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Review Article

Compressive Review on Plant Profile, Phytochemistry and Pharmacology of *Crotalaria pallida* Action

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Abstract

Medicinal plants have significantly influenced the evolution of human civilization. Medicinal plants have long been used as a source of medicine in almost every society. Many modern medications are made from medicinal plants, which are considered to be abundant sources of traditional medicines. Medicinal herbs have been used for centuries to treat illnesses, preserve food, enhance flavor, and stop disease outbreaks. The biological traits of plant species used worldwide are typically caused by the secondary metabolites that the plants produce. Plant-derived compounds regulate microbial growth in a variety of settings. In this review, we presented a general overview of the therapeutic herbs. Healing with medicinal plants has been around since the dawn of humanity. The relationship between humans and their quest for natural remedies has roots in ancient history, which is well-documented through numerous sources: written records, enduring landmarks, and even ancient herbal medicines *Crotalaria pallida*, often referred to as the smooth crotalaria, is a type of flowering plant belonging to the Fabaceae family. *Crotalaria pallida* Aiton. is a species with extensive medicinal characteristics. Traditionally, the plant has been utilized to alleviate joint swelling, reduce fever, serve as a vermifuge, and treat skin ailments. Additionally, the plant and its components are claimed to exhibit anti-inflammatory, antimicrobial, antioxidant, antibacterial, and antifungal properties. Fresh leaves and dried leaf powder were employed for examining macroscopy, microscopy, preliminary phytochemical screening, and fluorescence analysis of the powdered drug.

Keywords: *Crotalaria pallida* action (Fabaceae), phytochemical constituent, pharmacological activity. medicinal uses

INTRODUCTION

The necessity of substituting some medications because of their adverse side effects is a prime example of the widespread use of plants to treat illness and preserve health. Since ancient times, people have used medicinal plants to cure various diseases; this approach is known as phytotherapy [1]. Because medicinal plants include a variety of secondary metabolites, or phytochemicals, that nature can repeatedly manufacture, they have therapeutic benefits. Plants' seeds, bark, roots, leaves, and fruits are the best sources of active metabolites. Consequently, various plants have used these phytochemicals as a defensive mechanism against infections. Since ancient times, phytochemicals have been utilized to cure different illnesses, and they are typically considered safer than synthetic medications [2,4].

In contrast to synthetic medications, which are seen to be harmful to both humans and the environment, these herbal products are now seen as a sign of safety. Even though herbs have long been valued for their therapeutic, flavorful, and aromatic properties, their significance was temporarily overshadowed by modern synthetic products. However, people are returning to naturals in the hopes of safety and security now that their naïve reliance on synthetics is over. It's time to market them internationally [5]. For a variety of reasons, traditional medical systems are still frequently used. The use of plant materials as a source of medicines for a wide range of human ailments has gained more attention due to factors such as population growth, an inadequate supply of medications, the exorbitant cost of treatments, side effects from several synthetic drugs, and the emergence of resistance to currently used drugs for infectious diseases [5]. The plant *Crotalaria pallida* Aciton, commonly known as “rattle box” in English, is an annual erect herb of about 1.50 m height belonging to the family Fabaceae, which grows gregariously in tropical and sub-tropical regions of India[6]. The stem produces fiber that is comparable to sunn-hemp. Coffee can be replaced with roasted nuts [6,7]. The plant is used as green manure and as a good cover crop in tea,

coconut, and rubber plantations in Sri Lanka and Southeast Asia to prevent soil erosion. The plant's various parts are used in traditional medicine to alleviate joint swelling and urinary tract infections [7].A novel antimicrobial peptide named Cp-AMP has been isolated and characterized from the seeds of *Crotalaria pallida* which showed promising bioactivity against urinary disease-causing bacteria *Proteus* as well as a potent phytopathogenic fungi *Fusarium oxysporum* [8]. The leaves showed estrogenic and mutagenic activities [9]. as well as antibacterial activities [10]. Chemical investigation on this plant is confined to alkaloids and flavonoids only [11,12].

