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A Review on Phytochemical and Ethano Pharmacology of Mallotus Philippnensis

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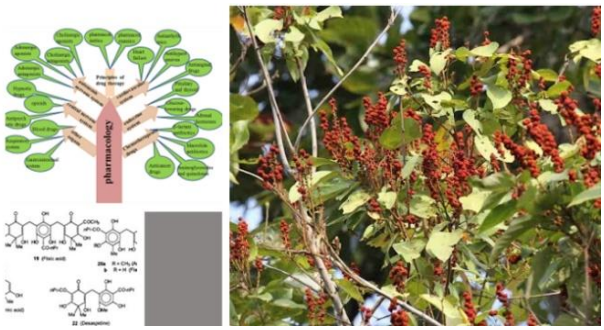
ABSTRACT

Mallotus philippinensis (Lam.) M Arg is a threatened plant species in the central ecoregion. It is a member of the Euphorbiaceae family. Mallotus philippinensis (Lam.) Muell. Arg. (Family: Euphorbiaceae) is a significant perennial plant utilised in traditional medicine. It is primarily prevalent in the tropical and subtropical climates globally. Despite its herbal origin, it is classified within one of the eight Sadharana rasa categories [Glands and hairs of Mallotus philippinensis (Kampillaka), Arsenic (Somala), Ammonium Chloride (Navasagara), Cowri (Kaparda), Amber (Agnijaara), Red Oxide of Mercury (Girisindoora), Cinnabar (Hingula), Litharge (Muddaarashringa)] in Rasa-shastra, the Ayurvedic study of minerals and metals. M. philippinensis is included within Virecana ghana, a group of medicinal plants or items utilised in purgation therapy in Ayurvedic medicine. Primarily, roots, fruits (including fruit powder), and leaves are utilised for therapeutic applications. The leaves possess a bitter flavour and exhibit a cooling, appetising quality. The glands and hairs of the fruit and leaves are advised for cutaneous issues. To date, research investigations have been conducted to validate and examine the pharmacological properties of M. philippinensis. This document aims to summarise the distribution, morphology, Ayurvedic and traditional applications, and scientific research about M. philippinensis. Researchers have empirically demonstrated the antimicrobial, hepatoprotective, anti-leukemic, anti-HIV, anti-inflammatory, anti-filarial, analgesic, hypnotic, antiproliferative, antifertility, purgative, anthelmintic, and antiallergic activities of various parts of M. philippinensis

GRAPHICAL ABSTRACT



Keywords- Herbal plant, pharmacological activity, Mallatus Philippiensis, Phytochemical screening.

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I. INTRODUCTION

Indigenous peoples and local ethnic communities have acquired and cultivated knowledge on the utilisation of certain plants for diverse health diseases and maladies since prehistoric times. These practices persist and are prevalent in remote regions of the Indian subcontinent where health facilities are scarce or nonexistent. Mallotus (family: Euphorbiaceae) is a substantial genus of trees and shrubs predominantly found in the tropical and subtropical areas of the Old World, with approximately 20 species in India. Mallotus philippinensis Muell., generally referred to as Kamala, Kampillaka, and Kapila, and locally known as Shendri, is a prevalent perennial shrub or small tree located in the outer Himalayas, reaching elevations of up to 1500 meters.[1][2] Mature fruits possess glandular hairs that aggregate into a reddish-brown powder, which is harvested by shaking and rubbing the fruits by hand against fabric. The gathered substance is a fine, granular powder, characterised by a dull red or madder red hue, and it is buoyant in water. [3][4] This plant is conventionally employed for antifilarial, antibacterial, anti-inflammatory, and immune-regulatory purposes, as well as serving as a purgative, anthelmintic, vulnerary, detergent, maturant, carminative, and alexiteric. It is beneficial in the treatment of bronchitis, abdominal ailments, splenomegaly, and possesses antimicrobial and antiparasitic properties, among others. Several other medicinal plants exhibit comparable anticestodal action.[5] Medicinal herbs traded from India include Aconitum species (root), Acorus calamus (rhizome), Adhatoda vasica (whole plant), Berberis aristata (root), Cassia angustifolia (leaf and pod), Colchicum luteum (rhizome and seed), Hedychium spicatum (rhizome), and Heradeum candicans (rhizome).[6,7][8]

This ethnomedicinal method has facilitated the identification of numerous therapeutically beneficial chemicals that have subsequently been turned into significant pharmaceuticals.[9][10] For example, the contemporary anti-malarial medications quinine and artemisinin have been derived from indigenous knowledge in the Amazon basin and China, respectively, where local populations utilise them for fever treatment. Moreover, around 65-75% of contemporary pharmaceuticals prescribed for cancer and other infectious diseases have been directly or indirectly sourced from traditional knowledge.[11][12]

