



REVIEW ARTICLE

A review on medicinal values and pharmacological importance of Moraceae

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Abstract

Mulberries and figs are related to the Moraceae family, which includes 50 genera and 1,400 species in tropical and subtropical regions worldwide. In terms of medicinal value, it is treated as one of the most important families. This review provides a comprehensive summary of the family's bioactive compounds, conventional utilize, and pharmaceutical application. The active components of the plant include flavonoids, alkaloids, glycosides, saponins, tannins, phytoalexin (chalconmoracin), anthocyanins, glycoproteins and many other compounds with pharmacological potential. The review found that there is a broad spectrum of important pharmacological potential, including antioxidant, hypoglycemic, anticancer, hepatoprotective, anthelmintic, antihypertensive, and antimicrobial effects. Based on a literature review and research on the bioactivity of Moraceae and its phytochemicals, its conventional uses, and its pharmacological effects, this article will hopefully supply the future researcher as herbal products have great potential.

Keywords

Moraceae, pharmacological activity, uses, bioactive, medicine, phytochemical and mulberry

Introduction

Moraceae commonly known as mulberry or fig family- consists of fifty genera and 1400 species, over 800 species of monoecious or dioecious trees, shrubs, hemiepiphytes, climbers and creepers in the tropics and subtropics worldwide (1). Most of the members of the family are widely distributed throughout the tropical and subtropical regions, but less so in areas with a more moderate environment. In addition to having small, petalless male or female flowers and alternate or opposite leaves, members of this family of plants also possess a milky latex. As a result of the fruits from various blooms joining together, many species have multiple fruits. The Moraceae, commonly known as mulberry family of the order (Rosales) with seven tribes Artocarpeae, Antiaropsidae, Castilleae, Dorsteniidae, Ficeae, Moreae and Soroceae (2). Members of this family include the sacred Aswatha/Bodhi tree (*Ficus religiosa*), which is the most revered tree in India, and the banyan tree, which is regarded as the India's national tree (*Ficus bengelensis*). Hinduism, Jainism, and Buddhism all see Aswatha as lucky. Ayurveda has also underlined its significance in terms of medicine. It has been reported that the plants possess antibacterial, anti-inflammatory, anti-diabetic, anti-oxidant, and immunomodulatory properties. The medicinal herbs of this family are

described by Bavamisra in Bavaprakasha nighantu under the names Vatadi Varga and Amradi Varga (3). The Moraceae have economic importance also. The members of the Moraceae is an important part of the tradition, food and medicine in India. The family includes high valued economic plants such as *Artocarpus atilis* (breadfruit), *Ficus carica* (edible fig), and *Morus* spp. (mulberry); trees used for paper, rubber, and timber; and some cultivated ornamentals, particularly *Ficus* spp., figs, which provide food for silkworm moth larvae in the leaves of *Morus alba* (4). The major objective of the present review paper is to focus on the current potential application of Moraceae family and to study and find out the different bioactive compounds, conventional utilize and pharmaceutical potentialities of the different species of the Moraceae.

Methodology

In the present study, we have used database found in the literature indexed by Scopus and Web of Science the most popular and novel database. Analysis were performed from 58% database found from literature indexed by Scopus and 30 % database found from literature indexed by Web of Science. We have mostly focussed on the ethnomedicinal, pharmacological and bioactive constituents of the family moraceae. We tried to collect all the available database of the members of the family Moraceae inclusively, the traditional uses of the plants, bioactive compounds , structure of some selected chemical constituents, pharmacoligical importance and hence anyalyses similarly. We excluded the databses of description of the plants of the moraceae family both morphologically and anatomically as these are most commonly available in different literature review. We have used the keywords to collect our database as mentioned in the keyword section.