Crotalaria is one of the largest genera in tropical Africa. The genus includes 690 species that are mainly situated in Africa and Madagascar. the. Species have also been found throughout in India [2]. This is an erect shrub, annual short-lived perennial herb of 1.5 m or more tall. Taproot white or brown and stem grooved, solid, glabrous. Leaves trifoliolate, alternate spiral, stalked, leaflets elliptic, more than 2 cm long/ wide, hairy on upper surface, margin entire, apexobt use base acute, pinnately veined. Flowers bisexual, grouped together in a terminal raceme, stalked, petals 5, yellow. Fruit a rounded. This species is used in traditional medicine. The plant is used to treat urinary problems and fever, a poultice of the roots is applied to swelling of joints and fever, and its leaves are used as a vermifuge [13,14]. The plant is grown as a ground cover and a green manure crop, especially in the inter-rows of rubber trees and coconut palms. Flowers are eaten as a vegetable in Cambodia, where the seeds are roasted and grounded for use as a sort of coffee beverage. The roots are sometimes chewed with betel nuts in Vietnam. In traditional medicine, the plant is used to treat urinary problems and fever, a poultice of the roots is applied to swelling of joints and an extract of the leaves is taken to expel intestinal worms [15]. India is home to over 81 species of Crotalaria, with *Crotalaria pallida* Aiton being one of the more noteworthy ones [16]. Most Crotalaria species are used as medicinal agents in India to treat various illnesses [17]. The phytochemical constituents are also reported in *Crotalaria pallida* Aiton include:

Alkaloids, Flavonoids, Phenols, Carbohydrates, Proteins, Steroids, Tannins, Saponins, Gums, and Reducing sugars. Synonymsare Crotalaria mucronata Desc, Crotalaria striata DC, Crotalaria falcata VAHL ex DC, Crotalaria brownei DC., Crotalaria fertilisDelile, Crotalaria hookeri Arn., Crotalaria pisiformis Guill. &Perr., Crotalaria siamica F.N. Williams, Crotalaria striata var. acutifolia Trin., Crotalaria tinctoriaBaill, Crotalaria zuccarininana D. Dietr [18,20].

Figure 1: Flower[51]

Figure 2: Leaf[51]

Figure 3: Fruits[51]

RESEARCH METHODOLOGY

A review of scientific literature from a variety of sources, including Google Scholar, Web of Science, SciFinder, Scopus, Science Direct, PubMed, Scielo, Springerlink, Google Patents, Espacenet, BioMed Central (BMC), and Medline, was conducted in order to identify relevant information on the botany, medicinal uses, phytochemistry, and biological activities of *C. pallida*. Common English names, dissimilar scientific names and synonyms, biological activities, medicinal uses, ethnobotany, ethnopharmacology, medicinal, pharmacology, phytochemistry, and therapeutic value, *C. pallida*, black oil plant, oriental bittersweet, climbing

staff tree, Jyotishmati, and intellect tree were among the keywords used to identify pertinent data. Books, book chapters, theses, websites, and conference proceedings were the sources of further literature

OCCURENCE AND DISTRIBUTION

The native range of *Crotalaria pallida* Aiton is the tropical and subtropical Old World, including Africa, the Indian subcontinent, and Asia. It is commonly found in India, Sri Lanka, and throughout South-East Asia. However, due to widespread cultivation, its natural distribution is obscured. It has escaped and is now naturalized in many other regions, including: The Lucayan Archipelago, The entire Caribbean region, Mexico south to South America, The Pacific, and Australia. *Crotalaria pallida* Aiton is an annual, perennial, or subshrub that grows primarily in the seasonally dry tropical biome. It is commonly found in waste lands and roadsides. *Crotalaria pallida* is NOT native to the Lucayan Archipelago. It is native to Africa, the Indian subcontinent, and Asia. It has escaped and is now naturalizing in the Lucayan Archipelago, the entire Caribbean region, and Mexico south to South America, the Pacific, and Australia. Africa Tanzania, Uganda, *Northeast Tropical Africa* Chad, Ethiopia, Sudan, *South Tropical Africa* Angola, Malawi, Mozambique, Zambia, Zimbabwe *Southern Africa* KwaZulu-Natal, Northern Provinces, Swaziland, *West Tropical Africa* Benin, Burkina, Gambia, The Ghana, Guinea, Guinea-Bissau, Ivory Coast Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, *West-Central Tropical Africa* Burundi, Cameroon, Central African Republic, Congo, Equatorial Guinea, Gabon, Gulf of Guinea Is, Rwanda, Zaire, *Western Indian Ocean* Comoros, Madagascar, Asia-Temperate *China* China North-Central China South-Central, China Southeast, Hainan *Eastern Asia* Taiwan, Asia-Tropical *Indian Subcontinent* Assam, Bangladesh, East Himalaya, India, Nepal, Pakistan, Sri Lanka, West Himalaya[21].

BOTNICAL DESCRIPTION

Crotalaria pallida, commonly known as the smooth crotalaria, is a species of flowering plant within the family Fabaceae

Stem- usually flowers and fruits as a shrub 1-1.5m tail but also flowers as an herb

Leaves- Compound leaf petiole about -1-6 cm long. Middle leaflet larger than the lateral leaflets. Leaflet blades about 1.5-8x0.6-4cm, broadest at or above the middle. Leaflet stalks about 0.3cmlong. Stipules about1-3mm long, recurved, hairy when young, purple at the base but green at the apex.

