



Review Article

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Pharmacological activities of parasitic plants of Loranthaceae – A review

Venkatachalam Soundarya^{id} and Natchimuthu Karmegam^{id}*

PG and Research Department of Botany, Government Arts College, Salem-636 007, Tamil Nadu, India

*Corresponding author; e-mail: kanishkarmegam@gmail.com

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Abstract

Medicinal plants are the part of human Society to combat many disorders. The plant derived drugs and other herbal therapeutics are widely used against several malfunctions. Other than medicinal herbs, mistletoe–hemi parasitic plants are also used to treat many diseases. Usually, mistletoe family is recognized based on their host plants. Loranthaceae, the largest family in the order Santalales with 76 genera and more than 1,100 species. Most of the Loranthaceae family members are aerial parasites. Family comprises of 10 genera and 60 species which are found in India. It has been scientifically established that every part of these plants has medicinal properties (flower, stem, leaf, fruits, seed and whole plants). Only a few species are having potential traditional medicinal values and extensively used in several medicinal systems. *Dendrophthoe falcata* holds the major part in this taxon. This species shows traditional medicinal values in Indian Ayurvedic system of medicine and other systems of natural medicine widely. There are many biologically active components present in the parasitic plants, flavonoid, quercetin, kaempferol, rutin, tannins, β - sitosterol, stigmasterol, β - amyryn and oleanolic acid. *Dendrophthoe falcata* was rich in flavonoids and quercetin and the major components are reportedly present in the leaves. Quercitrin (quercetin 3-0- α - rhamnoside) has been separately isolated as a major component from the ethanolic extract of *Dendrophthoe falcata* leaves and this quercitrin phytochemical is highly responsible for antioxidative potency. Nanoparticles phytosynthesized from these plants are also studied for their pharmacological activities. It has been revealed that the medicinal properties of mistletoes based on host plants are scanty.

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Introduction

Parasitic plants

Comparing to world vegetations, there is just 1% of hemi-parasitic taxa present. Parasitic plants connect the vasculature of a host plant and take part or all the water, nutrients and assimilates they need to complete their life

cycle. Usually, mistletoe was recognized based on their host plants. So, it is known as destroyer of host plants. These hemi-parasitic plants spread through seed-eating birds (Sinoriya et al., 2011).

Ethnomedicinal utility

Medicinal plants are the part of human society to

combat many diseases. The plant derived drugs and other herbal therapeutics are widely used against several malfunctions (Ajithkumar et al., 2020). Other than medicinal herbs, mistletoe–hemi parasitic plants also used to treat many diseases (Sinoriya et al., 2011)

Dendrophthoe falcata holds the major part in this taxon. This species shows traditional medicinal values in Indian Ayurvedic system of medicine. The *Dendrophthoe falcata* is known to possess rich flavonoids and quercitrin, the major components present in the leaves (Hasan et al., 2006). *Dendrophthoe pentandra* is called as clove mistletoe which is taken for determining the secondary metabolites responsible for antioxidant activity and also traditionally used for cough, hypertension, ulcers and skin infections (Elsyana et al., 2016). *Dendrophthoe falcata* was ethnomedicinally used for treating ulcers, asthma, paralysis, skin diseases and wounds (Haque et al., 2014; Sinoriya et al., 2011).

Dendrophthoe falcata has been reported for its many biological active components such as flavonoid, quercetin, kaempferol, rutin, tannins, β - sitosterol, stigmasterol, β - amyryl and oleanolic acid (Anarthe et al., 1970). *Dendrophthoe falcata* has long been used in indigenous system of medicine as astringent, narcotic, asthma, diuretic, ulcers, swelling, wounds and menstrual disorders.

Decoction of whole plant is used by women as an antifertility agent and it also has a potent anti-cancer activity (Anarthe et al., 1970; Atun et al., 2018). *Dendrophthoe pentandra* has been traditionally used for its anti-diabetic property. *Taxillus liquidambaricola* has been traditionally used for various ailments like treating rheumatic arthralgia, threatened abortion and also used for treating hypertension (Deng et al., 2011). *Dendrophthoe Pentandra* is known to be traditionally used for treating cancer in Indonesia and also traditionally used for treating cough, diabetes, hypertension, small pox, skin infection (Endharti et al., 2018; Mustarichie et al., 2016).