Result

Characteristic feature of the family

Leaves of the members of the family are simple and alternate, rarely opposite in arrangement. The stipules are tiny, lateral, or occasionally they form a cap over the bud, leaving a cylindrical scar. Unisexual, tiny, and typically thickly aggregated, the blooms are. These assemblages usually appear as pendulous aments or catkins. The perianth typically has 4 or 5 undifferentiated sepals; however there might occasionally be fewer or no perianth segments. Four stamens, one in front of each perianth segment, are usual for male flowers. The bicarpellate pistil on the female flowers typically has two styles, albeit one of them may be suppressed. A single pendulous ovule in a single locule is present in either a superior or inferior ovary. Fruit is of drupe and achene types, sometimes coalesced and otherwise aggregated to form a multiple accessory fruit (5). Some of the selected plants of Moraceae having medicinal values were shown in figure -1.

Systematics of Moraceae

Kingdom: Plantae

Subkingdom: Viridiaeplantae

Infrakingdom: Streptophyta

Division: Tracheophyta

Infradivision: Angiospermae

Class: Magnoliopsida

Super order: Rosanae

Order: Rosales

Family: Moraceae(Mulberries)

The Moraceae, the mulberry family of the order (Rosales) with seven tribes Artocarpeae, Antiaropsidae, Castilleae, Dorsteniidae, Ficeae, Moreae and Soroceae (6).



Fig 1: Someselected plants of Moraceae having medicinal importance

Ethnomedicinal uses of moraceae

Indigenous communities have developed ethno-medical knowledge of biodiversity over many generations and have solved many problems through that knowledge. Based on the fundamental information a database has been developed which represents a great deal of value for exploiting bioresources commercially. The information could be useful for many other related fields like pharmacology, phytochemistry, physics, botany and many industries for developing alternative therapies (7,8). Most commonly used medicinal plants of Moraceae family by the ethnic group of people includes: *Ficus racemosa* Linn.; roots are used for hydrophobia, barks as treated of galactagogue, fruits are mainly used for dry cough, blood disorders, menorrhagia, burning sensation and leprosy, Leaves are astringent and can also be applied to treated for bronchitis; *Ficus religiosa* Linn., Fruits can be used in digestion, acts as laxative and aphrodisiac; checks vomiting (9) *Ficus bengalensis* Linn., Latex commonly used for rheumatism and lumbago. Most parts of *Ficus hispida* Linn; are used for the cure of many diseases by the Indian herbalist, but mostly leaves are of great interest in medicinal fields including anti-inflammatory, antipyretic, antitussive, anti-ulcer, antidiarrheal, hepatoprotective, haemostatic and astringent among the other parts of the plant. The ripe fruits of *Morus alba* L., *M. australis* and *M. macroura* Miq. are used to cure sore throat and skin infections; *Ficus thonningii*, is traditionally used for the curing of many diseases like diarrhoea, diabetes mellitus and gonorrhoea (10). The widespread uses of plant derived extracts in the curing of different ailments has attracted the researchers to development of the key interest for identification and characterization of the active compounds which give the extracts their therapeutic potential which is shown in figure-2, 3 & Table-1.

Bioactive compounds

Ethno-botany is now regarded as an integral part of scientific research in finding new bioactive compounds due to improved understanding and advances in scientific research. Numerous bioactive compounds were identified in *Ficus carica* Linn, a member of the Moraceae family such as phenolic compounds, organic acids, phytosterols, triterpenoids, anthocyanin composition, coumarins, and volatile compounds such as hydrocarbons, aliphatic alcohols, and few other classes of secondary metabolites. Most species of *Ficus carica* contain phenolic compounds, organic acids, and volatile compounds (26,27). The *Ficus*