Flowers -Inflorescences about 15-45 cm long. Flowers borne singly in the axils of deciduous, about 2-5mm long, bracts. Calyx is about 6- 7.5 mm long, and the lobes are about as long as the tube. Petals: standard about 10-12x8 mm; wings much shorter than the keel; keel about 12- 15 mm long. Standard and keel marked by red-purple striations (veins). Stamens 10, dimorphic, five anthers long and basifixed, and five anthers short and dorsifixed. Another filament fused to form a tube open on one side. Pollen orange. Ovary densely clothed in white hairs.

Fruit – Pods cylindrical, about 30-45x8-9mm, grooved on one side, clothed in erect hairs. Seeds rattle when pods are shaken. Seeds about 3x2mm, mottled light and dark brown, laterally compressed, +/- hook-shaped or boomerang-shaped. Radicle beside and +/- parallel to the axis of the cotyledons.

Seedlings-Cotyledons about 13-17x6-7mm. First pair of leaves trifoliolate and alternate. At the tenth leaf stage: stipules filiform to narrowly triangular, about1-5mm long. Stems, terminal buds and petioles densely clothed in pale brown prostrate hairs. Two small ridges run down the stem from the base of each petiole. Seed germination time 6 to 25 days.

This shrub (annual or short-lived perennial herb) has height of about 1.5 m. The stout stem is hairy and has longitudinal grooves. Leaves are trifoliate with a 2– 8.5 cm long petiole, leaflets 3-13 x 2–5 cm and elliptical to obovate. Flowers are yellow, often reddish brown veined and borne on 15–40 cm long racemes, each with 20-30 flowers. Fruits are 3-5 x 0.6-0.8 cm, 30-40 seeded that are heart-shaped, 3 x 2 mm, shiny, mottled ochre and dark grey-green or brown [22].

The plant is grown as a ground cover and a green manure crop, especially in the inter-rows of rubber trees and coconut palms. Flowers are eaten as a vegetable in Cambodia, where the seeds are roasted and grounded for use as a sort of coffee beverage [22].

PHYTOCHEMICAL CONSTITUENTS

Several classes of phytochemicals, including pterocarpanoids, alkanes, alkaloids, flavonoids, terpenes, and fatty acids, have been shown to be present in *C. pallida*. Below is a discussion of each of these classes:

1 Pterocarpanoids

Major pterocarpanoids namely, crotafurans A (5'-(1-Methylethenyl)furo[2',3': 9,10]pterocarpan-3-ol=rel-(5bR,11bR)-5b,11b-Dihydro-2- (1-methylethenyl)-6H-furo[2',3': 6,7]benzofuro[3,2-c][1]benzopyran-9-ol); crotafurans B (1-(3-Hydroxyfuro[2',3': 9,10] pterocarpan-5'yl)ethanone=rel-1-[(5bR,11bR)-5b,11b-Dihydro-9-hydroxy-6H-furo[2',3':6,7]benzofuro[3,2-c][1]benzopyran-2-yl]ethanone); crotafurans C (5'-(1-Methylethenyl)furo[2',3': 9,10]pterocarpan-3,6adiol= rel-(5bR,11bR)-5b,11b-Dihydro-2-(1-methylethenyl)-6H-furo[2',3': 6,7]benzofuro[3,2c][1]benzopyran-5b,9-diol); crotafurans D (1-(3,6a-Dihydroxyfuro[2',3': 9,10]pterocarpan-5'-yl)ethanone rel-1-[(5bR,11bR)-5b,11b-Dihydro-5b,9-dihydroxy-6H-furo[2',3':6,7] benzofuro[3,2-c][1]benzopyran-2yl]ethanone), and Crotafurans E (5'-(1-Methyl-1,2-dihydroxyethyl)-furo [2',3':9'10]pterocarpan-3-ol) have been reported from the bark of *C. pallida* [23].

2 Alkane

Thin-layer chromatography (TLC) and Gas liquid chromatography (GLC) studies characterize the n-alkane composition in *C. pallida* epicuticular wax of

leaves, flowers and seeds and identified twenty-one n-alkanes from C_{15} to C_{35}. In the leaf wax long chain hydrocarbons, Heneicosane (C_{19}), Tricosane (C_{23}), Tertacosane (C_{24}), Pentacosane (C_{25}), Hexacosane (C_{26}), Heptacosane (C_{27}), Octacosane (C_{28}) Nonacosane (C_{29}) and Hentriacontane (C_{31}) were predominant whereas flowers and seeds exhibited higher values of medium-chained n-alkanes (C_{17}-C_{27}) [24].