Systematic position

Kingdom : Plantae
Division : Tracheophyta
Class : Magnoliopsida
Order : Santalales
Family : Loranthaceae Juss.

Distribution

Loranthaceae is the largest family in the order Santalales with 76 genera and more than 1,100 species. Most of the Loranthaceae family members are aerial parasites. Family comprises of 10 genera and 60 species are found in India. Mistletoes are highly specialised angiosperm are of the family Loranthaceae. Loranthaceae is closely related to the family Santalaceae, but it can be distinguished by its aerial parasitic habit.

Dendrophthoe falcata, *Dendrophthoe neelgherrensis*, *Dendrophthoe pentandra*, *Elytranthe albida*, *Elytranthe capitellata*, *Elytranthe parasitica*, *Helicanthes elasticus*, *Helixanthera hookeriana*, *Helixanthera intermedia*, *Helixanthera ligustrina*, *Helixanthera obtusatus*, *Helixanthera odorata*, *Helixanthera parasitica*, *Helixanthera wallichiana*, *Macroselon cochinchinensis*, *Macroselon globosus*, *Macroselon trigonus*, *Scurrula buddleioides*, *Scurrula cordifolia*, *Scurrula elata*, *Scurrula parasitica*, *Scurrula pulverulenta*, *Taxillus cuneatus*, *Taxillus heyneanus*, *Taxillus recurvus*, *Taxillus tomentosus*, *Taxillus umbellifer*, *Taxillus vestitus* and *Tolypanthus lagenifer* are the species present in India along with some other species. Only a few species are having potential traditional medicinal values and extensively used in several medicinal systems such as Ayurvedha, Homeopathy, Siddha, Unani, and Naturopathy. Mistletoe plant parasites are found in a wide variety of host plants (Table 1).

Morphological characters of Loranthaceae family

Shrubs, aerial hemi-parasites on angiospermic plants, leaves opposite or alternate. Simple, usually pinnately veined, margin entire. Terminal or axillary racemes, spikes or umbel inflorescence. Flowers usually bisexual, actinomorphic or zygomorphic, 4-6 merous. Calyx adnate to the ovary, limb annular to cupular, persistent. Petals usually 4-6, may be polypetalous or gamopetalous, valvate. Stamens as many as petals, opposite and adnate to them, anthers are basifixed, sometimes dorsifixed. 2-4 locule is present. Longitudinally dehiscence. Ovary inferior. Style simple, stigma small. Fruit berry with a viscin layer outside the vascular bundles, seed 1.

Phytosynthesis of nanoparticles

Nanoparticles had been synthesized using the

Loranthaceae family members, which plays a prominent role in the field of pharmaceutical and biomedical applications. Previously silver and selenium

nanoparticles are synthesized from these plants. Mostly, silver nanoparticles synthesized from Loranthaceae plants showed significant pharmacological activities.

Table 1. Common host plants of Loranthaceae parasites.

| Plant species | Host plant | References |
|-------------------------------|-------------------------------|---|
| <i>Scurrula ferruginea</i> | <i>Tecoma stans</i> | (Hong et al., 2021) |
| <i>Dendrophthoe falcata</i> | <i>Mangifera indica</i> | (Anarthe et al., 1970; Mohesh et al., 2022) |
| | <i>Azadirachta indica</i> | (Sathishkumar et al., 2014) |
| | <i>Melia azedarach</i> | (Atun et al., 2018) |
| | <i>Mangifera indica</i> | (Jincy and Sunil, 2020; Sunil Kumar et al., 2020) |
| <i>Helicantes elasticus</i> | <i>Nerium oleander</i> | (Ajithkumar et al., 2020) |
| | <i>Hevea brasiliensis</i> | |
| | <i>Citrus maxima</i> | |
| | <i>Saraca asoca</i> | |
| | <i>Anacardium occidentale</i> | |
| | <i>Murraya koenigi</i> | |
| <i>Agelanthus brunneus</i> | <i>Camellia reticulata</i> | (Johnny et al., 2016) |
| <i>Globimetula braunii</i> | <i>Azadirachta indica</i> | (Okpanachi et al., 2018) |
| <i>Taxillus yadoriki</i> | <i>Neolitsea sericea</i> | (Park et al., 2018) |
| <i>Loranthus micranthus</i> | <i>Kola acuminata</i> | (Ogechukwu et al., 2011) |
| <i>Loranthus europaeus</i> | Oaks | (Benabderrahim et al., 2019) |
| <i>Dendrophthoe trigona</i> | <i>Ficus benghalensis</i> | (Puneetha et al., 2013) |
| <i>Dendrophthoe pentandra</i> | <i>Syzygium aromaticum</i> | (Elsyana et al., 2016) |