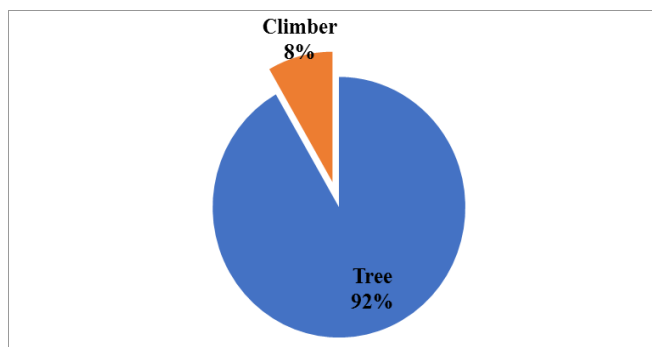


Figure-2. Growth forms of utilized species

racemosa Linn. species contains both primary and secondary metabolites that includes carbohydrates, vitamin K₁, vitamin C, flavonoids, tannins, phenolic substance, alkaloids, mucilage, glycosides, steroids, saponins, coumarins, terpenoids, triterpenoids, lupen-3-one, β -sitosterol-d-glucoside,, rusolic acid, α hydroxyl ursolic acid, oleanolic acid, maslinic acid, lanosterol, α phenolics, protocatechuic acid, bergapten, stigmaterol and bergaptol also used for treating many diseases (28).

The Moraceae family is a rich plant source of cardiac glycosides which are ubiquitous in the *Ficus* genus e.g. in *Ficus religiosa* and *Ficus racemosa* (29,30). Some essential oils has also been found to be present in the species of the family Moraceae. Leaves of *Ficus thonningii* contain essential oils which are composed mainly of 6, 10, 14 trimethyl-2-pentadecanone (18.8%), phytol (14.7%), acorenone (7.6%) and β -gurjunene (6.3%) (31) Which is shown in figure-4 and Table-2

Pharmacological Importance of Moraceae

The species of Moraceae family contains larger group of chemical compounds like polyphenols including flavonoids, anthocyanins, and carotenoids responsible for many pharmacological activities. Extracts of mulberry fruits possess many biochemical activities including the scavenging free radicals, antihyperlipidemia and anti-atherogenic (51). Cardiac glycosides are inhibitors of Na⁺/K⁺-ATPase and have been used to treat heart failure and atrial arrhythmias (52).

Antioxidant Activity

The flavonoids present in the mulberry plants are good antioxidants and acts as scavenger reducing the free radical formation (53). It has been reported that the mulberry fruits contain higher polyphenols and mature fruits are rich in anthocyanins which acts as an excellent antioxidant agent than vitamin C (54).

By using ferric reducing antioxidant method the antioxidant properties of the *Ficus carica* fruits were identified. The highest concentrations of polyphenols, flavonoids, and anthocyanins were found in fruits, along with the highest antioxidant capacity (55). Four mulberry species, *M. alba*, *M. nigra*, *M. indica*, and *M. laevigata*, were studied for their antioxidant potential, and the results showed higher total phenol and alkaloid contents, with values of [(8807.20) - (165012.25)] mg/100g fresh weight and [(3903.22) - (6605.25)] mg/100g fresh weight, respectively. According to the findings, mulberry fruit is a likely source of food for diet and radical scavenging activity (56).

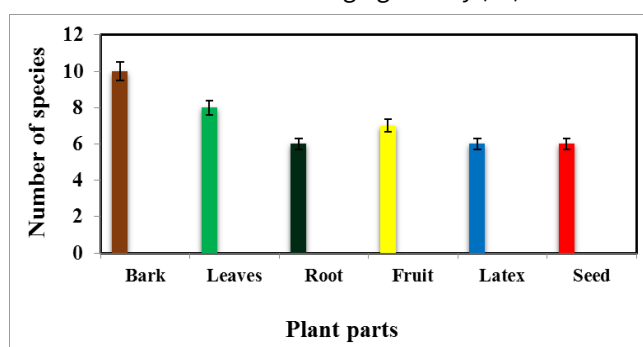


Figure-3. Plant parts use in preparation of ethnomedicine

Table-1: Botanical name, habit, tribe, parts used, formulation and pharmacological uses of the plants of Moraceae family