3 Fatty acids

Gas chromatography- Mass spectrometry (GC-MS) analysis of *C. pallida* oil revealed the presence of unsaturated fatty acid in greater amount than saturated fatty acids. Arachidic acid (37.99%) and palmitic acid (32.48%) are the most abundant saturated fatty acids whereas in linolaidic acid (10.47%) is reported to be predominant unsaturated fatty acid [25].

4 Flavonoids

isolated a new isoflavones 5,7,4'-trihydroxy-2'-methoxyisoflavone along with some other constituents namely b-sitosterol, lupeol, morin, weighteone, 2'-hydroxygenistein, daidzein and 2'-hydroxydaidzein, taxifolin, naringenin, quercetin-7-O-b-d-glucopyranoside, and naringenin-7-O-b-dglucopyranoside from the barks of *C. pallida*.[26]. Three new flavonoids viz. cropalliflavones A, cropalliflavones B and cropalliflavones C and two homoisoflavonoids along with six previously known flavonoids diosmetin, luteolin, acacetin-8-C-neohesperidoside, obovatachalone, 5,3',4'-trihydroxy-2'',2''dimethylpyrano(5'',6'':7,8) isoflavone and alpinumisoflavone, have been isolated from the seeds of *C. pallida* [27].

5 Alkaloids

Two more alkaloids, cropallin A, cropallin B have also been reported from *C. pallida* seeds [27] Usaramine-N-oxide and usaramine alkaloids isolated from the seeds of *C. pallida* using High Pressure liquid chromatography-Mass spectrometry (HPLC-MS) [28].

6 Miscellaneous compounds

Spectroscopic analysis of *C. pallida* seeds showed one sesquiterpenoids, (-)-methyldihydrophosphate, six phenylpropanoids namely, ferulic acid, *p*-hydroxyl ethyl cinnamate, ethyl caffeate, *p*hydroxycinnamic acid methyl ester, 4,4'-bis(1-propenoic acid methyl ester)-3'-methoxydiphenyl ether, and ethyl (E)-3-(4-(4-((E)-3-ethoxy-3-oxoprop-1-en-1-yl)-2-methoxyphenoxy) phenyl) acrylate; one phenolic acid, sonchifolinin B; and one lignin, ethyl (E)-3-[(2R,3R)-2,3-dihydro-2-(4-hydroxy-3-methoxyphenyl)- 7methoxy-3-ethoxy carbonyl-1-benzofuran-5yl] propenoate [27].

MEDICINAL AND TRADITIONAL USES

The plant is used as green manure, young seeds are used as food, roasted ripe seeds can be substituted for coffee, stem fiber is used as a material for thread, etc. *C. pallida* is used as a ground cover and a green manure crop throughout the humid tropics, through on a limited scale. In tea, rubber, and coconut plantations in Sri Lanka and Southeast Asia, and in cocoa plantations in West Africa, it is used as a green manure and planted in the interrows to reduce erosion. It is one of the oldest green manure crops in Indonesia, but lost popularity because of its susceptibility to diseases and pests [29,31].

Up to the 1960s, C*. pallida* was widely cultivated for soil cleansing and as a green manure crop in the south-earth United States, replacing the more toxic Crotalaria spectabilis Roth. It's useful as a fodder crop as well. However, because the seed can occasionally become poisoned when blended with fodder grains, its usage is no longer advised. The seeds were once used to make a fermented food in west Java. To get rid of the toxic parts, the seeds were cooked for two hours, wrapped in banana leaves, and allowed to ferment for a few days. The blooms are used as a vegetable in Cambodia. In Indochina, roasted seeds are used to make a type of coffee. The roots are occasionally consumed with betel nut in Vietnam.

In traditional medicine, *C. pallida* is used to treat urinary problems. A poultice made of the roots is applied to painful swelling of joints, and an extract of the leaves is taken as a vermifuge. In Laos the plant is used to reduce fever [29,31].

CULTIVATION

A plant of the lowland tropics and subtropics.

Elevation- it has been successfully grown at elevations up to 1,800 miters [32].

Rainfall- It grows in a wide range of annual rainfall conditions, from 850 mm to over 3,000 mm, and occurs occasionally in rather dry locations.

Temperature- The average annual temperature varies from 16-26°c Succeeds on a wide range of soils, except on peat soils that developed under coarse grass. It is considered well suited to sandy soils and has succeeded in saline conditions in Thailand. It requires a sunny position, growing poorly in shade. Often grown as a green manure, the plant can escape from cultivation and become naturalized. It is reported to be invasive in many areas, where it grows in open and disturbed sites such as pastures, waste ground, roadsides and sand dunes at elevations up to 1,070 miters.

This species has a symbiotic relationship with certain soil bacteria, these bacteria form nodules on the roots and fix atmospheric nitrogen. Some of this nitrogen is utilized by the growing plant but some can also be used by other plants growing nearby.