Phytochemical components

Quercitrin (quercetin 3-0- α - rhamnoside) was separately isolated as a major component from the ethanolic extract of *Dendrophthoe falcata* leaves which is highly responsible for antioxidative potency (Hasan et al., 2006). Methanolic leaf extract of *Macrosolen*

parasiticus showed sixteen phytochemicals. The identified major phytochemicals were dihydrochrysin, 1,6-Anhydro-beta-D-glucopyranose, and minor constituents were adenosine, 4'-de(hydroxymethyl)-4'-[N-ethylaminoformyl], 4alpha-phorbol 12,13-didecanoate and agaricic acid (Paramesh Sharath and Naika, 2022) (Table 2).

Table 2. Phytochemical components reported from Loranthaceae members.

| Plant species | Phytochemical components | References |
|-------------------------------|---|------------------------------------|
| <i>Dendrophthoe falcata</i> | Quercitrin | (Hasan et al., 2006) |
| <i>Macrosolen parasiticus</i> | Dihydrochrysin | (Paramesh Sharath and Naika, 2022) |
| | 1,6-Anhydro-beta-D-glucopyranose | |
| | Adenosine, 4'-de(hydroxymethyl)-4'-[N-ethylaminoformyl] | |
| | 4alpha-Phorbol 12,13-didecanoate | |
| | Agaricic acid | |

Pharmacological activities

The mistletoe parasitic plants exhibit a variety of biological and pharmacological activities (Table 3).

Anti-oxidant activity

Ethanolic leaf extract taken from *Dendrophthoe falcata*

showed significant anti-oxidant activity using DPPH radical scavenging assay, which is compared to standard ascorbic acid. This activity was done using the phytochemical component called quercetin (Pattanayak and Sunita, 2008). *Dendrophthoe pentandra* was taken for investigation of anti-oxidant activity. The leaf extract of this plant contained secondary metabolites which were responsible for antioxidant activity as

reported by Alharits et al. (2019). Aqueous extract of *Dendrophthoe pentandra* collected from *Stelephocarpus burahol* shows the maximum anti-oxidant activity (Artanti et al., 2012). Stem extract of *Dendrophthoe falcata* showed the highest anti-oxidant activity and the presence of phenolic and flavonoid

contents are responsible for anti-oxidant activity (Atun et al., 2018). *Taxillus liquidambaricola* ethanolic extract was used to evaluate the anti-oxidant activity and it showed significant Trolox Equivalent Antioxidant Capacity (TEAC) and 1,1-Diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activities (Deng et al., 2011).

Table 3. Pharmacological activities using parasitic plant extract.

