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Mallotus Philippensis Mull.Arg: A review on Ethnobotany, Physiocochemical Properties and Pharmacological studies

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ABSTRACT

As an ancient source of medication plant as a medicinal plants were used since from prehistoric period. *Mallotus philippensis* is the one of the most mysterious plant, it is commonly known as kamala tree (or) kumkum tree (or) red kamala belongs to the family Euphorbiaceae distributed both tropical and subtropical region of the old world with 150 species of medium sized perennial shrub or small dioecious tree. It is used in traditional medicine for treatment of various disease including anticancer, anti fertility, anti inflammatory, anti oxidant, hepatoprotective, anti cestodal, anti leukaemic and antidiabetic activity. The purpose of this review highlights the ethnobotanical, physiocochemical and pharmacological research of *mallotus philippensis* and to investigate its therapeutical effectiveness, which might be helpful for researchers to scientifically validate its uses. Furthermore, to isolate the new bioactive phytoconstituents responsible for its claimed ethnobotanical uses.

Keywords: *Mallotus Philippensis*, Ethnobotany, Pharmacology, Pharmacognosy, Kamala

INTRODUCTION

Medicinal plant also called medicinal herbs. Plant synthesis numerous chemical compounds for their functions and defence against insects, diseases, fungi and herbivorous mammals. Plant synthesis compound has numerous medicinal purposes from prehistoric period. Evidence exists that herbs used as medicine over 4000 years like Unani manuscripts, Egyptian papyrus and Chinese writings. It describes that additional system like Unani, Egyptian and Chinese medicine respectively, which are developed and widely practiced.[1] On the report of WHO, 80% people worldwide rely on herbal medicines for their primary health care needs.[2] Around 21,000 plant species have potential for being used as medicinal plants. India has the most rich source of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. About 8,000 herbal remedies have been identified in Ayush systems in India and numerous herbal are not identified yet.[3] Ayurveda,

Unani, Siddha and Folk (tribal) medicines are the major systems of indigenous medicines. Among these systems, Ayurveda and siddha medicine are most developed and widely practiced in India.[4] Ayurveda is a natural system of medicine originated in India more than 3,000 years ago. Thus, Ayurveda translates to knowledge of life. Unani medicine also called Unani tibb, Arabian medicine, or Islamic medicine**,** a traditional system of healing and health maintenance. The origins of Unani medicine are found in the doctrines of the ancient Greek physicians Hippocrates and Galen.[5] Siddha is a one of most ancient medicine system, originated in south India between 2500 and 1700 BC. It deals with treating body, mind as well as soul.[6] Folk medicine are traditional medicine as practiced non-professionally especially by people who are isolated from modern medical services and usually use the plant derived remedies on an empirical basis. Due to urbanization most of herbal treatments are omitted, due to uncomfortable use by all peoples.[7]

Now a days, majority of them get aware about Treatment with medicinal plants is very safe as there is no or minimal side effect. These are mainly sync with nature, which is the biggest advantage. Fortunately, it can be used by any age, groups and sexes. Medicinal plants are considered as a rich resources of ingredients which can be used in drug development either pharmacopoeial, non-pharmacopoeial or synthetic drugs, and pharmacological action.[4] From these medicinal plant the most endangered, mysterious and a miracle stick plant[8] is *Mallotus philippensis* which contains numerous beneficial effects.

Mallotus philippensis (Mull.Arg)is a plant in the spurge family, it is also known as Kamala,[2] medium size perennial shrub or small dioecious tree upto 20 meters, belongs to the family Euphorbiaceae.[9] Mallotus are widely distributed tropical as well as subtropical region. The genus mallotus comprise of about 150 species in the world and about 20 species alone have been reported in India. Kamala tree commonly appears in rainforest, evergreen forest or in moderate to high rainfall areas, mostly seen at height below 1,600 meters from sea level. It is found in South Asia, Southeast Asia, Srilanka, China, Pakistan, Afganistan, from Malaysia to Australia, Western ghats of India and throughout Indian Himalayan.[10]

BIOLOGICAL SOURCE[11]

