., 126.38% (ZI-19.76 mm) as compared to the control drug (ZI-15.64). Nevertheless, 75% and 50% concentrations showed 92.92% and 79.45% sensitivity (ZI-14.53 mm and 12.42 mm, respectively) [20].

c. *Swietenia mahagoni*

A study has been conducted on the antimicrobial activity of seed extract using agar disc diffusion and broth dilution assays. Antimicrobial tests were conducted using a culture of twenty pathogenic microorganisms (local isolates). A 50 ml nutrient broth culture was grown at 37°C and nutrient agar slant was maintained at 4°C for the bacteria strains. Based on disc diffusion assays, minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) values, the oily extract was evaluated for its antimicrobial activity against Gram-positive, Gram-negative, yeast, and fungus strains.

An additional study found that pet ether extracts from S mahagoni seeds are effective against Staphylococcus aureus with a maximum zone of 20 mm. As compared to other solvent extracts, n-hexane seed extract showed a maximum zone of 17 mm against Escherichia coli [21].

S mahagoni (L.) leaf methanolic extracts were evaluated for antifungal activity. Inhibition zones ranged from 17.2 to 22.1 mm for C albicans, A flavus, and A niger at 50 mg/mL and 12.0 to 18.1 mm for 25 mg/mL. The inhibition zones measured at 15 mg/mL ranged from 9.5-13.1 mm, with slightly less activity detected at 15 mg/mL. Conversely, there was no activity detected against A. fumigatus or C. glabrata. According to the screening results, the MIC and MFC for A. flavus and A. niger are 12.5 and 25 mg/mL, respectively. C albicans and *A niger* are inhibited by 100 mg/mL methanolic extract of this

plant. C albicans and Rhizopus spp. were both susceptible to the methanolic extract activity [22].

Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris, and Bacillus subtilis are inhibited by alcoholic and aqueous extracts of the leaf, stem/bark, and root. As with ampicillin and benzyl penicillin, the effectiveness of the inhibitor is comparable.

2. Anti-oxidant property

a. *Martynia annua*

A variety of *in vitro* methods were employed to study the anti-oxidant activity of *M. annua* leaves extracts in aqueous and methanolic medium, including reducing H_2O_2, DPPH radical scavenging, power test, nitric-oxide scavenging assay, super-oxide radical scavenging tests as well as total anti-oxidant capacities. Aqueous extracts were found to have lower antioxidant activity than methanolic extracts [23].

A study using spectrophotometric methods was conducted to determine the amount of ascorbic acid, flavonoids, tannins, and phenols in *M. annua* parts. A significant number of flavonoids, phenols, tannins, and ascorbic acids were found in the leaves and stem of *M. annua* compared to the endocarp and seed. According to a study, *M. annua* contains natural antioxidants [24].

A study showed that the extracts of *M. annua* in methanol and water. In vitro methods were employed to evaluate anti-oxidant activity of leaves, including Nitric-oxide, DPPH, Super oxide Hydrogen peroxide scavenging assays, Reducing power assays as well as Hydroxyl radical and Superoxide radical scavenging activity. Antioxidant activity was higher in methanol extracts than in aqueous extracts.

The ethyl acetate soluble partitionate of the plant displayed the highest free radical scavenging activity with a IC50 value of only 3.8 µg/ml. At acidic pH, the Phosphomolybdeum method assay measures total antioxidant capacity by reducing Mo (VI) to Mo (V). A green phosphate/Mo (V) complex is formed after the reduction occurs. A total antioxidant activity is expressed as mg of L-ascorbic acid per gm of dried extract using the phosphomolybdenum method, which is a quantitative method. Leaf and bark ethyl acetate partitionate showed the greatest antioxidant capacity, and their L-ascorbic acid contents per gram of dried extract were 46.67 mg and 33.78 mg, respectively. According to the results, the IC50 is the amount of antioxidant needed to decrease DPPH by 50% from its initial concentration. IC50 is a measure of antioxidant power, and the lower it is, the stronger it is.

b. *S. mahagoni*

A study evaluated the antioxidant properties of the plant extract by observing its ability to scavenge free radicals. A plant extract concentration ranged from 100 to 0.78 µg/mL. A nonlinear regression curve was plotted against the mean percentage of radical scavenging activity to obtain the IC50 value, the concentration of the plant extract that caused a 50% reduction in the DPPH concentration. In comparison to the control positive, 69.9 mg/mL was found for the leaf extract and 53 mg/mL for the leaf extract. Consequently, *S mahagoni* has a strong antioxidant effect [25].