It is cultivated by seed and the seedling will emerge after 21-30 days after sowing. The germination rate of fresh seeds is higher compared to the stored ones. The 30 cm tall-plants must be topped in order to promote branching [32,34].

REPORTED PHARMACOLOGICAL ACTIVITY

Here, the several significant pharmacological actions of *C. pallida* are examined.

1. Antioxidant Activity

Alam et al., 2014evalutedAntioxidant properties of *C. pallida* were investigated by various workers using

Ferric ion reducing antioxidant power (FRAP), 2,2-diphenly-l-picrylhydrzyl (DPPH) and 2,2-azinobis-3-ethylbenzothiazoline6-sulfonic acid (ABTS). The leaves extract exhibited free radical scavenging activity with IC_{50} value of 37.60µg/ml compared to standard ascorbic acid IC_{50} value of 16.95µg/ml [35].

Govindappa et al., 2011a studied Five different extracts namely ethanol, ethyl acetate, chloroform, petroleum ether, and aqueous extract of *C. pallida* were used to screen antioxidant activity. The ethanol, ethyl acetate and petroleum ether extract exhibited greater scavenging activity in both DPPH and FRAP assays. The FRAP and DPPH activity of the extracts was 88%, 72% and 73% and 3617.89±0.03, 2189.33±0.01 and 1133.26±0.03, respectively [36].

Kiruthiga et al., 2014 investigated The enzymatic superoxide dismutase (SOD) antioxidant assay of *in vivo* leaves and *in vitro* callus of *C. pallida* showed high activity of 0.78±0.036 units/g and 3.563±0.16 units/g of tissue, respectively. The DPPH, hydroxyl scavenging activity (HRSA) and superoxide anion radical scavenging activity of *in vivo* leaves extract and *in vitro* callus tissue showed the IC_{50} values of 25±0.16 and 23.57±0.07, 90.18±3.57 and 77.41±2.5, 72.58±1.55 and 42.96±0.29, respectively [37].

Islam et al., 2018 examined the Petroleum ether extract of *C. pallida* stem exhibited remarkable DPPH free radical scavenging activity with IC_{50} value of 126.96µg/ml. Petroleum ether, chloroform and methanol stem extract of *C pallida* were most effective in scavenging free radical[38].

2. Antibacterial activity

Alam et al., 2014 Disk diffusion method was performed to screen for antibacterial activity of different solvent extracts such as ethanol, ethyl acetate, chloroform, petroleum ether and aqueous extracts of *C. pallida*. The ethanol leaves extract exhibited mild antibacterial activity against *Vibrio cholera, Shigella dysenteriae and Shigella flexneri* compared to standard drug kanamycin[35].

Islam et al. (2018 studied The Petroleum ether and chloroform stem extract, which showed mild to moderate antibacterial activity against Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa, except Bacillus cereus, while the methanol extract did not show any inhibitory effect against the tested bacteria [38].

Pelegrinietal et al., 2009 reported A novel peptide *Cp*-AMP with molecular mass 5340Da was isolated from the seeds of *C. pallida*. The *Cp*-AMP inhibits the development of *Fusarium oxysporum* and Proteus sp. a gram-negative bacteria [39].

Govindappa et al., 2011a evaluated Ethanol extract showed the maximum inhibition against bacteria and fungi. The minimum microbial concentration (MMC) of ethanol, petroleum ether and ethyl acetate extracts ranged from 0.3-3.2mg/ml for bacteria and 0.6-4.0mg/ml for fungi respectively [36].

Ukil et al., 2016 said The fatty acid of *C. pallida* leaf showed antibacterial activity against *Bacillus subtilis*, *Acinetobacter junii* and *Escherichia coli* with MIC value of 80 ± 0.58, 10 ± 0.25 and 10 ± 0.14 respectively [40].

3. Anti-inflammatory activity

Bulbul et al., 2017 evaluated anti-inflammatory activity by the carrageenan-induced paw oedema test in rats. At both 50 and 100mg/kg doses the carrageenan induced rat paw oedema was greatly reduced [41].

Hu et al., 2017 said Cropalliflavone C isolated from *C. pallida* seeds showed moderate anti-inflammatory activity with IC_{50} value of 16.07µM. The Cropalliflavone A, Cropalliflavone B, Usaramine-N-oxide, Cropallin A and Cropallin B exhibited weak activity with IC_{50} value ranging from 45.44 to 78.50 µM while luteolin, usaramine and acacetin-8-C-neohesperidoside were ineffective [27].

Weng et al., 2003 reported Thepterocarpanoids, crotafurans A and B isolated from *C. pallida* inhibited the NO_2^- accumulation in lipopolysaccharide (LPS) stimulated RAW 264.7 macrophage-like cells with IC_{50} value of 23.0±1.0 and 19.0±0.2µM, respectively [23].