Botanical Name	:	*Mallotus philippensis*(Lam.) Muell.Arg.
Synonym	:	*Croton philippense* Lam.
		Echinus philippensis (Lam.) Baill.
		Rottlera tinctoria Roxb.
Family	:	Euphorbiaceae

VERNACULAR NAMES[11-12]

English	:	Kamala tree, Monkey face tree
Tamil	:	Kamala, Kapila, Kurangu manjanathi, Kungumam, Shenyari
Malayalam	:	Ponni, Pinoo, Pipponnakam, Sinduri, Manjana
Kannada	:	Kapila, Kunkumadamara, Chandrahettu
Telugu	:	Kunkuma chettu, Kunkuma, Chendiramu
Sanskrit	:	Kampilyaka, Kapila
Hindi	:	Kaamalaa, Rohini, Kambila
Marathi	:	Sinduri, Shendri, Kupila
Arabic	:	Kampileh, Kinbil
Assam	:	Gangai, Puddum, Lochan

TAXANOMY[12-13]

Kingdom	:	Plantae
Subkingdom	:	Viridiplantae
Super division	:	Embryophyta
Division	:	Tracheophyta
Subdivision	:	Spermatophytina
Class	:	Magnoliopsida
Subclass	:	Rosidae
Order	:	Malpighiales

Family	:	Euphorbiaceae
Genus	:	Mallotus Lour.
Species	:	*Mallotus Philippensis* (Lam.) Mull.Arg.

GEOGRAPHICAL DISTRIBUTION[11, 14]

Mallotus is widespread from Sri Lanka, Southern China, Taiwan and Ryukyu Islands, Thailand, Vietnam, Philippines and throughout Malaysia to northern Australia and western Himalayas through India. Species name refer to be collect in *Philippines* is known as Banato.

BIOLOGY[12]

M. Philippinesis flowers mature from March to April and fruits mature in July to August. It has extra floral nectarines it attracts by ants.

BIOPHYSICAL LIMITS[15-16]

CLIMATE PARAMETER;

Annual rainfall	: 700-3000 mm.
Annual temperature	: 15-26°C.
Mean of maximum temperature	: 24-34°C
Mean of minimum temperature	: 2-23°C.
Frosts (approx. no. per year)	: 3<20.
Frost intensity	: Light to moderate (0 to -5°C).
Altitude	: 10-850 meters.

TOLERANCE OF EXTREMES IN CLIMATE

Drought	: Moderate.
Frost	: 0° to -5°C.
Wind	: Tolerates salt-laden coastal wind.

SOIL FACTORS

Texture	: Clay loam, loam, sandy loam, sandy clay loam or sand.
Soil pH reaction	: Acidic or neutral.
Soil depth	: Skeletal to shallow (less than 30 cm).
Drainage	: Well drained.
Salinity	: Non saline.
Fire sensitivity	: Killed by severe fires.

PROPAGATION AND CULTIVATION[17-18]

Propagation mainly takes place by seeds which are sown beginning of rainy season and falls during summer season. Fresh seeds are advised for germination. Germination rate is poor due to drought and insect attack; it is sow about 5cm depth. After one year of growth transplantation of plant into field is takes place. Dried seeds are stored for 6 months with their nature in air tight bags or tin. Trees can also reproduce from root suckers, but their growth is very slow/moderate. At present, these are not cultivated due to short longevity, less than 15 years.

BOTANICAL DESCRIPTION[19-21]

Habitat: Semi Evergreen, Moist deciduous, Evergreen & dry slope forests as well as plain forest. (Figure: 1a)

Habit : Evergreen shrub and small trees with many branches upto 25m tall and torso upto 50cm in diameter. Barks are in grayish color with intermediate wrinkles and small branches are grayish brown. Growth rate is moderate and short lived.(Figure: 1b)

Leaves : Alternative, Spiral and Simple, leathery, ovate to Lanceolate in shape. (7.5 – 15cm long, 3.2 - 7.5cm wide). Margins are entire or sparsely serrate. Apex are acute or acuminate, Strong 3 nerved base tip, green colored upper surface and red colored glands with hairs in lower surface.(Figure: 1c)

Flowers: Dioecian, small, sub terminal panicles.(Figure: 1d)

Male flowers - Clustered, sessile, pedicellate, erect terminal spikes 2-10cm long, each flower contain numerous stamen with stellate hair.