There was evidence that the seed of *S.mahagoni* is a powerful antioxidant. Various in vitro assays have demonstrated the potency of the methanol extract. Extracts of the seed had a hydrogen peroxide scavenging activity of 49.5, which was comparable to that of ascorbic acid (51.1). FRAP activity of the seed extract was 0.728 mmol Fe++/g, which was greater than ascorbic acid (0.405). When concentrations of 1 mg/mL were used, the extract showed 23.29% DPPH-scavenging activity, which was less than that of ascorbic acid [26].

c. *Lannea coromandelica*

A study used Brand-Williams' method to evaluate the antioxidant capacities of MELC and AELC with minor modifications [27]. A specific concentration of 100-500 µl of MELC and AELC dissolved in ethanol was used to test DPPH-free radical scavenging efficiency. AELC and MELC free radical scavenging efficiency is measured by the degree of color change from purple to yellow. A successful inhibition of DPPH-free radicals was achieved using MELC and AELC. A higher concentration of extract led to greater DPPH activity as the extract concentration was increased. A comparison was made between the inhibitory effects of and ascorbic acid. In comparison to AELC, MELC had greater antioxidant activity. Among its many functions, iron transports oxygen, breathes, and activates many enzymes. It is important to note that flavanoids are anti-oxidants and chelators.

Researchers developed a method to determine the antioxidant activity of MLCB by using phosphomolybdenum. A good reducing power was observed in the DPPH and total ROS removal method with MLCB as a good antioxidant [28].

Researchers assessed the antioxidant effects of LCBE using RAW 264.7 cells and understood the molecular mechanisms by performing a variety of in vitro antioxidant assays. As well as quenching cellular reactive oxygen species (ROS) generation without causing any toxicity, the extract scavenged numerous free radicals by hydrogen atom transfer and/or electron donation. Antioxidant properties of LCBE significantly reduced the production of cellular ROS. Based on these findings, it is an ideal candidate for a naturally occurring, readily available, and inexpensive phytochemical, as well as a strategy to prevent diseases associated with oxidative stress [29].

3. *In-vitro* anti-cancer activity

a. *M. annua*

M annua extracts were tested for cytotoxicity through a bioassay to determine lethality. The half mortality of brine shrimp nauplii was observed to occur at 239.48 ppm

for the alcoholic extract and 328.21 ppm for the acetone extract of *M annua*. *M.annua* showed cytotoxic potential in the study.

A study showed that the Human Leukemia Cell Line K-562 had a superior anticancer response to aqueous extract of *Martynia annua*. The *Martynia annua* extract was most effective against fast proliferating cells (Leukemia cells) and possibly a cell cycle arrest is the mode of action (to be determined in the future). They concluded that further research was needed to investigate its effect on cancers targeted by the drug [30].

b. S. mahagoni

Various concentrations of the methanolic extract of *S.mahagoni* (L.) leaves were assessed for their cytotoxic effect on HCT-116 and normal skin fibroblasts BJ-1 using the MTT reduction assay. HCT-116 cells were incubated for 48 hours with plant extracts, showing a powerful anticancer effect. Also, a simple test was conducted on the normal skin fibroblast cell line and showed little effect (22.7%) at 100 mg/mL after 48 hours. A positive control at 37.6 grams/mL was doxorubicin, a drug used for cancer treatment. Accordingly, *S.mahagoni* leaves contain a powerful anticancer component compared to doxorubicin [31].