| Plant species | Part used | Extract used | Activity studied | Concluding remarks | References |
|-----------------------------|-----------|---------------------|--|--|-------------------------------|
| <i>Agelanthus brunneus</i> | Leaf | Aqueous | Larvicidal activity | lectin was isolated from <i>Agelanthus brunneus</i> showed an effective larvicidal agent against <i>Culex quinquefasciatus</i> mosquito larvae and could be developed used as biological control agent. | (Johnny et al., 2016) |
| <i>Dendrophthoe falcata</i> | Aerial | Ethanol | Wound healing, Anti-microbial, Anti-oxidant activity | Ointment from <i>Dendrophthoe falcata</i> ethanol extract showed the significant results in wound healing, antimicrobial and antioxidant activities. | (Pattanayak and Sunita, 2008) |
| <i>Dendrophthoe falcata</i> | Stem | Ethanol | Anti-convulsant and muscle relaxant activity | <i>Dendrophthoe falcata</i> ethanolic extract significantly inhibited seizures induced by MES, reduced the duration of Hind limb tonic extensor phase (HLTE) and a decline in motor coordination. | (Sinoriya et al., 2011) |
| <i>Dendrophthoe falcata</i> | Leaf | Methanol Aqueous | Anti-inflammatory Anti-oxidant | Methanolic and aqueous extracts of <i>Dendrophthoe falcata</i> leaves on animal models have potent anti-inflammatory and in-vitro antioxidant effects. | (Patil et al., 2011) |
| <i>Dendrophthoe falcata</i> | Stem | Methanol | Contraceptive activity | methanolic stem extract of <i>Dendrophthoe falcata</i> decreased the Serum testosterone levels and showed significant effect on fertility in male rats as reported in folk remedies | (Gupta and Kachhawa, 2007) |
| <i>Dendrophthoe falcata</i> | Stem | Methanol | Anti-fertility activity | <i>Dendrophthoe falcata</i> methanolic stem extract brought about the inhibition of spermatogenesis. And showed excellent antifertility activity. | (Gupta et al., 2008) |
| <i>Dendrophthoe falcata</i> | Stem | Ethanol | Anti-oxidant activity Anti-microbial activity | Stem extract showed a high content of phenolic and flavonoid compounds, very high antioxidant and moderate antimicrobial activities. And used as natural antioxidants and the treatment of various infections caused by microbes | (Atun et al., 2018) |
| <i>Dendrophthoe falcata</i> | Leaf | Methanol | Hyper-glycemic activity | Leaf extract showed a promising hyperglycemic activity when compared with the standard drug metformin. | (Mohesh et al., 2022) |
| <i>Dendrophthoe falcata</i> | Leaf | Petroleum ether | Diuretic activity | Rats treated with <i>Dendrophthoe falcata</i> leaf extract had diuretic effect supporting the ethno-pharmacological use as diuretics. | (Reddy et al., 2019) |

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|-------------------------------|-------------|--|---|--|----------------------------|
| <i>Dendrophthoe falcata</i> | Leaves | Ethanol | Anti-diarrhoeal and insecticidal activity | Four fractions of <i>Dendrophthoe falcata</i> leaves exhibited strong to moderate toxicity in concentration dependant fashion on the insect. among the extracts ethanol fraction showed maximum mortality rate. | (Haque et al., 2014) |
| <i>Dendrophthoe falcata</i> | Stem | Methanol | Anti-inflammatory and <i>in-vitro</i> anti-oxidant activity | Methanolic and aqueous extracts of <i>Dendrophthoe falcata</i> leaves on animal models have potent anti-inflammatory and <i>in-vitro</i> anti-oxidant effects. | (Anarthe et al., 1970) |
| <i>Dendrophthoe pentandra</i> | Leaf | Methanol | Anti-diabetics and Anti-oxidant activity | <i>Dendrophthoe pentandra</i> extracts tested (MeOH and water extracts) were non-toxic and show significant anti-diabetes activity, whereas for antioxidant activity, only MeOH extracts show significant activity. | (Artanti et al., 2012) |
| <i>Dendrophthoe pentandra</i> | Whole plant | Ethanol | Acute and Sub-chronic Toxicity activity | Ethanol extract of the herb <i>Dendrophthoe pentandra</i> was non-toxic, but long-term use is not recommended. | (Mustarichie et al., 2016) |
| <i>Dendrophthoe pentandra</i> | Leaf | Aqueous | Anti-cancer activity | The combination of doxorubicin and <i>Dendrophthoe pentandra</i> leaf extract significantly reduced the percentage of surviving. Whereas the number of apoptotic cells increased significantly. Anti-cancer effect of doxorubicin can be enhanced when combined with <i>Dendrophthoe pentandra</i> leaf extract. | (Endharti et al., 2018) |
| | Leaf | Ethanol | Hyper-glycemic activity | Oral administration of ethanolic leaf extract of <i>Dendrophthoe pentandra</i> reduced MDA levels in hyperglycemic rats. It shows maximum hyperglycemic activity. | (Syafitri et al., 2023) |
| <i>Dendrophthoe pentandra</i> | Leaf | aqueous | Anti-cancer and Anti-proliferative activity | Aqueous extract of <i>Dendrophthoe pentandra</i> leaves possessed antiproliferative activity on K562 and MCM-B2 cancer cell lines. The inhibition activity clove mistletoe had a potent natural anticancer activity | (Elsyana et al., 2016) |
| <i>Dendrophthoe trigona</i> | Leaves | Petroleum ether, chloroform, methanol, ethanol and distilled water | Anti-oxidant activity | The presence of large number of secondary metabolites in <i>Dendrophthoe trigona</i> extracts was responsible for antioxidant activity and reducing power. | (Puneetha et al., 2013) |
| <i>Elytranthe parasitica</i> | Stem | Petroleum ether, chloroform and methanol | Anti-bacterial, and anti-cancer activity | The methanolic stem extract showed, moderate cytotoxicity on prostate, and pancreatic cancer cell lines at higher concentrations. But it has no cytotoxic effects on normal mouse embryo fibroblast cells (MEF-L239). | (Sharath and Naika, 2022) |