Sl. No	Scientific name	Local name	Habit	Parts used	Formulation	Pharmacological effect	Reference
1	<i>Artocarpus heterophyllus</i> Lamk	Kathal or Panas (Hindi)	Tree	Leaf, root	powder	Anti-inflammatory, antifungal, antidiabetic, antibacterial, antihelmintic	(11)
2	<i>Artocarpus lacucha</i> Buch-Ham	Badahar (Hindi)		Leaf, seed, bark	decoction and paste	Antioxidant, antibacterial, cytotoxic, anti-inflammatory, analgesic, antinociceptive, schistosomicidal, neuroprotective, anti-glycation, anti-diarrheal, immunostimulant, anticholesterol, and hepatoprotective	(12)
3	<i>Artocarpus lakoocha</i>	Monkey fruit (English)	Tree	Fruit	Extract	Antibacterial, antitubercular, antiviral, antifungal, antiplatelet, antiarthritic, tyrosinase inhibitory and cytotoxicity	(13)
4	<i>Ficus auriculata</i> Lour.	Elephant ear fig (English), Chandmurai (Nepali), Phagoora (Hindi)	Tree	Figs, leaves	Extract	Antibacterial, hepatoprotective, antidiabetic, anti-inflammatory	(14,15)
5	<i>Ficus bengalensis</i> L.	Indian banyan or banyan fig (English)	Tree	Latex, root, bark, leaf	Paste and Extract	Antibacterial properties, antidiabetic and anti-infectious and anti-tumor properties	(16)
6	<i>Ficus Elastica</i> Roxb	Rubber tree (English), Athabor (Assamese), Rabbaru (Telugu)	Tree	Leaves	Paste and Extract	Antioxidant and antimicrobial activities	(17)
7	<i>Ficus hispida</i> L. f.	Dumoor (Bengali), Gobla (Hindi)	Tree	Leaves, stem bark and roots	decoction and paste	Antiulcerogenic, cardioprotective and antidiabetic activities	(18)
8	<i>Ficus palmate</i> Forssk.	Anjiri (Hindi), Kadanjura (Manipur), Pepri (Gujarati)	Tree	Stem bark, leaf and roots	paste and powder	Antimicrobial, hepatoprotective and antiulcer activities	(19)
10	<i>Ficus Pumila</i> L.	Creeping fig (English), Latabata (Bengali)	Climber	Stem and leaves	powder	Analgesic and anti-inflammatory activities	(20)
11	<i>Ficus racemosa</i> L.	Nepali - Gular, Dumri	Tree	Whole plant	Extract	Hypoglycemic, anti cancer, hepatoprotective activities	(21)
12	<i>Ficus religiosa</i> L.	Peepal, Asbattha (Bengali), Pippala (Sanskrit)	Tree	Leaf, fruit and bark	Extract	Cardioprotective, antidiabetic, antitumor, antioxidant, antihelmintic, antimicrobial and antiparasitic activities	(22)
13	<i>Ficus retusa</i>	Indian Laurel fig (English), Phrapasi (Hindi), Chiri (Assamese)	Tree	Leaves and stem barks	Paste and powder	Hepatoprotective properties	(23)
14	<i>Ficus semicordata</i>	Wedge leaf fig (English)	Tree	Leaves, fruit and latex	Extract	Antidiarrheal and antioxidant activities	(24)
15	<i>Ficus thonningii</i> Blume	Strangler fig (English)	Tree	Leaves, stem bark and root	powder and decoction	Antimicrobial and antidiarrheal activities	(25)