Female flowers - Sessile, short spikes, globosely ovoid, distinct 3 greenish yellow styles, 3 lobed ovaries with red glands.

Fruit : Fruits are 3 lobed capsules with depressed-globose,5-13mm in diameter, covered by blazing red powder substance, minute stellate hairs in outer layer, contain 3 seeds in one fruit. (Figure: 1e)

Seed : 3 Seeds are Subglobose, black on mature with white endosperm with 4mm diameter.(Figure: 1f)

Flowering and Fruiting: *Mallotus Philippensis* flowering period from June to November, fruits appear within 3 months after flowering and it may fall during post rainy season.

Fig: 1(a)

Fig: 1(b)

Fig: 1(c)

Fig: 1(d)

Fig: 1(e)

Fig: 1(f)

Fig 1: Photographs of (a) Habitat, (b) Habit, (c) Leaves, (d) Flowers, (e) Fruits, (f) Seeds

CHEMICAL CONSTITUENTS[22-23]

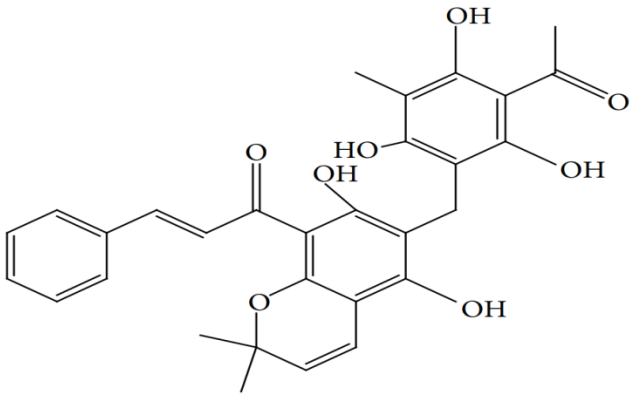
M.Philippensis contains different natural compounds like phenol, diterpenoid, steroid, flavanoid, cardenolide, triterpenoide, coumarin and isocoumarin, etc.

MAJOR CONSTITUENTS

Some researcher contributes towards isolation of some novel constituents from that one of major chemical constituent is Rottlerin/Mallotoxin.[24] (Figure: 2)

OTHER CONSTITUENTS

Kamalachalcones A and B, Mallotophilippens C, D and E, Isorallorottlerin, Isorottlerin, etc.[25]



Rottlerin.

Fig2: Structure of Rottlerin

PHYSIOCOCHEMICAL PROPERTIES

PHYSICOCHEMICAL TESTS

Following physicochemical parameter were determined by using a coarse powdered fruit of *Mallotus philippensis* per standard procedure.[26-28]

ASH VALUE

Total ash, acid insoluble ash and water soluble ash were determined in the powdered fruit of *Mallotus philippensis* as per standard procedure. These values are used to determining the quality and purity of crude drug in powdered form.

TOTAL ASH

2gm weight of air dried *Mallotus philippensis* fruits powder was taken in previously ignited silica crucible. The powder was spread uniformly and incinerated in an incinerator at a temperature not more than 450ºC. The crucible were cooled in desiccators and weighed. The procedure was repeated until the constant weight was obtained.

The percentage of the total ash was calculated using the formula:

Total ash (% w/w) = (Weight of ash/ Weight of sample) × 100.

ACID INSOLUBLE ASH

The total ash obtain by above procedure and it was boiled with 25 ml of dilute Hydrochloric acid for 5 minutes, filtered through ashless filter paper and insoluble ash was washed with hot distilled water until the filtrate gets neutral. The insoluble ash along with ashless filter paper was taken in silica crucible and incinerated at 450ºC then cooled and weighed.

The percentage of acid insoluble ash was obtained and calculated using the formula:

Acid insoluble ash (% w/w) = (Weight of acid insoluble ash/ Weight of sample) × 100

WATER-SOLUBLE ASH

The total ash obtained by above procedure and it was boiled with 25 ml of distilled water for 5 minutes, filtered through ashless filter paper. The insoluble ash along with ash less filter paper was transferred into silica crucible and incinerated at 450ºC then cooled and weighed.