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|---|--------------|----------|--|--|----------------------------|
| <i>Elytranthe parasitica</i> | Stem | Methanol | Anti-proliferative and apoptosis-inducing activity | pinocembrin and its related derivatives may be the chief phytochemicals present in methanolic extract of <i>Elytranthe parasitica</i> stem involved in apoptosis-mediated cytotoxicity of the enriched fraction. | (Kumar et al., 2017) |
| <i>Globimetula braunii</i> | Leaf | Ethanol | Phytochemical screening and hypoglycemic activity | A Pharmacological study of the extract and fractions of <i>Globimetula braunii</i> leaves have significant blood glucose reduction effect. phytoconstituents especially the flavonoids, phenols and triterpenoids are responsible for hypoglycemic activity. | (Okpanachi et al., 2018) |
| <i>Helicanthes elasticus</i> | Leaf | Methanol | Anti-ulcer and anti-inflammatory activities | Treatment showed a reduction in ulcer index against ethanol and pylorus ligation induced ulcerations. Moreover, it also showed a highly significant reduction in carrageenan and cotton pellet induced inflammations. <i>Helicantes elasticus</i> leaves possess anti-inflammatory activity and promoted ulcer protection. | (Jincy and Sunil, 2020) |
| <i>Helicanthes elasticus</i> | Leaves | Methanol | Anti-inflammatory and anti-arthritis effects | The hemi-parasitic plant obtained from <i>Hevea brasiliensis</i> , <i>Nerium oleander</i> and <i>Anacardium occidentale</i> showed high anti-inflammatory responses whereas those from <i>Nerium oleander</i> had high anti-arthritis efficacy. <i>Helicanthes elasticus</i> showed a therapeutically significant effect on arthritis and inflammatory activity. | (Ajithkumar et al., 2020) |
| <i>Helicanthes elasticus</i> | Whole plants | Aqueous | Immunomodulatory effect | Alcoholic and aqueous extract of <i>Helicanthes elasticus</i> significantly increased antibody formation. <i>Helicanthes elasticus</i> holds potential immunomodulatory activity especially humoral immunity without significant modification in cell mediated immune. | (Sunil Kumar et al., 2020) |
| <i>Loranthus longiflorus</i> Desv. Var. <i>Falcatus</i> | Whole plant | Methanol | Anti-cancer activity | Methanol extract and purified compound from <i>Loranthus longiflorus</i> showed the significant effect against A-549, HeLa and HepG2 cell lines | (Lalitha et al., 2020) |
| <i>Loranthus micranthus</i> | Leaves | Methanol | Immunomodulatory effect | Immunomodulatory property was increased by the methanol leaf extract and it confirms the efficacy of this plant in mitigating against wide array of disease conditions orchestrated by immunodeficiency | (Ogechukwu et al., 2011) |
| <i>Loranthus parasiticus</i> | Leaves | Ethanol | Neuroprotective effect | It is capable in managing neurological disorder where oxidative stress is implicated. It showed good neuroprotective activity. | (Wong et al., 2012) |