Recently, two anti-diabetic medication formulations (BGR-34 and IME9) were produced in India, drawing upon the traditional medicinal traditions of several local populations. [13][14] Consequently, the ethnomedicinal practices of diverse ethnic groups have yielded indigenous knowledge that facilitates the identification of therapeutically beneficial chemicals from plants for contemporary research. [15][16] The amalgamation of traditional and contemporary knowledge may yield superior outcomes for humanity.[17][18] The therapeutic qualities of Kamala are noted in ancient Indian texts such as the Charaka Samhita, Sushruta Samhita, Indian Materia Medica, and Indusyunic Medicine (2-4). Ancient medical traditions such as Ayurveda and Yunani endorse its application as an alexiteric, anthelmintic, appetite stimulant, bitter, carminative, cooling agent, purgative, styptic, and vulnerary.[19][20] Certain medicinal qualities of this species have been developed into commercially accessible medicine formulations, such as Krimighatni Bati and Krimikuthar Rasa for intestinal worms, and Roghan Kameela and Zimad Jarb for dermatological problems.[21][22][23]

Nonetheless, these conventional applications may be impractical or excessive; hence, scientific authentication and validation of these features are essential for the development of effective contemporary pharmaceuticals. The pharmacological characteristics and extraction of active chemical components from this tree have advanced significantly[24][25] during the past few decades. Consequently, several significant phytochemical substances, including cardenolides, flavonoids, tannins, fatty acids, chalcone, and phloroglucinol derivatives, have been isolated and described from this plant (9). These significant active compounds exhibit notable pharmacological actions, including anti-cancer, anthelmintic, anti-fertility, antibacterial, anti-oxidant, and anti-inflammatory effects, among others, which are anticipated to be identified in the near future.[26][27]

Notwithstanding recent advancements in pharmacological science, our knowledge regarding the validity of traditional therapeutic applications of this tree remains restricted. Methods to Articles that lack minimum inhibitory concentration (MIC) data for antibacterial research, as well as antioxidant assays utilising 2,2-diphenyl-1-picrylhydrazyl (DPPH) and other in vitro assays, have been excluded. Nevertheless, many papers that were pertinent were incorporated despite not fulfilling the aforementioned criteria, as they offered insights for additional research on the topic. The chemical structures depicted in the text were generated from previously published research utilising the ChemOffice® (16.0) software provided by PerkinElmer, Inc. All remaining figures were generated utilising the R programming language.[28][29]

Scientific Classification [30-32]

KINGDOM: Plantae
SUBKINGDOM: Tracheobionta
SUPERDIVISION: Spermatophyta
DIVISON: Magnoliophyta6
CLASS: Magnoliopsida
SUBCLASS: Rosidae
ORDER: Euphorbiales
FAMILIY: Euphorbiaceae
GENUS: Mallotus
SPECIES: Mallotus philippinensis

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II. VERNACULAR NAMES[34-35]

- 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

Botanic Description

A tree of modest to medium stature that can attain a height of up to 25 meters and possess a trunk diameter of up to 40 centimetres. The bark is grey and smooth, occasionally featuring creases or corky protrusions. The leaves are arranged oppositely on the stem, exhibiting an ovate to oblong morphology, measuring 4 to 12 cm in length and 2 to 7 cm in width.[36][37] The flowers develop from March to April. The fruits ripen from July to August. The stems exhibit fluting and irregularity at the base. The branchlets are glandular and reddish-brown in colour. Minute red glands may be discernible on the leaves when observed with a magnifying glass. The petioles measure 2 to 5 cm in length and are slightly thickened at both ends. The veins are prominent and visible beneath the leaf. The kamala tree is located in various regions, including the western Himalayas, India, Sri Lanka, Southern China, and throughout Malesia to Australia. The kamala tree is capable of thriving in several soil types, including fertile soil, limestone, and rocky terrain. It can even endure barren soils. The kamala tree can thrive in temperatures ranging from 16 to 28 degrees Celsius. It may thrive at elevations of up to 1,225 meters.[38] The Mallotus philippinensis thrives optimally in regions receiving 800-2,000 mm of yearly precipitation. It may thrive in both forest and open scrubland, frequently occurring with other species. It is particularly prevalent in evergreen woods.[39]