4. Anthelmintic activity

Panda et al (2015a) used ethanol, ethyl acetate, n-butanol and petroleum ether extract of leaves of *C. pallida* to evaluate anthelmintic activity on Indian earthworms *Pheretimaposthuma*. Among all the extracts, petroleum ether and ethanol exhibited significant and dose-dependent anthelmintic activity. Compared to standard drug albendazole petroleum ether showed better activity [42].

Alam et al., 2014 used The ethanol leaves extract of *C. pallida* showed dose-dependent decrease in paralysis and death time of *Paramphistomumcervic*ompared to reference drug albendazole [35].

5. Cytotoxic and Apoptotic activity

Hu et al., 2017 examined Flavonoids and alkaloids from the seeds of *C. pallida* were used to evaluate cytotoxicity against the MCF-7 and $CaCo_2$ cell lines. Cropalli flavone B showed moderate cytotoxicity against MCF-7 cell line with IC_{50} of 6.77µM while other compounds showed little or no cytotoxicity against MCF-7 and $CaCo_2$ cell lines.[27].

Dinakar and Govindappa, 2017 studied Low molecular weight proteins (LMWPs) with a molecular weight of against *Allium cepa* root tips and MCF-7 cell lines respectively. The 14KDa protein exhibited antimitotic properties and apoptotic activity and can be used to prevent the progression of cancer in susceptible individuals [43].

Umashanakr et al., 2015 evaluted The compound, coumarin isolated from the endophyte of *C. pallida* when tested against HeLa cancer cell lines. Coumarin significantly inhibited the proliferation of HeLa cell lines with an IC_{50} value of 0.156µg/ml [44].

6 Anti-HIV properties

Govindappa et al. (2013 investigated Coumarins isolated from the flowers, stems, roots, and leaves of C. pallida by the microwave extraction method. The flower extract having coumarins greatly inhibited the HIV replicating enzymes such as βglucosidase, α-glucuronidase, α-glucosidase, pepsin, reverse transcriptase and protease. The *C. pallida* coumarins can be a potential drug to control HIV disease [45].

Govindappa et al., 2011b examined HIV protease inhibitor activity was determined by pepsin assay using methanol and ethanol extract of different parts (leaf, stem, and flower) of *C. pallida*. The methanol and ethanol extracts of flower and stem exhibited significant inhibition of pepsin enzyme as compared to standard Pepstatin A [46].

7. Antidiabetic activity

Panda et al., 2015b used The ethanol, n-butanol, ethyl acetate and petroleum ether extracts of *C. pallida* leaves were used to determine the antidiabetic activity in alloxan-induced diabetic rats. The extract at 300mg/kg body weight exhibited greater antidiabetic activity on the first, third, fifth and seventh days. The ethanol extract showed highly significant antidiabetic activity while other extracts displayed mild effect compared to standard drug Glibenclamine. The ethanol leaves extract of *C. pallida* can be a potential antidiabetic drug [47].

8. Analgesic and antipyretic activity

Panda et al., 2015c said Substances that reduce pain sensation are called analgesics. The *C. pallida* is used extensively by tribal people for treatment of various diseases. Analgesic and antipyretic activity were evaluated on albino mice by hot plate and tail immersion methods and Brewer's yeast-induced pyrexia, respectively. The ethanol, n-butanol, ethyl acetate, and petroleum ether extracts of *C. pallida* were used at 100 and 200mg/kg to determine analgesic and antipyretic activity. The ethyl acetate and n-butanol exhibited greater analgesic effect at 200mg/kg than the other two extracts compared to standard pentazocine (10mg/kg). On the other hand, petroleum ether and ethanol leaves extract at 200mg/kg showed significant antipyretic activity compared to standard drug paracetamol (100mg/kg) [48].

9. Anti-proliferative activity

Rumondor et al., 2017 evaluated the the Anti-proliferative activity of C. pallida leaves and seeds extracts by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay on MCF-7 breast cancer cell lines. Four different extracts (ethanol, ethyl acetate, n-hexane and aqueous) were used. The ethyl acetate extract exhibited significant anti-proliferative activity with IC_{50} value of 29.67µg/ml. The ethyl acetate extract of *C. pallida* can be a potential anti-cancer drug [49].