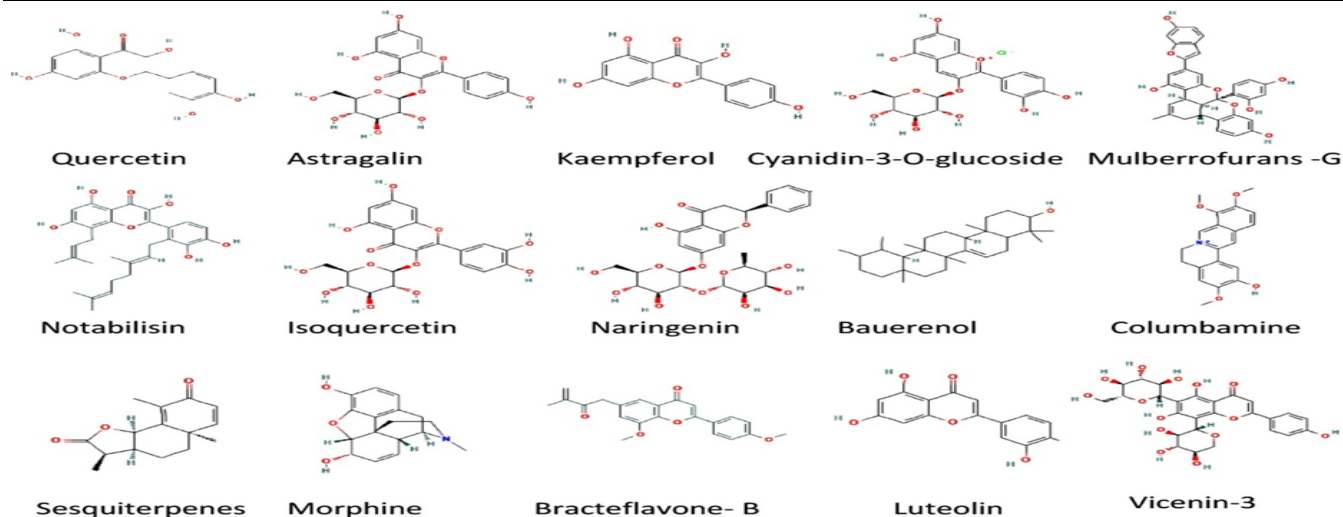
**Figure-4:-** Structure of selected bioactive compounds isolated from different plants of Moraceae family.

Table-2: Bioactive compounds with categories of Moraceae family.