III. BIOLOGICAL SOURCE

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

Ecology

The kamala tree is indigenous to the western Himalayas, India, Sri Lanka, Southern China, Malesia, and Australia. [40] The kamala tree is frequently located in evergreen forests, particularly in secondary forests, where it may occasionally serve as the predominant undergrowth. It is likewise located in open scrubland. [41] The kamala tree is frost-resistant, drought-tolerant, and can endure significant shade. The kamala tree is capable of thriving in several soil types, including fertile, limestone, and rocky soils. The tree thrives well in temperatures ranging from 16 to 28°C. [42] The kamala tree thrives in regions with annual precipitation ranging from 800 to 2000 mm. The annual temperature ranges from 16 to 28 degrees Celsius. The mean yearly precipitation ranges from 800 to 2,000 mm. The M. philippensis species exhibits tolerance to several soil types, including barren soils and limestone.[43] Acidic and rugged terrain. Primarily located in Afghanistan, Australia, Bhutan, Cambodia, China, India, Indonesia, Japan, and Malaysia.[44]

IV. CULTIVATION & HABITATS

- **Habitat**: Semi Evergreen, Moist deciduous, Evergreen & dry slope forests as well as plain forest. (Figure: 1a) [45]
- **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)[46]
- **Flowers**: Dioecian, small, sub terminal panicles. (Figure: 1d)[47]
- **Male flowers** - Clustered, sessile, pedicellate, erect terminal spikes 2-10cm long, each flower contain numerous stamen with stellate hair.[48]
- **Female flowers:** Sessile, short spikes, globosely ovoid, distinct 3 greenish yellow styles, 3 lobed ovaries with red glands.[49]
- **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.

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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

V. CHEMICAL CONSTITUENTS

The tree is mostly recognised for kamala powder, composed of glandular and stellate non-glandular hairs from its capsules, historically utilised as an anthelmintic and as an orange dye for silk. Early chemical investigations indicate that kamala includes phenolic compounds, with rottlerin (malotoxin) being the principal constituent. The chemical was initially isolated by Anderson in 1855.Consequently, significant studies conducted by British researchers.India and German investigators prior to World War II The structure (Ia) was approved for rottlerin [32]. The structure of isoallorottlerin (II) was elucidated through synthesis by Brock Mann and Mater(13) and McGookin et al[35]; however, its natural occurrence could not be definitively established. Cardillo et al.[17] (1965) isolated two additional compounds from kamala, which they designated as 3-hydroxy rottlerin (Ib) and 3,4-dihydroxy rottlerin (Ic).No isoallorottlerin (II) was

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detected.Crombie et al. [18] (1968) identified two novel compounds from kamala extract, devoid of the methylene bridge, which they designated as the "red compound" and the "yellow compound." The structures (III) and (IV) were proposed for these compounds. The leaves of Mallotus philippinensis Muell Arg. contain nitrogen and ash. The nitrogen content was assessed using Kjeldahl's method, yielding a result of 2.14%. The ash content was determined by ashing the leaves in a silica crucible within a muffle furnace at 600-700°C, resulting in a value of 13.37%. Leaves contain bergenin in negligible quantities. The tree bark comprises approximately 6-10% tannins, and the petroleum ether extract analysed by chromatography on silica gel produced cetylaleuritolic acid at a concentration of 0.006%. Local inhabitants utilise kamala as a dye. It is innocuous, odourless, and highly stable. Kamala dye, when dissolved in lipids in minimal quantities, imparts a pale yellow hue that is inherent to b. An extract of the leaves and blossoms is conventionally employed as a cure for toothache due to its anaesthetic effects, as well as for stomatitis, influenza, cough, rabies, tuberculosis, and throat ailments. It has also been utilised in the treatment of rheumatism and fever. It possesses potent diuretic properties and the capability to dissolve urinary stones. It also demonstrates antimalarial and antibacterial properties, along with high-quality fat. Kamala also comprises other chemicals like as wax. Traces of volatile oils, tannins, sugars, gums, starch, and cellulosic components. Oxalic acid and inorganic substances.The composition of phloroglucinol derivatives remains reasonably consistent across materials from various origins. Composition of phlorglucinol derivatives extracted from kamala [34]S.V. Puntambekar: F.A.S.C., Forest Research Institute and Colleges. Dehradun (1951). Analytical assessment of the lipid extract from the seeds of Mallotus philippensis muel. Arg. [11] Maeda: Mitsuru, Fukami: Harukazu Namikawa, Koshi The recognised process for manufacturing dye compositions from Mallotus philippenses, including those obtained through extraction with water and alcohol from the plant's body.November 3, 2005.[41] The phytochemical effects of Kamala (Mallotus philippensis) utilising thidiazuron have been documented by Muhammad Arfan. Hazrat Amin, Magdlena, Karamaca, Gnieszka Kosinska, Wieslaw Wiczkowski, and Ryszard Amarowcz (2009) conducted efficient research on the antioxidant activity of phenolic fractions derived from the bark extract of Mallotus philippensis, which is a rich source of biologically active compounds, including phloroglucinals, tannins, and terpenes. Utilising methanol (2009).[42]

VI. 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.[43]

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.[44]

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.[45]

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.[46]

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. 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.[47][48]

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

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chemical constituents present in it.[49]

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

VII. 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 X100Other Compounds

Unsaturated fatty acids, that is triplyunsaturated hydroxy acid kamlolenic acid, different fatty acids and glyceride have been reported from kamala (M. philippinensis) seed oil.