High concentrations of the extract were found to be moderately cytotoxic in the bioassay. There was a LD50 of 0.68 mg/mL after 24 h of exposure. An acute oral toxicity threshold greater than 5000 mg/kg was found for the seed extract in mice, indicating relative non-toxicity [32].

C. *Lannea coromandelica*

By using neutral red assays and 4-,6-diamidino-2-phenylindole (DAPI) staining in a study, six extracts were tested for anticancer effects on human hepatocellular carcinoma cell line (HepG2) *in vitro*. DNA fragmentation was determined through agarose gel electrophoresis. On the basis of their IC50 values and selectivity indices (SI), six crude extracts were classified into three groups. It was comparable to melphalan in terms of cytotoxicity and SI for DC (twig) crude extract on HepG2 cells (P = 0.023). There was moderate cytotoxicity and a lower SI in the crude extracts of DC (leaves), LC (twigs), and BA (twigs). The DNA fragmentation assay only showed laddering for DC (twig) and LC (twig) extracts, despite all crude plant extracts causing apoptosis in more than 50% of DAPI-positive apoptotic HepG2 cells. In both compounds, 2-palmitoylglycerol was the predominant component. In DC (twig) crude extract, pyrogallol and lupeol were the major compounds. It had a high toxicity but a low selectivity due to hexadecanoic acid and octadecenoic acid. HepG2 cells were induced to apoptosis by ethanol extracts of DC and LC twigs. The cytotoxicity of DC (twig) toward HepG2 cancer cells may be caused by pyrogallol and lupeol [33].

4. Anti- diabetic activity by inhibition of α-glucosidase enzyme

a. Martynia annua

There was a range of 36.24 to 59.13 percent inhibition of a-glucosidase by the plant extract. Inhibition of α-glucosidase by plant extract was greatest at 50 g/mL (59.13%), which was more than metformin's maximum inhibitory effect at 10 g/mL (53.70%); the IC50 was 42.28 ± 039 mg/mL. Various plant extracts inhibit salivary a-amylase. It inhibited salivary a-amylase by 73.3 % at a concentration of 50 g/mL, greater than metformin's 58.4% at 10 g/mL, and its IC50 was 34.11 mg/mL. Upon analysis, it was found that methanolic extracts induced high levels of a-amylase inhibition as well as a-glucosidase enzyme activity. It was found that the methanolic extract of Martynia annua showed good anti-diabetic activity in both STZ-induced diabetic rats and STZ-NIC induced diabetic rats [34].

A study of *Martynia annua* seeds has never been conducted for their antidiabetic properties. The IC50 for the ethanol extract was found to be 78.78 x 3.19 mg/mL, whereas the IC50 for the standard (Acrobose) was 240 ± 0.03. Using an in vitro α-glucosidase assay to determine the anti-diabetic properties of Martynia annua mature fruit extracts, the results showed that the ethanol extract had an IC50 of 78.78 ± 3.19 micro gram per ml [35].

b. Lannea coromandelica

L. coromandelica leaves extract administered at 200 and 400 mg/kg significantly lowered blood glucose levels in diabetic mice in a dose-dependent manner, but not as much as Glibenclamide. In alloxan-induced hyperglycemic mice, methanol leaves extract of L coromandelica demonstrated significant antihyperglycemic activity; in addition, they can enhance the effects of diabetes mellitus based on body weight and blood glucose levels. In addition, it was suggested that the regrowth of islet-c cells following alloxan destruction might explain why guinea pigs injected with the drug were able to recover [36].

As compared to normal rats, L coromandelica leaf extracts (100 and 200 mg/kg b.w.) significantly reduced glucose levels in glucose-loaded animals and in alloxan-induced diabetic rats. Hyperglycaemia is reported to be caused by Alloxan because it destroys pancreatic beta cells, resulting in a massive reduction in insulin release. A phenolic and flavonoid compound was identified in ethanolic leaf extract from L.coromandelica. As a consequence, flavonoids in L.coromandelica extract may play a role in antidiabetic activity [37].