Sl. No.	Plant	Category of bioactive compounds	Name of the compounds	Reference
1	<i>Artocarpus heterophyllus</i>	Flavonoids	6-(3-methyl-(E)-1- butenyl) chrysin; 2-(4-Hydroxyphenyl)-8-(3-methyl-but-2-enyl)-chroman- 4-one; dinklagin C; 5,7,3',5'-tetramethoxy-6-C-prenylflavone; bracteflavone B	(32)
2	<i>Artocarpus hypargyreus</i>	Flavonoids	Hypargy flavones A-C; hypargy stilbene A; rubraflavone C; mulberrofuran N; cudraflavones A and C; cycloartocarpin A; norartocarpin; brosimone I	(33)
3	<i>Artocarpus lakoocha</i>	Flavonoids	Integrin, lakoochanone, (+)-afzelechin-3-O- α -L-rhamnopyranoside; (+)-catechin; moracin C; morachalcone A sanggenofuran B, (E)-2-methoxy-4,3',5'- trihydroxy stilbene; engeletin; isomige chalcone B; cyclocommunin, oxyresveratrol	(34)
4	<i>Ficus auriculata</i>	Flavonoids	Ficuisoflavone; alpinumiso flavone; methoxyiso flavone; 5,7,4'-Trihydroxy-3'-hydroxymethylisoflavone;	(35)
5	<i>Ficus benghalensis</i>	Terpenoids/ Terpenes	β -amyrin, 3-friedelanol, Friedelin, lupeol, betulinic acid, 20-traxasten-3-ol	(36)
6	<i>Ficus benjamina</i>	Alkaloids	Columbamine , laudanoline , alkaloids , methylcoridaldine, salsoline , calycanthidine anabasine , tomatidine , acridine derivative, sophocne blinine, harmine, obscurinervine diolergoline, ellipticine , indicine N-oxide , matridine ,scoulerine hydroxy morphine ,aspidospermidin, nicodicodine ,adenocarpine , lycocernuine, dasycarpidan , retronecine, clemastine, anabasine p-bromo atropine , columbamine laudanoline crinamidine ,oscurinervinediol , matridine , solasodine, nicodicodine ibogamine lutidine cinchophen , wajamalicine	(37)
7	<i>Ficus callosa</i>	Glycosides	Megastigmane glycosides	(38)
9	<i>Ficus cordata</i>	Flavonoids	2'-O-methylartnonin V acanthophorbins A-B; myricitrin; quercetin- 3,4'-dirhamnoside; infectoriin	(39)
10	<i>Ficus deltoidea</i>	Flavonoids	8-C-glucopyranosyl-6-C-xylopyranosylapigenin; isovitexin 2''-O-rhamnoside; rhoifolin; vitexin; 6-C- β -D-xylopyranosyl-8-C- α -L arabino pyranosyl apigenin isovitexin; vicenin-2; schaftoside; vicenin-3; orientin 2''-O-rhamnoside;isoschaftoside; 6,8-di-C- α -L-	(40)
11	<i>Ficus exasperata</i>	Flavonoids	Quercetin-3-O- β -rhamnoside, apigenin C-8-glucoside; isoquercetin 6-O-4-hydroxybenzoate	(41)
12	<i>Ficus hirta</i>	Flavonoids	Luteolin; naringenin-7-O- β -D-glucoside; eriodictyol-7-O- β -D-glucoside; apigenin; pinocembrin-7-O- β -D-glucoside	(42)
13	<i>Ficus religiosa</i>	Terpenoids/ Terpenes	β -eudesmol, epi- α -cadinol, γ -eudesmol, epi- γ -eudesmol, phytol, linalool, Lupeol, α -amyrin, α -cadinol, α -eudesmol,	(43)
14	<i>Ficus semicordata</i>	Terpenes	Acyclic monoterpenes, cyclic monoterpene, sesquiterpenes	(44,45)
15	<i>Morus alba</i>	Flavonoids	Quercetin; quercetin 3-O- β - glucoside : kaempferol; kaempferol 3-O- β -rutinoside; Astragaln; taxifolin; rutin; luteolin	(46)
16	<i>Morus australis</i>	Flavonoids	Mulberrofurans F-G; cudraflavones B-C; austraoone A; kuwanon C; kuwanon H; moracenin B; mousingin L; morcin M; morusin; cathafuran B	(47)
17	<i>Morus atropurpurea</i>	Flavonoids	Naringenin; dihydrokaempferol; eriodictyol; dihydroquercetin; dihydromyricetin; quercetin; cyanidin 3-O-glycoside; cyanidin 3-O-rutinoside; cyanidin; pelargonidin 3-O-glucoside	(48)
18	<i>Morus laevigata</i>	Flavonoids	Notabilisin A; notabilisin D; notabilisin E; 3',4',5,7-tetrahydroxy-3-methoxy-6-geranylflavone; hultenilae viginas A-C; taxifolin; gemichalcone A; sanggenol F	(49)
19	<i>Morus mongolica</i>	Flavonoids	Cyanidin-3-O-rutinoside; cyanidin-3-O-glucoside; pelargonidin-3-O-glucoside; rutin; quercetin; isoquercetin; kaempferol ;morin hydrate	(50)

Hypoglycemic Activity

The leaves of mulberry are one of the important herbal medicines proved to act against hyperglycemic patients worldwide. Studies reported that the mulberry leaf extract possess antioxidant, ant-hyperglycemic, and anti-glycation activities. A very active medicinal compound, 1deoxynojirimycin (DNJ) known as moranolin and some of its derivatives like alpha-glucosidase inhibitors isolated from the bark of mulberry tree has been used as medicines to treat diabetes mellitus (57,58). Several studies in animals and humans have shown that the mulberry or sericulture products containing DNJ suppress postprandial increases of glucose (50,60).