10. Miscellaneous activity

Bulbul et al., 2017 reported Anti-nociceptive activity was evaluated using acetic acid-induced writhing test, formalin-induced paw licking teat and tail immersion methods in mice. Acetic acid-induced test at 50mg/kg and 100mg/kg significantly reduced the pain by 37.50% and 47.70% respectively. The ethanol leaves extract of *C. pallida* greatly inhibited formalin-induced paw licking in mice. The extract at 100mg/kg and produced 40.44% and 27.94% inhibition in the first phase and 50mg/kg body weight produced 48.15%, and 20.37% inhibition in second phase. In the tail immersion test, the ethanol extract caused significant inhibition of pain 64.91% at a dose of 100 mg/kg [41].

Kabir et al., 2015 examined *In vitro* thrombolytic activity of methanol extract of *C. pallida* exhibited clot lysis effect with 41.81±4.12% compared with standard streptokinase 75±0.09% while sterile distilled water showed negligible clot lysis with 4.8±0.12%. [50].

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REFERENCES

1. Kuna L, Jakab J, Smolic R, Raguz-Lucic N, Vcev A, Smolic M. Peptic ulcer disease: a brief review of conventional therapy and herbal treatment options. J Clin Med. 2019;8(2):179. https://doi.org/10.3390/jcm8020179 PMid:30717467 PMCid:PMC6406303

2. Choi W, Choi CH, Kim YR, Kim SJ, Na CS, Lee H. HerDing: herb recommendation system to treat diseases using genes and chemicals. Database. 2016; 2016: baw011. https://doi.org/10.1093/database/baw011 PMid:26980517 PMCid:PMC4792522

3. Lin LT, Hsu WC, Lin CC. Antiviral natural products and herbal medicines. J Tradit Complement Med. 2014;4(1):24-35. https://doi.org/10.4103/2225-4110.124335 PMid:24872930 PMCid:PMC4032839

4. Gupta M, Kapoor B, Gupta R, Singh N. Plants and phytochemicals for treatment of peptic ulcer: an overview. South Afr J Bot. 2021; 138:105-114 https://doi.org/10.1016/j.sajb.2020.11.030

5. Zahid. (2016). Introduction and Importance of Medicinal Plants and Herbs. Retrieved from https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl (n.d.). Retrieved from http://tropical.theferns.info/viewtropical.php?id=Crotalaria ferruginea . (n.d.). Retrieved from http://tropical.theferns.info/viewtropical.php?id=Crotalaria longirostrata

6. Chopra RN, Nayar SL, Chopra IC. Glossary of Indian Medicinal Plants. Publications and Information Directorate, Council of Scientific and Industrial research, New Delhi, 1956.

7. Aguilar NO. Crotalaria pallidaAiton. In: Farida Hanum van der Maesen LJG (eds) Plant Resources of South-East Asia Auxiliary plants., Leiden, The Netherlands; Backhuys Publisher, 2012; 11.

8. Pelegrini PB, Farias LR, Saude ACM, Costa FT, Carlos B Jr., Silva LP, Oliveira AS, Gomes CEM, Sales MP, Franco OL. A novel antimicrobial peptide from Crotalaria pallida seeds with activity against human and phytopathogens. Current Microbiology, 2009; doi: 10.1007/s 00284-009-9451-6.

9. Boldrin PK, Resende FA, Hohne APO, de Camargo MS, Espanha LG, Nogueira CH, Melo, MDSF, Vilegas W, Varanda EA. Estrogenic and mutagenic activities of Crotalaria pallida measured by recombinant yeast assay and Ames test. BMC Complementary and Alternative Medicine, 2013; 13: 216. https://doi.org/10.1186/1472-6882-13-216 PMid:24134316 PMCid:PMC3766270

10. Kiruthiga R, Rakkimuthu R, Aravinthan KM. Antibacterial activity of Crotalaria pallidaAiton. (Fabaceae). Indian J Pharm Biol Res, 2014; 2(1): 82-5. https://doi.org/10.30750/ijpbr.2.1.13

11. Weng JR, Tsao LT, Yen MH, Wang JP, Lin CA. Anti-inflammatory constituents and new pterocarpanoid of Crotalaria pallida. Journal of Natural Products, 2003; 66(3): 404-7. https://doi.org/10.1021/np020135d PMid:12662101

12. Ko H, Weng JR, Tsao LT, Yen MH, Wang JP, Lin CA Anti-inflammatory flavonoids and pterocarpanoid from Crotalaria pallidaand C. assamica. Bioorganic & Medicinal Chemistry Letters, 2004; 13: 1011-14. https://doi.org/10.1016/j.bmcl.2003.11.074 PMid:15013012

13. MM Le Roux; BE Van Wyk; AN Moteetee ; PM Tilney. Afr. J. Bot., 2009, 75, 410. https://doi.org/10.1016/j.sajb.2009.02.075