An in-silico docking study of *L.coromandelica* leaves showed that Tropylpropanaltosylhydrazone, a Cdk5 inhibitor, could be a promising diabetes drug.

c. Swietenia mahagoni

Both diabetics and diabetics treated with insulin transdermally showed significantly higher blood glucose levels ($p<0.001$). Transdermally treating diabetic animals with seed extract resulted in a significant reduction ($p<0.05$) in hyperglycemia. It also causes toxic effects in the liver, kidneys, and pancreas, as a result of injecting

STZ into the body. Hence, diabetic ketoacidosis (Type-1 diabetes) and hyperosmolar nonketotic diabetes produce acute metabolic complications that increase glucagon concentration [38]. Cortical hormones and catecholamines could be heightened by STZ stock. As a result, the extract is able to regenerate pancreatic isolate in rats that have been induced with STZ to become diabetics. Thus, the transdermal delivery method of S.mahagoni seed extract contributes to the prevention of diabetic complications and serves as an adjuvant in the drug delivery of antidiabetic drugs.

The ethanolic extract of *S.mahagoni* seed inhibited the activity of α-amylase *in vitro*. Moreover, a study published in 2015 found that both the aqueous and ethanol extracts of this plant (maceration and reflux extraction methods) inhibited α-glucosidase, as well as having hypoglycemic properties in vivo. The best results were obtained by macerating ethanolic extracts with glucose. These compounds also showed anti-diabetes effects in vivo.

According to a study [39], *Swietenia mahagoni* extract has approximately half the activity of rosiglitazone as PPAR-agonists for diabetic mice (db/db). Using both oral glucose tolerance (OGTT) and normo-glycemic activities tests, methanol extracts of the seeds of Swietenia macrophylla King were evaluated on streptozotocin-induced (STZ) diabetic rats. Compared to glibenclamide, MEMS showed promise as an antidiabetic. Diabetic rats showed significant reductions in BGL, serum lipids, and liver glycogen levels.

A lower fasting blood glucose level was also observed in rats treated with extract (300 mg/kg) or glibenclamide (30 mg/kg). Furthermore, rats treated with extract showed improvements in their body weight profiles.

Using herbal teas made from *Andrographis paniculata* herbs and *Mahagoni* seeds (2:1) for seven days at 0.4 ml/20g body weight, a researcher found that alloxan diabetic mice had the highest reduction in blood glucose levels (88.20, 43.16 mg/dl) when compared to other ratios [40].

CONCLUSION

It has been concluded from the above review *M. annua*, *L. coromandelica* leaves and seeds of *S.mahagoni* contain natural antioxidants that are potent therapeutic agents for the prevention of oxidative stress-related degenerative diseases. As well as they have potent anti-bacterial and anti-microbial effects against many microbes. The plant extracts showing effectiveness against cytotoxicity and anti-diabetes. Further researches on this plant may aid to produce potent drugs as source of herbal medicine for so many diseases.