Resinous coloured material contains active parts of rottlerin and isorottlerin. It also contains homorottlerin, red role 50%, yellow role 5%, mature 2%, volatile oils, tannin, gum citric acid, and oxalic acids

Pharmacological Activities

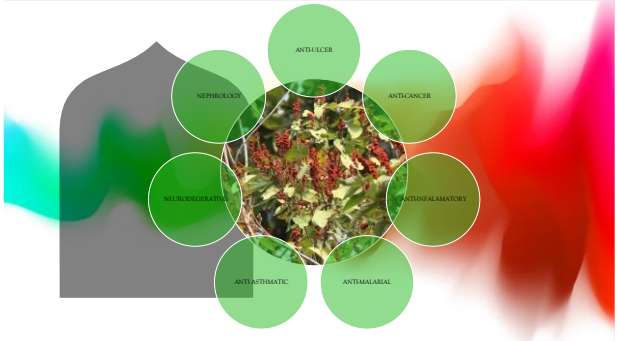

Fig: 2 Pharmacological activities of

VIII. MALLOTUS PHILIPPENSIS

Antioxidant activity and Antiradical Activity

Various extracts from the fruits and bark of Mallotus philippensis were produced and assessed for their total antioxidant activity (TAA), antiradical activity against DPPH (2,2-diphenyl-1-picrylhydrazyl radical), and reducing power. The total phenolic and tannin concentrations in the extracts were quantified. The bark extract exhibited the most potent antiradical activity and reducing capacity, with a total antioxidant activity of 5.27 mmol Trolox equivalents per gramme. The TAA of alternative extracts varied from 0.05 to 1.79 mmol Trolox equivalents per gramme of extract. The concentration of total phenolics in the bark extract was 541 mg/g.[50]

Antimicrobial Activity

The antimicrobial efficacy of hexane, chloroform, and ethanol leaf extracts demonstrated notable activity against human pathogens, including Streptococcus pneumoniae, which causes brain abscesses, pneumonia, and septic arthritis; Proteus vulgaris; Pseudomonas aeruginosa, responsible for urinary tract infections and septicaemia; Salmonella typhi, which leads to typhoid fever; Vibrio species, associated with diarrhoeal infections; and the fungus Candida albicans. The antibacterial efficacy of the hexane, chloroform, and ethanolic stem extracts exhibited concentration-dependent activity against all tested bacteria, with inhibition zones ranging from 12 to 26 mm at varying doses. Only the ethanol extract exhibited antimicrobial action against the fungus A. flavus and C. albicans, with the zone of inhibition ranging from 16 to 22 mm at different doses. [50]

Anti-filarial Activity

The effect of aqueous and alcoholic leave extracts of *Mallotus philippensis* (Lam.) was studied on the spontaneous movements of the whole worm and nerve-muscle (n.m.) 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 them n.m. preparation of *S. 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. The concentration required to inhibit the movements of n.m. preparation was 1/5th for aqueous and 1/11th for alcoholic extract compared to that for the whole worm, suggesting a cuticular permeability barrier. The stimulatory response of acetylcholine was blocked by aqueous extract on whole worm movements. On the microfilariae the LC50 and LC90 were 18 and 20 ng/mL for aqueous and 12 and 15 ng/mL for alcoholic extracts, respectively.[51,52]

Anti-Leukaemic Activity

The root extract of *Mallotus philippensis* was tested on human promyelocytic leukemia HL-60 cell proliferation, cell cycle regulators, and apoptosis in order to investigate its antileukemic effect. Hexane fraction showed promising toxicity against p53-deficient HL-60 cells (IC50 1.5mg dry roots equivalent/mL medium) after 72h and, interestingly, inhibition of cell

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proliferation was preceded by the upregulation of the protooncogenes Cdc25A and cyclin D1 within 24 hours suggesting its antileukemic effect in HL-60 cells. After isolation and identification by GC-MS, polyphenols were the main compounds of the hexane extract that inhibited proliferation and induced apoptosis.[53]