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|-----------------------------------|-------------|---|---|--|------------------------------------|
| <i>Loranthus regularis</i> | Aerial part | Methanol | Anti-inflammatory, antinociceptive, antipyretic and anti-oxidant activities | Traditional use of <i>Loranthus regularis</i> clearly indicate that the plant could be a potential anti-inflammatory and antioxidant agent. | (Mothana et al., 2012) |
| <i>Macrosolen cochinchinensis</i> | Leaves | Methanol | Anti-nociceptive and antioxidant activity | the leaves extract of <i>Macrosolen cochinchinensis</i> have excellent anti-nociceptive activities and moderate antioxidant properties | (Rahman et al., 2012) |
| <i>Macrosolen parasiticus</i> | Stem | Aqueous | Cytotoxic activity | Aqueous extracts of <i>Macrosolen parasiticus</i> showed maximum cytotoxic activity against MCF-7 breast cancer cells | (Lobo et al., 2015) |
| <i>Macrosolen parasiticus</i> | Leaf | Methanol | In vitro anti-cancer activity | <i>Macrosolen parasiticus</i> contains a wide variety of secondary metabolites and also it proved a potential anticancer agent for PC- 3 cells. | (Paramesh Sharath and Naika, 2022) |
| <i>Scurrula atropurpurea</i> | Whole plant | Chloroform | Anti-cancer activity | <i>Scurrula atropurpurea</i> extract on inhibition of cells. HeLa culture growth through DNA repair and apoptosis intrinsic pathways mechanism and possessed the significant anti-cancer activity. | (Parwati et al., 2015) |
| <i>Scurrula ferruginea</i> | Whole plant | Aqueous | Anti-inflammatory | <i>Scurrula ferruginea</i> showed anti-inflammatory capability attributed to inhibition of iNOS and IL-1 β mRNA expression, NO creation, IL-1 β , IL-6, IL-10, and TNF- α , protein production, indicating <i>Scurrula ferruginea</i> showed highest anti-inflammatory activity | (Hong et al., 2021) |
| <i>Tapinanthus dodoneifolius</i> | Leaves | Methanol | Anti-microbial properties | Methanolic extract from the leaves of <i>Tapinanthus dodoneifolius</i> showed the promising antimicrobial activity against drug resistant bacteria and fungi. | (Deeni and Sadiq, 2002) |
| <i>Taxillus chinensis</i> | Stem | Ethanol | Inhibitory ability | The ethanolic extract could well reduce body weight and appetite in mice possibly through inhibiting FAS | (Wang et al., 2008) |
| <i>Taxillus chinensis</i> | Stem | Aqueous | Immunomodulatory activities | Aqueous stem extract displayed significant antioxidant activities and were also found to be effective immunomodulators in a concentration-dependent manner. | (Zhang et al., 2013) |
| <i>Taxillus cuneatus</i> | Leaves | Petroleum ether, Chloroform, Ethyl acetate and methanol | Anti-oxidant and Anti-bacterial properties | Extracts revealed a concentration dependent activity, which increased gradually with increasing concentration of the extracts. All the extract showed the significant anti-oxidant and anti-bacterial activity. | (Puneetha and Amruthesh, 2016) |
| <i>Taxillus liquidambaricola</i> | Whole plant | Ethanol | Anti-oxidant, analgesic, and anti-inflammatory activity | Anti-inflammatory mechanisms of ethanolic <i>Taxillus liquidambaricola</i> extract decreased the level of MDA, iNOS, and COX-2 through increasing the activities of CAT, SOD, and GPx | (Deng et al., 2011) |

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|----------------------------|--------------|---------|--------------------------|--|------------------------------|
| <i>Taxillus tomentosus</i> | Whole plants | Ethanol | Anti-inflammatory effect | in the edema paw. So, it possessed the excellent Antioxidant, analgesic, and anti-inflammatory activity <i>Taxillus tomentosus</i> ethanolic extract induced into urolithiatic rats, reduced the formation of urinary stones. This extract showed a significant anti-urolithiatic activity. | (Venkateswarlu et al., 2016) |
| <i>Taxillus yadoriki</i> | Branch | Ethanol | Anti-inflammatory effect | <i>Taxillus yadoriki</i> ethanol extract showed a potential anti-inflammatory effect by suppressing NF-κB and MAPK signaling activation, and increasing ATF3 expression. | (Park et al., 2018) |

Anti-inflammatory activity

Helicanthes elasticus is an endemic hemiparasite which gives an effective expression towards various ailments. This species taken from *Hevea brasilienses*, *Nerium oleander* and *Anacardium occidentale* showed effective anti-inflammatory activity (Ajithkumar et al., 2020). Ethanolic extract of *Taxillus liquidambaricola* was taken to analyse the anti-inflammatory mechanisms which decreases the level of malondialdehyde (MDA), inducible nitric oxide synthase (iNOS), cyclooxygenase 2 (Cox-2) through increasing the of catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GPx) in the paw oedema (Deng et al., 2011).