The percentage of water soluble ash was obtained and calculated using the formula:

Water soluble ash (% w/w) = (Weight of water soluble ash/ Weight of sample) × 100

SULPHATED ASH

Heat a silica crucible to redness for 10 minutes and allowed to cool and weight is taken. Add 1gm of *Mallotus philippensis* in crucible and weigh accurately. Ignite gently at first until the substance got thoroughly charred. Cooled and moisten the residue with 1ml of Sulphuric acid, heat gently until white fumes are evolve and ignited at 800º ± 25º until all black particles are disappeared. Allow the crucible to cool, add a few drops of sulphuric acid and heated gently. Ignite at 800º ± 25º then cooled and weighed. Repeat the operation until two successive weighing do not differ more than 0.5mg.[29] (Table: 1)

Weight of sulphated ash (%w/w) = (Weight of sulphated ash/ Weight of sample) x 100

DETERMINING OF EXTRACTIVE VALUE

Extractive values are useful for determining the crude drug and it gives an idea about the nature of the chemical constituents present in it.[30]

DETERMINATION OF ALCOHOL SOLUBLE EXTRACTIVE VALUE

About 5gm of air dried coarse powdered drug was weighed and macerated with 100ml of 90% alcohol in a closed flask for 24 hours, shake frequently during the first 6 hours and then allowed to stand for 18 hours. Thereafter, it was filtered rapidly with precaution against loss of the solvent. 25 ml of the filtrate was evaporated to dryness in flat bottom swallow dish. Dried at 105°C and weight is taken.

The percentage of the alcohol soluble extractive value was calculated by using formula:

Extractive Value (% w/w) = ((Weight of residue ×100) / (25× Weight of sample)) × 100

DETERMINING OF WATER SOLUBLE EXTRACTIVE VALUE

About 5gm of air dried distilled powdered drug was taken and macerated with 100 ml of distilled water in a closed flask for 24 hours, shake frequently during the first 6 hours and then allowed to stand for 18 hours. Thereafter, it was filtered rapidly with precautions against loss of the solvent. 25 ml of the filtrate was evaporated to dryness in a flat bottomed shallow dish, dried at 105°C and weighed. (Table: 2)

The percentage of the water soluble extractive value was calculated by using formula:

Extractive Value (% w/w) = ((Weight of residue ×100) / (25× Weight of sample)) × 100

MOISTURE CONTENT

1gm air dried coarse powder fruits of *Mallotus philippensis* was accurately weighed in crucible and dried at 105°C in hot air oven to constant weight and cooled in desiccator.

Percentage of Moisture content was calculated using the formula.[26-28](Table: 3)

Moisture content (%w/w) = Difference in wt. before and after drying/
Weight of sample before drying X100

EVALUATION OF PHYSIOCOCHEMICAL PROPERTIES OF*MALLOTUS PHILIPPENSIS* DRIED FRUIT

DETERMINATION OF ASH VALUE

Table 1: Different Ash values of *Mallotus philippensis fruits.*

S.NO	Total ash (%w/w)	Acid insoluble ash (%w/w)	Water soluble ash (%w/w)	Sulphated ash (%w/w)
1.	5%	3.8%	1.5%	5%

DETERMINATION OF EXTRACTIVE VALUE

Table 2: Different Extractive values of *Mallotus Philippensis fruits.*

S.NO	Alcohol soluble Extractive value(%w/w)	Water soluble Extractive value(%w/w)
1.	45.7%	2.2%

MOISTURE CONTENT ESTIMATION

Table 3:Moisture content of *Mallotus philippensis* fruits.

S.NO	Moisture content(%w/w)
1.	4.8%

ETHANOBOTANICAL USES

A large number of ethnic people from various geographical areas practice the traditional utilization of *Mallotus philippensis* as medicinal (Ethomedicine) and economic purposes.

Table 4: Traditionally the various parts of the plants were used for various purposes.