Anti-HIV Activity

Four phloroglucinol derivatives, named mallotophenone (5-methylene-bis-2,6-dihydroxy3-methyl-4-methoxyacetophenone), mallotochromene (8acetyl-5,7-dihydroxy-6-(3-acetyl-2,4- dihydroxy-5-methyl-6methoxybenzyl)-2,2-dimethylchromene), mallotojaponin (3- (3,3(dimethylallyl) S-(3(acetyl-2,4-dihydroxy-5-methyl6-methoxybenzyl)-phloracetophenone) and mallotolerin (3(3-methyl-2-hydroxybut-3-enyl)-5-(3-acetyl-2,4- dihydroxy5-methyl-6-methoxybenzyl)- phloraceto-phenone) were tested for their ability to inhibit the activity of human immunodeficiency virus- (HIV-) reverse transcriptase. The mode of inhibition of mallotojaponin was found to be competitive with respect to the template primer, (rA)n (dT)12–18, and noncompetitive with respect to the triphosphate substrate, dTTP. The *Ki* value of mallotojaponin for HIV-reverse transcriptase was determined to be 6.1μM.[254-56]

Antitumor Activity

Four known friedelane-type triterpenoids, friedelin, 3-hydroxy-D:A-friedoolean-3-en-2one, 2β-hydroxy-D:A-friedooleanan-3-one, and 3α-hydroxy-D:A-friedooleanan-2-one, and two known lupanetype triterpenoids, lupeol and betulin, were isolated from the stem bark of *Mallotus philippensis* and were tested for their inhibitory effects on Epstein-Barr virus early antigen (EBV-EA)activationinducedby12-O-tetradecanoylphorbol 13-acetate (TPA). The inhibitory effect of compounds 2 (IC50 = 292mol ratio/32pmol/TPA) and 4 (IC50 = 288) wasstronger than those of the other compounds tested and the positive control, curcumin (IC50 = 343). Compound 3αhydroxy-D:A-friedooleanan-2-one strongly inhibited mouse skin tumor promotion in an in vivo two-stage carcinogenesis model.[57]

Anti-tuberculosis Activity

Organic extract of *Mallotus* plant which yields five compounds after bioassay directed fractionation. The most active compound against Mycobacterium tuberculosis was 8- cinnamoyl5, 7-dihydroxy-2, 2-dimethyl- 6-geranylchromene for which the name mallotophilippen-F is suggested. The second compound 8-cinnamoyl-2,2- dimethyl-7- hydroxy-5-methoxychromene was isolated from a natural source for the first time, while the remaining three compounds, rottlerin, isoallorottlerin, or isorottlerin and the so-called red compound, 8-cinnamoyl-5,7-dihydroxy-2, 2, 6-trimethylchromene, had been already isolated from this plant. Isolated compounds were identified by 2D-NMR and C-13 NMR.[58]

Anti-Inflammatory and Immunoregulatory Activity

Chalcones derivatives from the fruits of *Mallotus philippensis* and mallotophilippens C, D, and E inhibit nitric oxide (NO) production and inducible NO synthase (iNOS) gene expression by a murine macrophage-like cell line(RAW264.7) which was activated by lipopolysaccharide (LPS) and recombinant mouse interferon-gamma (IFN-gamma). Further investigations suggest the downregulation of cyclooxygenase-2 gene, interleukin-6 gene, and interleukin-1b gene expression. The above results show that these chalcones have good anti- inflammatory and immune-regulatory effects.[59]

Hepatoprotective Activity

Methanolic extract of *Mallotus philippensis* leaves decreases the CCl_4-induce delevation in biochemical parameters (SGOT, SGPT, SALP, direct bilirubin, total bilirubin and MDA) on pretreatment at doses100–200mg/kg and also reversed the functional and antioxidant parameters. This study suggests that leave extract was effective in functional improvement of hepatocytes. Histopathological studies also suggest the hepatoprotective activity of plant.[60]

IX. CONCLUSION

Present review confirms the medicinal values of Mallotus philippensis and it can be used against human pathogens and a promising candidate for hepatoprotection, anti leukaemic, anti-HIV, anti-inflammatory, analgesic, hypnotic, antioxidant potential and healing skin lesions and many more. These findings may lead to further development of novel pharmaceutical preparations from M. philippensis in the future. Literature search has shown that this plant has immense medicinal & economic uses in different systems of Medicine in India as well as throughout the world. Though it has such medicinal & economic property it is now rarely available and has been categorized as an endangered plant could be unawareness about its uses in general public as well as its difficulty in natural reproduction, so different methods of its conservation & propagation should be adapted so as to prevent its extinct.

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