Anti-inflammatory capability was analysed in aqueous stem extract of *Scurrula ferruginea*. *Scurrula ferruginea* taken from *Tecoma stans* showed significant anti-inflammatory activity (Hong et al., 2021). Methanolic leaf extract of *Helicanthes elasticus* exhibited a highly significant reduction in carrageenan and cotton pellet induced inflammations (Jincy and Sunil, 2020).

Anti-diabetic activity

Dendrophthoe falcata leaf extract was mixed with the enzyme called amylase. Alpha-amylase is the responsible enzyme, which breaks the large molecules and also increases the blood pressure level. The concentration of leaf extract increases the enzyme activity was decreased and it shows the potent anti-diabetic property. Anti-diabetic activity was investigated using the methanolic stem extract of *Dendrophthoe falcata* taken from *Mangifera indica*. This extract significantly reduced the sugar level, blood cholesterol and triglyceride, and also improved the alloxan-induced reduction of blood protein to normal level (Anarthe et al., 1970). *Dendrophthoe pentandra*

grown in *Camellia sinensis* taken for investigating anti-diabetic activity. Methanol extract was used for the study which revealed considerable anti-diabetic activity (Artanti et al., 2012).

Anti-cancer activity

Dendrophthoe pentandra is commonly called as clove mistletoe. The leaf extract of *Dendrophthoe pentandra* displayed significant cytotoxic effect. This mistletoe also had potential anti-cancer property (Elsyana et al., 2016; Endharti et al., 2018). *Elytranthe parasitica* stem extract was taken to study the anti-proliferative and apoptosis-inducing effects. Pinocembrin is a phytochemical which is responsible for apoptosis-mediated cytotoxicity, and also showed highest effect on colorectal cancer (Kumar et al., 2017). Methanol extract of *Loranthus longiflorus* was used to evaluate anti-cancer activity which confirmed the significant cytotoxic effect against A-549 HeLa and HepG₂ cell lines (Lalitha et al., 2020). *Macrosolen parasiticus* leaf extract showed various secondary metabolites and also it proved a potential anti-cancer agent for PC-3 cells (Lobo et al., 2015).

Contraceptive activity

Contraceptive activity has been reported from the methanolic stem extract of *Dendrophthoe falcata* where the extract revealed significant antifertility effect in male rats (Gupta and Kachhawa, 2007).

Wound healing activity

Ethanolic extract from aerial parts of *Dendrophthoe falcata* was taken for investigating the wound healing efficiency A potent wound healing capacity of this extract was reported by Pattanayak and Sunita (2008).

Anti-microbial activity

The ethanolic aerial part extract of *Dendrophthoe falcata* exhibited significant anti-microbial activity against the selective bacteria and fungi (Pattanayak and Sunita, 2008). The extract of *Dendrophthoe falcata* showed moderate activity against the selective microorganisms (Atun et al., 2018). *Tapinanthus dodoneifolius* obtained from 14 different host plants which revealed a significant anti-microbial activity against selective drug resistant bacterial and fungal species isolated from farm animals (Deeni and Sadiq, 2002).

Anti-urolithiatic activity

Ethanolic extract of *Taxillus tomentosus* plant used to investigate the potential of anti-urolithiatic activity. Ethanolic extract showed good response to anti-urolithiatic activity when compared to the standard drug cystone (Venkateswarlu et al., 2016).

Anti-arthritic activity

Methanolic extract of *Helicanthes elasticus* collected from *Nerium oleander* showed the maximum anti-arthritic efficacy. Its curative property showed variations with respect to their host plants (Ajithkumar et al., 2020).

Hyper-glycemic activity

Methanolic leaf extract of *Dendrophthoe falcata* was used to study acute hyperglycemic activity in alloxan-induced acute diabetic adult zebrafish which revealed good hyper-glycemic activity (Mohesh et al., 2022).