Some parts of the the plant *Morus nigra* has shown good antidiabetic properties on extracts and active constituents. Research has been done on the ability of methyl jasmonate-treated *M. nigra* leaf extracts and its cell suspension cultures to lower blood sugar levels and cause an accumulation of flavonoid content in cell cultures (61). In diabetic rats treated with streptozotocin (STZ), extracts from *M. nigra* leaves boosted insulin levels up to 500 mg/kg/day and dose-dependently lowered plasma glucose concentrations. In addition, hydroethanolic extracts of *M. nigra* leaves significantly boosted blood insulin levels (at doses of 10 mg/kg) and lowered fasting and 2-hour glucose concentrations in rats with type 2 diabetes that had been induced by nicotinamide-STZ (62).

Hepatoprotective activity

Studies have shown that the species of mulberry plants found to contain several compound few of them exhibited hepatoprotective activities (63). The experiments has been done in rats with chronic liver injury induced by subcutaneous injection of 50%v/v Carbon tetrachloride in a liquid paraffin at a dose of 3 ml/kg, it is given on alternate days for 4 weeks. The stem bark extract of *Ficus racemosa* were tested for hepatoprotective efficacy given in doses of 250 and 500 mg/kg. All biochemical markers, including SGOP, SGPT, serum bilirubin and alkaline phosphate, were evaluated and compared with standard silymarin, a known hepatoprotective. The extract exhibited a significant reduction in all parameters and shows hepatoprotective activity (64).

Anticancer effect

The bioactive compounds like 6-O-acyl-b-D-glucosyl-b-sitosterols, i.e., AGS (acyl moiety: linoleyl, oleyl, stearyl and palmitoyl) was isolated from latex of fig tree. Palmitoyl derivative of AGS showed potent inhibitor for numerous cancer cell lines like DU-145, DG-75 and Jurkat cancer cell lines comparative to other derivatives linoleyl, oleyl and stearyl (65).

The methanolic extract of mulberry leaves shows efficient cytotoxic behavior against cancer cells. Mulberry also contains several anticancer compounds. *M. fructus* fruit extract induces cancer cell death in vitro and in vivo. The in vitro effect is due the cell death in an ROS dependent mitochondrial apoptotic pathway (66). Phenolic compounds from *M. alba* induces in vitro anticancer activity in hepatoma cells by cell cycle arrest at G2-M phase and inhibition of topoisomerase II activity (67).

Prenylated cytotoxic flavonoids such sanggenon, cyclomorusin, morusin, atalantoflavone, kaempferol etc. can be found in abundance in *M. alba*. With an IC50 value of 0.64 M against HeLa cells, morusin is the most effective of them all. (68). Another brief study had shown that the n-hexane and aqueous methanol extract of *M. nigra* leaves displayed dose-dependent anticancer activity against the HeLa cell line (human cervical cancer), with IC50 values of 185.9 8.3 g/mL and 56.0 1.7 g/mL, respectively (69).

Anthelmintic activity

The bark extracts of mulberry tree show antihelmintic activity. Studies on the antihelmintic activity was carried on some selected plants of Moraceae which includes *Ficus bengalensis*, *Ficus religiosa*, *Ficus glomerata*, *Morus indica* and *Morus laevigata*. Studies reported that the methanolic extracts of those selected plants significantly caused paralysis (12.50 ± 0.50 , 25 ± 1.00 , 19.50 ± 0.50 , 15.50 ± 0.50 and 9.50 ± 0.50 , respectively), and death (70.50 ± 0.50 , 68.5 ± 0.50 , 69.00 ± 1.00 , 43.50 ± 0.50 and 40.00 ± 1.32 , respectively) of worms especially at higher concentration (100 mg/ml) compared with reference drug sample of Albendazole (Paralysis time: 10.60 ± 0.53 and Death time: 36.27 ± 1.42) (70).