REFERENCES

1. Siddiqui S, Verma A, Rather AA, Jabeen F, Meghvansi MK. Preliminary phytochemicals analysis of some important medicinal and aromatic plants.Advances in Biological Research, 2009; 3:188-195.
2. UNESCO. FIT/504-RAF-48. Terminal report. Promotion of enthnobotany and the sustainable use of plant resources in Africa, Paris. 1998, 60-61.
3. Delahaye C, Rainford L, Nicholson A, Mitchell S, Lindo J, Ahmad M. Antibacterial and antifungal analysis of crude extracts from the leaves of *Callistemon viminalis. Journal of Medical and Biological Sciences.* 2009; 3(1):1-7.
4. Brinda P, Sasikala B, Purushothaman KK. Pharmacognostic studies on *Merugan kilzhangu.* B.M.E.B.R. 1981; 3(1):84-96.
5. Lodhi S, Singhai AK. Preliminary pharmacological evaluation of Martynia annua Linn leaves for wound healing. Asian Pacific Journal of Tropical Biomedicine. 2011; 1: 421-427.
6. Chopra R.N, Nayar S.L, Chopra J. C. "Glossary of Indian Medicinal plants", National Institute of Science Communication, New Delhi 1996:181.
7. Traditional knowledge on ethno-medicinal uses prevailing in tribal pockets of Chhindwara and Betul Districts, Madhya Pradesh, India - Nath Vijendra and Khatri Pavan Kumar.
8. Rahman M, Khatun A, Uddin SJ, Shilpi JA. Comparative effect of Lanneacoromandelica (Houtt.) Merr. Leaves and stem barks on acetic acid induced pain model in mice and chromagenic reagents: exploring the analgesic potential and phytochemical groups. Pharmacologyonline 2016 Apr 30;1(1):146-52.
9. Basuri TS, Patil C, Dhal NK. In vitro evaluation of antibacterial activity of crude ethanolic extract of Lanneacoromandelica. J Pharm Res 2011;4:1246-7.
10. Jain SK, Tarafder CR. Medicinal plants-lore of the sandals- A revival of PO Bodding's work. Econ Bot 1970;24:241- 78.
11. Waziiroh E, Harijono and Kamilia K: Microwave-assisted extraction (MAE) of bioactive saponin from mahogany seed (Swietenia mahogany Jacq). International Conference on Green Agro-industry and Bioeconomy IOP Conf. Series. Earth and Environmental Science 2018, 1-8.
12. Darussalam H, Nuryastuti T and Mustofa M: Antimicrobial activity of bioactive compounds isolated from Swietenia mahagoni (L) Jacq. against Staphylococcus aureus and Pseudomonas aeruginosa. Journal of Medical Science 2014; 46: 161-166.
13. Nweze EL, Okafor JI, Njoku O (2004) Antimicrobial activities of methanolic extracts of Tremaguineensis (Schumm and Thorn) and Morinda Lucida Benth used in Nigeria. Biol Res 2(1):39–46
14. Govindachari TR, Suresh G, Banumathy B, Masilamani S, Gopalakrishnan G (1999) Antifungal activity of some B, D-seco limonoids from two meliaceous plants. J Chem Ecol 25(4):923–933