Hypo-glycemic activity

Globimetula braunii ethanolic leaf extract significantly proven the safety and significant blood glucose reduction effect which showed maximum hypo-glycemic activity (Okpanachi et al., 2018).

Chalinomimetic activity

Loranthus ferrugineus methanolic extract was used to analyse the mechanism of spasmogenic action in guinea pig ileum. The spasmogenic effect was higher when they mediated through a direct action on intestinal muscarinic receptors (Ameer et al., 2009).

Anti-proliferative Activity

Leaf extract of *Dendrophthoe pentandra* possessed effective anti-proliferative activity on K562 and MCM-B₂ cancer cell lines (Elsyana et al., 2016).

Anti-diarrhoeal activity

Ethanol extract was taken of *Dendrophthoe falcata* to study anti-diarrhoeal activity which showed maximum anti-diarrhoeal activity (Haque et al., 2014).

Insecticidal activity

Ethanol, chloroform, aqueous and methanol extract from *Dendrophthoe falcata* was taken to analyse insecticidal activity. Ethanolic and chloroform extract possessed highest mortality against *Sitophilus oryzae* (Haque et al., 2014).

Anti-ulcer activity

Methanolic leaf extract of *Helicanthes elasticus* showed highly significant anti-ulcer activity (Jincy and Sunil, 2020).

Larvicidal activities

Lectin was isolated from the leaf extract of *Agelanthus brunneus* which showed effective larvicidal activity against *Culex quinquefasciatus* mosquito larvae (Johnny et al., 2016).

Anti-metastatic activity

Aqueous extract of *Helixanthera parasitica* was screened for anti-metastatic effect. It showed a significant inhibitory effect on the cancer cell line invasion (Lirdprapamongkol et al., 2003).

Phyto-synthesis of nanoparticles from parasitic plants

Ebokaiwe et al., (2019) reported the effect of selenium nanoparticles synthesized from the leaf extract of *Loranthus micranthus* ameliorative potentials in hepatorenal oxidative damage in streptozotocin induced rats. Green synthesis of silver nanoparticles from leaf extract of *Dendrophthoe falcata* exhibited significant anti-bacterial activity (Kora, 2012; Sathishkumar et al., 2014).

Table.4 Nanoparticles synthesized from Loranthaceae members.

| Plant species | Parts used | Extract | Types of nanoparticles | Activity | References |
|-----------------------------|------------|---------|------------------------|-------------------------|-----------------------------|
| <i>Dendrophthoe falcata</i> | Leaves | Aqueous | Silver nanoparticles | Anti-cancer activity | (Sathishkumar et al., 2014) |
| <i>Dendrophthoe falcata</i> | Leaves | Aqueous | Silver nanoparticles | Anti-bacterial activity | (Kora, 2012) |
| <i>Loranthus micranthus</i> | leaves | Aqueous | Selenium nanoparticles | Anti-diabetic activity | (Ebokaiwe et al., 2019) |

Conclusions

Medicinal plants are the part of human Society to combat many diseases. The plant based traditional medicines plays a crucial role in health care system. The plant derived drugs and other herbal therapeutics are widely used against several malfunctions. It has been scientifically established that every part of plants has medicinal properties include flower, stem, leaf, fruits, seed & whole plants. Other than medicinal herbs, mistletoe – hemi parasitic plants also used to treat many diseases. The plant extract was highly effective to treat antimicrobial, anti-oxidant, anti-inflammatory, anti-diabetic, anti-larvicidal, hepato-curative, anti-cancer activity, wound healing capacity. There are many biological active components are present in parasitic plants such as flavonoid, quercetin, kaempferol, rutin, tannins, β - sitosterol, stigmasterol, β - amyryn and oleanolic acid. Quercitrin (quercetin 3-0- α - rhamnoside) was separately isolated as a major component from the ethanolic extract of *Dendrophthoe falcata* leaves. Quercitrin Phytochemical is highly responsible for antioxidative potency. Nano-technology is a technique capable of achieving high degree of precision in the functions. This can be performed by the controlling the reaction conditions of the molecules participating in the synthesis of the nanoparticles. Mostly silver nanoparticles showed maximum pharmacological activities.

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