Plants parts	Uses
Leaves	Bitter, Cooling and Appetizer.[31]
Fruits	Heating, Purgative, Anthelmintic, Vulnerary, Detergent, Maturant, Carminative, Alexiterric, Urinary tract infection, Styptic and Diabetes.[31-34]
Kamala Powder (Skins of Fruit)	Preservative for Dairy products and Vegetable oils. Additives for Ointment.[31] Skin Diseases like Scabies, cutaneous affection, Ring worm, Skin irritation, Burns, Boils, Blisters, Wounds, Freckles, Pityriasis and Syphilitic ulcers.[35-36]
Seed oil	Cooling Foodstuffs, Beverages, Varnishes and Rapid drying paints.[37]
Seed cake	Natural Fertilizers.[38]
Wood Pulps	Printing papers and Writings.[38]
Bark(Paste)	Skin burns, Stop bleeding, Digestive disorder.[39-41]
Root	Stomach pain, Respiratory disorder.[41-42]
Whole plant	Snake bite.[43]

PHARMACOLOGICAL ACTIVITY

ANTI ALLERGIC ACTIVITY

A. Daikonya *et al.*,[44] identified that 2 new phloroglucinol derivatives from the *Mallotus philippinensis* fruit by using chemical and spectral data, as 1-(5,7-dihydroxy-2,2-dimethyl-6-(2,4,6-trihydroxy-3-isobutyryl-5- methyl-benzyl)-2H-chromen-8-yl)-2methyl-butan-1-one and 1-(6-(3-Acetyl-2,4,6-trihydroxy-5-methylbenzyl)-5,7-dihydroxy-2,2 -dim-ethyl-2H-chromen-8-yl)-2-methyl-butan-1-one, named these compounds as Mallotophilippens A and B respectively. These

compounds inhibited the production of Nitric Oxide (NO) and inducible nitric oxide synthase (iNOS) gene expression by murine macrophage like cell line (RAW 264.7), which were activated by Lipopolysaccharide (LPS) and recombinant mouse interferon--g (IFN-g).

T.K. Chan *et al.*,[45]tested the Rottlerin in animal models of IgE dependent anaphylaxis and anti allergic mechanism in mast cells. Anti allergic action of Rottlerin has been tested in passive cutaneous and passive systemic anaphylaxis mouse models. In anaphylactic contraction of bronchial ring isolated from sensitized guinea pig. This experiment proves anti allergic effect of Rottlerin by blocking the IgE induced mast cell degranulation.

ANTI CANCER ACTIVITY

V.Sharma[46] tested the glandular hair fraction are 95%,50% alcoholic and aqueous extract of *Mallotus philippensis* fruit powder against 14 human cancer cell lines, among these different fractions; 95% ethanolic extract showed the highest cytotoxic effect as compared to 50% ethanolic and aqueous portion. Results revealed that the 95% ethanolic extract showed highest *in vitro* cytotoxic effect against all the 14 human cancer cell lines. The chloroform soluble fraction (100µg/ml) was produced from 95% ethanolic extract, which found that significant cytotoxicity potential against 10 human cancer cell line from 7 various tissues.

ANTI CESTODAL ACTIVITY

The 50% alcoholic extract of *Mallotus Philippensis* fruit glandular hair was prepared (200mg/kg) and administered orally daily once for 10 days and 22 days.*MPE* significantly enhance wound contraction & decrease both epithelization period and scar area compared with control group.*MPE* was found to be decrease free radicals, Myeloperoxidase but enhanced antioxidants and connective tissue markers.[47]

ANTI DIABETIC ACTIVITY

V.Nandhini *et al.*,[48]studied the antidiabetic activity of the *Mallotus philippensis*. The hydro ethanolic bark extract has shown significant increase in body weight, insulin and significant decrease in blood glucose and HbA1c level on administration of extract orally for 30 days to STZ induced diabetic rats at different doses of 200 and 400mg/kg according to body weight.

The antidiabetic effect of the *Mallotus philippensis* was studied by sumithira *et al.*,[49] The ethanolic fruit extract showed, Decrease in blood glucose level, HbA1c level and increases in plasma insulin level when compared to diabetic animal. Administered orally for 21 days to STZ induced diabetic rat at a different dose of 200 and 400 mg/kg respectively. The extract showed activities in both enzymatic and non enzymatic antioxidant like SOD, CAT, GPx and GSH, Vit C, Vit E respectively. Decrease in serum parameters also seen in cholesterol level, ALT and AST levels.