15. Sermakkani M, Thangapandian V. Antibacterial and phytochemical analysis of *Martynia annua* L. Plant Archives. 2010; 10(1): 223-225.
16. Kumar S et al. systemic review: pharmacognosy, phytochemistry and pharmacology of martynia. Int J Res Med. 2012; 1(1):34-39.
17. Kaur R, Jaiswal ML, Jain V. Protective effect of *Lannea coromandelica* Houtt. Merrill. Against three common pathogens. J Ayurv Integrative Med 2013 Oct;4(4):224
18. Moat A.G., J. W. Foster., & M. P. Spector: Microbial Physiology Fourth Edition. New York: Wiley-Liss (2002)
19. Bauer AW, Kirby WM, Sheriss JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. Am J Clin Pathol 1966; 45:493-6.
20. Karaman, I., Sahin, F., Gulluce, M., Ogutcu, H., Sengul, M. & Adiguzel, A. (2003). Antimicrobial activity of aqueous and ethanol extract of Juniperus oxycedrus L. Journal of Ethnopharmacology 85: 231–235.
21. Pragadheeswari R and Sangeetha K: Herbal coated natural nonwovens for the development of foot insoles with reference to a diabetic foot ulcer. International Journal for Research in Applied Science & Engineering Technology 2017; 5: 2905-2914.
22. Laxmaiah CH, Srikanth V, Gouda KS, Debnath S, Chiranjib B (2011) Antimicrobial activity of S. mahagoni L. (Leaf) against various human pathogenic microbes. Indo Am J Pharm Res 1(4):257–261
23. Lodhi S, Singhai A K. Preliminary pharmacological evaluation of Martynia annua Linn leaves for wound healing. Asian Pacific Journal of Tropical Biomedicine 2011; 1(6): 421-427.
24. Kar D M et al. Analgesic and antipyretic activity of fruits of Martynia annua Linn. Hamdard Med. 2004; 47: 32.
25. Chaves N, Santiago A, Alías JC (2020) Quantification of the antioxidant activity of plant extracts: Analysis of sensitivity and hierarchization based on the method used. Antioxidants (basel) 9(1):76
26. Sahga G, Ramanathan S, Sasidharan S, Mordi MN, Ismail S, Mansor SM. In vitro antioxidant and xanthine oxidase inhibitory activities of methanolic Swietenia mahagoni seed extracts. Molecules. 2009; 14(11): 4476-4485.
27. Olajire A, Azeez L. Total antioxidant activity, phenolic, flavonoid and ascorbic acid contents of Nigerian vegetables. African Journal of Food Science Technology. 2011;2(2):22-9.
28. Vinnarasi J, Raj AAA, Rose GL. Phytochemical Screening and Cytotoxic Activity of Martynia annua L. Leaves Extracts. 2014;4.
29. Ogbole OO, Segun PA, Adeniji AJ (2017) In vitro cytotoxic activity of medicinal plants from Nigeria ethnomedicine on Rhabdomyosarcoma cancer cell line and HPLC analysis of active extracts. BMC Complement Altern Med 17:494
30. Prieto, P., M. Pineda and M. Aguilar, 1999. Spectrophotometric quantitation of antioxidant capacity through the formation of a phosphomolybdenum complex: Specific application to the determination of vitamin E. Anal. Biochem., 269: 337-341
31. Md Badrul Alam, Kyoo-Ri Kwon, Seok-Hyun Lee and Sang-Han Lee. Lannea coromandelica (Houtt.) Merr. Induces Heme Oxygenase 1 (HO-1) Expression and Reduces Oxidative Stress via the p38/c-Jun N-Terminal Kinase–Nuclear Factor Erythroid 2-Related Factor 2 (p38/JNK–NRF2)-Mediated Antioxidant Pathway. Int. J. Mol. Sci. 2017, 18, 266.
32. Rahul Kumar Gupta & Renu Bharat Rathi. Evaluation of Anticancer Action of *Martynia annua* Linn Root Extract on Different Human Cancer Cell Lines. JPRI, 33(26A): 96-109, 2021.
33. Saiyad MF, Gohil KJ. 2013. To investigate antidiabetic potential of *Martynia annua* Linn. Flower extracts in wistar rats. World J Pharm Res. 2(2):486–499.
34. Elbashir SMI, Devkota HP, Wada M, Kishimoto N, Moriuchi M, Shuto T, Misumi S, Kai H, Watanabe T. 2018. Free radical scavenging, a-glucosidase inhibitory and lipase inhibitory activities of eighteen Sudanese medicinal plants. BMC Complem Altern Med. 18(1):282.
35. K. C. Gorray, D. Baskin, J. Brodsky, and W. Y. Fujimoto, "Responses of pancreatic b cells to alloxan and streptozotocin in the guinea pig," Pancreas, vol. 1, no. 2, pp. 130–138, 1986.
36. Halliwell B, Gutteridge JM, Free Radicals in Biology and Medicine, 2nd Edn,. Oxford: Clarendon Press: 215, (1985).
37. Premjanu N, Jayanthy C, Antidiabetic activity of Phytochemical isolated from *Lannea coromendelica* leaves –an in-silico approach. Journal of Chemical and Pharmaceutical Sciences, 41-44, (2014).
38. Hajra, S., Mehta, A., Pandey, P., Vyas, S., 2011. Antioxidant and antidiabetic potential of ethanolic extract of *Swietenia mahagoni* (Linn.) seeds. Int. J. Pharmaceut. Res. Dev. 3 (3), 180–186.
39. Dan-dan Li, Jun-hua Chen, Qing Chen, Guo-wei Li, Jing Chen, Jian-min Yue, Min-li Chen, Xiao-ping Wang, Jian-hua Shen, Xu Shen & Hua-liang Jiang. Swietenia mahagony extract shows agonistic activity to PPAR γ and gives ameliorative effects on diabetic db/db mice. Heliyon 6 (2020).
40. http://refhub.elsevier.com/S2405-8440(20)30381-9/sref76