Anti-hypertensive effect

Experiments shown mulberry leaves possesses ample level of γ -aminobutyric acid (GABA) and hence exert their antihypertensive activity. It was reported that a single administration of an aqueous extract from mulberry leaves (WEML) lowers systolic blood pressure (SBP) transiently (71). According to studies, the antihypertensive efficacy of mulberry leaf extract would be comparable to GABA alone in spontaneously the antihypertensive efficacy of mulberry leaf extract would be comparable to GABA alone in spontaneously hypertensive rats (SHR). Mulberry leaves (ML) exert their antihypertensive impact through γ -aminobutyric acid (GABA). Studies showed that a single dosage of a water extract made from the leaves of *Morus alba* L. (WEML) temporarily reduced systolic blood pressure (SBP) in a dose-dependent way. Interestingly, WEML had a considerably greater impact on decreasing SBP than GABA alone did following therapy. With an IC 50 value of 29.8 mg/ml, we further discovered that WEML significantly reduced angiotensin I-converting enzyme (ACE) activity in vitro. These findings imply that WEML has a brief antihypertensive impact in vivo that might entail an ACE inhibition mechanism in addition to GABA (72).

Antimicrobial activity

Various extracts of mulberry plant have shown antimicrobial activities against few gram positive and gram negative bacteria. Experimental reports against antimicrobial activities of mulberry proved that it could be employed as a natural antibacterial agent in oral care recipes against pathogenic bacteria of oral cavity (73). The antibacterial activity of the white mulberry extracts was screened against certain important enteric and/or foodborne pathogens, such as *Escherichia coli*, *Salmonella typhi* DMST 22842, *Shigelladysenteriae* DMST 1511, *Staphylococcus aureus* ATCC 25923, and *Vibrio cholerae*. The growth inhibition zone for all examined bacterial

species ranged between 13.67 and 25.67 mm for ethanol or water extraction, 24.83-29.33 mm with positive control for gentamicin, and no clear zone for the negative controls. Aqueous mulberry extracts were appeared clearly superior to ethanolic extracts against *E. coli*, *S. typhi* and *V. cholerae*. The effectiveness of aqueous or ethanolic extracts against *S. dysenteriae*, however, was equivalent, and the inhibition zones matched those of the positive control drug, gentamicin 1 mg/mL (74).

Conclusion and Future Aspects

Medicinal herbs have a hopeful future since there are total of about ½ million plants worldwide, most of them have not yet been studied in medical practice, and current and future studies on medical activities can be effective in treating diseases (75). Researchers have carried out many studies in different aspects of the species of the Moraceae family. Many plant metabolites and bioactive compounds from the family Moraceae were studied. Many species of the family were still unexplored for phytochemical and biological activities. Enormous scope still exists for phytochemical exploration using bioassay-guided isolation. Researchers should also focused on isolation of bioactive compounds, its purity with bioactivity and convenient examination of therapeutic effects and determination of toxic doses to control the quality of the therapeutic formulation. Research should also be focussed on the the possibility of genetic engineering techniques to boost the synthesis of bioactive compounds. The present review paper highlighted the characteristics, ethnomedicinal uses, bioactive compounds and its pharmacological importance of the family Moraceae. The members of the Moracea family are rich in bioactive compounds that includes flavonoids, alkaloids, steroids, glycosides, terpenoids, saponins, tannins, phytoalexin (chalcones, anthocyanins, glycoprotein and possess pharmacological properties including antioxidant, anti-helminthic, anti-carcinogenic, anti-hepatoprotective, anti-hypertensive, antimicrobial activities. If all the possible aspects of the medicinal plants under the Moraceae family were studied with modern technology then definitely in the coming future the research will afford an eloquent support for the clinical uses of the medicinal plant species under the family Moraceae in contemporary remedy.

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Authors' contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data.

Compliance with ethical standards

Conflict of interest: The authors express no conflict of interest.

Ethical approvals: This study does not involve experiments on animals or human subjects.

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