ANTI FILARIAL ACTIVITY

Dr. Shafeeque Ahmed *et al.*,[50]reported the effect of powdered tablet of *M. philippinensis* fruit possess anthelmintic activity and are sufficiently safe to treat gastro-intestinal infection. Thus the study seems to support the empirical use of the crude plant as a deworming agent in unani and traditional medicines practiced commonly on the Indo- Pakistan subcontinent.

R. Singh*et al.*[51]reported the effect of aqueous and alcoholic leave extracts of *Mallotus philippensis* (Lam.) on the spontaneous movements of the whole worm and nerve-muscle preparation of Setaria cervi and on the survival of microfilariae *in vitro*. Both the extracts result in inhibition of spontaneous motility of whole worm and preparation of Setaria cervi characterized by initial stimulation followed by depression in amplitude. The tone and rate of contractions remained visibly unaffected. Aqueous extract at higher concentration showed immediate reduction in tone.

ANTI FERTILITY ACTIVITY

Reproductive parameters of female rat exhibit adverse effect by seeds extract of *Mallotus Philippensis*. According to the studies, extract reduce serum Follicular stimulating hormone and Lutenizing Hormone levels, probably by affecting hypothalamic pituitary axis in experimental animal. This reduced level may affect Follicular development, Quality of ovulated eggs, Corpus luteum formation, Oestrus cycle and maintenance of pregnancy in rats.[52]

ANTI HIV ACTIVITY

Four phloroglucinol derivatives, named Mallotophenone (5-methylene-bis-2,6-dihydroxy-3-methyl-4-methoxyacetophenone), Mallotochromene (8-acetyl-5,7-dihydroxy-6-(3-acetyl-2,4-dihydroxy-5-methyl-6-methoxybenzyl)-2,2-dimethylchromene), Mallotojaponin(3-(3,3(dimethylallyl) S-(3(acetyl-2,4-

dihydroxy-5-methyl-6-methoxybenzyl)-phloracetophenone), and Mallotolerin(3-(3-methyl-2-hydroxybut-3-enyl)-5-(3-acetyl-2,4-dihydroxy-5-methyl-6-methoxybenzyl)-phloracetophenone), were tested for their ability to inhibit the activity of Human Immunodeficiency Virus (HIV) reverse transcriptase. The mode of inhibition, Mallotojaponin was found to be competitive with respect to template primer, (rA)n (dT)12–18, and noncompetitive with respect to triphosphate substrate, dTTP.The K*i* value of mallotojaponin for HIV reverse transcriptase was determined to be 6.1 μM.[53]

ANTI INFLAMMATORY AND IMMUNOREGULATORY ACTIVITY

3 novel chalcone derivatives Mallotophilippens C, D and E were isolated from the fruits of *Mallotus philippinensis* MUELL. ARG., which inhibit Nitric Oxide (NO) production and inducible NO synthase (iNOS) gene expression by a murine macrophage like cell line (RAW 264.7) which was activated by lipopolysaccharide (LPS) and recombinant mouse interferon gamma (IFN-G). Further investigation suggests that down regulation of cyclooxygenase 2 gene, interleukin 6 gene and interleukin 1b gene expression. Daikonya.A *et al.*reported these 3 chalcones have good anti-inflammatory and immunoregulatory effects.[54]

ANTI LEUKAEMIC ACCTIVITY

Various fraction of *Mallotus Philippinensis* root was tested on human promyelocytic leukemia HL-60 cell proliferation, cell cycle regulators and apoptosis in order to investigate it antileukemic effect. In which hexane fraction was showed promising toxicity against p53 deficient HL-60 cells. After isolation and identification by GC-MS, polyphenols were main compounds of hexane extract that inhibited proliferation and induced apoptosis.[55]

ANTI MICROBIAL ACTIVITY

The antimicrobial activity of hexane, chloroform and ethanol leaf extract of *Mallotus philippensis* against the human pathogens such as *Streptococcus pneumoniae*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, Septicaemia, *Salmonella typhi*, *Vibrio* species, *Candida albicans*. The antimicrobial activity of the hexane, chloroform and ethanolic extract of stem showed concentration dependant activity against all the tested bacteria with zone of inhibition ranged from 12-26nm. But only the ethanol extract showed antimicrobial activity against the fungi *A. flavus* and *C. albicans* with the zone of inhibition ranged from 16-22mm at various concentrations.[56]

Antimicrobial activity of the crude extract of *M. philippinensis* exhibited significant antimicrobial activity against various bacterial like Bacillus cereus var mycoides, Bacillus pumilus, Bacillus subtilis, Bordetella bronchiseptica, Micrococcus luteus, Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa and Streptococcus faecalis & fungus like Candida albicans, Aspergillus niger and Saccharomyces cerevisiae, its properties that support folkloric use in the treatment of some diseases as broad-spectrum antimicrobial agents.[57]

M.Gangwar *et al.*,[58] reported that the Glandular hair of fruits *Mallotus* exhibit significant antibacterial activity against human pathogenic bacteria with MIC ranging 15 to 20mg/mL and this extract does not show any inhibition against different species like *candida*. This shows that extract possess Antibacterial activity without any Antifungal potential.

ANTI OXIDANT ACTIVITY AND ANTIRADICAL ACTIVITY

Arfan. M et al., Studied the Antioxidant and Antiradical property of Mallotus Philippensis bark, 6 fractions named as I-VI reported from the methanolic extract of *M.p* on Sephadex LH-20 column using ethanol and acetone water as the mobile phase. These were evaluated to total antioxidant, antiradical and reducing power. Among these fraction IV possessed the strongest of both antioxidant property and reducing power.[59]

ANTI PROLIFERATIVE ACTIVITY

Antiproliferative effect was evaluated against Thp-1 cells line from the isolated compound of *M. philippensis* fruits extract in which 4'-Hydroxy rottlerin shows 54% growth inhibition ofThp-1 cell line. Other isolated compounds were also tested against different fungi and were found to be very effective IC 50 value.[60]

ANTI TUBERCULOSIS ACTIVITY

Bioassay directed fractionation of *Mallotus philippensis* yields 5 compounds. The most active of which against *Mycobacterium tuberculosis* was a new compound as 8-cinnamoyl-5,7-dihydroxy-2,2-dimethyl-6-geranylchromene for which the name Mallotophilippen F is suggested. The second

compound as 8-cinnamoyl-2,2-dimethyl-7-hydroxy-5-methoxychromene was isolated from a natural source for the first time, while the remaining 3 compounds are Rottlerin, Isoallorottlerin and Isorottlerinm these are called as "Red compound", 8-cinnamoyl-5,7-dihydroxy-2,2,6-trimethylchromene had been already isolated from this plant. Isolated compounds were identified by 2 D NMR and C 13 NMR.[61]

HEPATOPROTECTIVE ACTIVITY

S.Ramakrishna *et al.*[62]studied that methanolic extract of *M.philippinensis* leaf decreases the CCl4 induced hepatotoxicity. Methonolic extract elevation in biochemical parameters like (SGOT, SGPT, SALP, direct bilirubin, total bilirubin, and MDA) on pretreatment at doses 100 to 200mg/kg and also reversed the functional, antioxidant parameters.

WOUND HEALING AND MESENCHYMAL STEM CELL (MSC) PROLIFERATION

Bark extract of *Mallotus philippinensis* has been tested *in vitro* for wound healing activity by examine the proliferation and migration of MSCs. KUM 6 cell proliferation and migration has been enhanced at 0.16–4 μg/mL and unregulated the activity of MSCs by secreting various cytokines to wounded site from bone marrow to systemic circulation and finally remodeled wounded tissues.[63]

CONCLUSION

From this review, it is evidence that *Mallotus philippensis* is a valuable botanical source because of its ethnobotanical uses for variety of disease. Physicochemical properties have been determined to be of future use in identifying authentic *mallotus philippensis* drug and setting the pharmacopoeial standards for further studies. Further, research work on experimental animals proved its ethnobotanical claim and pharmacological activity. In order to ensure the safety of *mallotus philippensis*, a detailed extension study required to isolate new chemical entity which responsible for its pharmacological activities.

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