14. SK Jain; SK Borthakur .Econ Bot, 1980,34(3),264-272. https://doi.org/10.1007/BF02858646

15. Chong KY, Tan HTW and Corlett RT (2009). A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore. pp 273.

16. Rather SA, Subramaniam S, Danda S, et al, Discovery of two new species of crotalaria (Leguminosae, Crotalarieae) from Western Ghats, India, PloS one, 13(2), 2018, e0192226. https://doi.org/10.1371/journal.pone.0192226 PMid:29447200 PMCid:PMC5813922

17. Wal P, Shukla V, Uzzaman Khan MM, et al, Medicinal Properties of Crotalaria burhia: A Review, Current Traditional Medicine, 10(3), 2024, 90-100. https://doi.org/10.2174/2215083810666230428095559

18. Suman paul a comprehensive review on ethnobotany, pharmacology, phytochemistry and biotechnology of crotalaria pallida aiton (fabaceae) : an important medicinal plant. JETIR 2019; 6(1): 45-50

19. Md. Zahidul Islam, Md. Tanvir Hossain,FoysalHossen, Sanjoy Kumar Mukharjee, Nahid Sultana andShujit Chandra Paul. Evaluation of antioxidant an antibacterial activities of Crotalaria pallida stem extract. Clinical Phytoscience (2018) 4:8 https://doi.org/10.1186/s40816-018-0066-y

20. Erladys M. Rumondor, MoelyonoMoektiwardoyo, Melisa I. Barliana. Anti-proliferative Activity of Crotalaria pallida Aitonon MCF-7 Breast Cancer Cells. Pharmacological& clinical pharmacy research volume 2 No .3 december 2017 https://doi.org/10.15416/pcpr.v2i3.16218

21. Crotalaria pallida. Flora of the Lucayan Archipelago-Scientific Names. Leon Levy Native Plant Preserve.

22. CrotalariapallidaAiton"(https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:322608-2) .KewScience, Plants of the World. 2017.

23. Weng JR, Tsao LT, Yen MH, Wang JP, Lin CN. Anti-inflammatory Constituents and New Pterocarpanoid of Crotalaria pallida. J. Nat. Prod. 2003; 66:404-407. https://doi.org/10.1021/np020135d PMid:12662101

24. Ukil S, Biswas I, Laskar S. Variation of n-alkanes and Micro-morphological pattern of the Epicuticular Wax in different plant organs of Crotalaria pallida. World J. of Pharm. Res. 2015; 4(11):1593-1608.

25. Ukil S, Laskar S, Sen SK. Exploration of Fatty Acid from the Seed Oil of Crotalaria pallidaAiton for Its Healthcare and Antibacterial Efficacy. Proc. Natl. Acad. Sci., India, Sect. A Phys. Sci. 2018;pp1-6. https://doi.org/10.1007/s40010-018-0489-3

26. Ko HH, Weng JR, Tsao LT, Yen MH, Wang JP, Lin CN. Anti-inflammatory flavonoids and pterocarpanoid from Crotalaria pallida and C. assamica. Bioorganic and Medical Chemistry Letters 2004; 14:1011-1014 https://doi.org/10.1016/j.bmcl.2003.11.074 PMid:15013012

27. Hu XR, Chou GX, Zhang CG. Flavonoids, alkaloids from the seeds of Crotalaria pallida and their cytotoxicity and anti-inflammatory activities. Phytochemistry 2017; 143:64-71. https://doi.org/10.1016/j.phytochem.2017.07.010 PMid:28777979

28. Diaz GJ, Almeida LX, Gardner DR. Effects of dietary Crotalaria pallida seeds on the health and performance of laying hens and evaluation of residues in eggs. Res. in Veterinary Sci. 2014; pp1-7. https://doi.org/10.1016/j.rvsc.2014.06.011 PMid:25062989

29. Henty E.E. and G.S. Pritchard. 1973. Weeds of New Guinea and their control. Botany bulletin No 7.

30. FaridahHamem and L.J.G Vander Macsen, 1997. Plant resources of south-east Asia, 11 auxiliary plants.

31. TavatchaiRadanachaless, J.F.Maxwell. 1994. Weeds of soybean fields in Thailand. Multiple Cropping Center Publications. Thailand.

32. Tropical Plants Database, Ken Fern. tropical.theferns.info. 2024-12-16.

33. Fadzil, S. R. Yap, A. C, Choo, Y. M. 2017. A New Cyclopentylidene and Other Chemical Constituents from Malaysian Crotalaria pallida (SiklopentilidenaBaru dan Juzuk Kimia Lain daripada Crotalaria pallida Malaysia). SainsMalaysiana. 46(9): 1581-1586 https://doi.org/10.17576/jsm-2017-4609-29

34. FaridahHanum, I. & van der Maesen, L.J.G. (Editors), 1997. Plant Resources of South-East Asia No. 11. Auxiliary Plants. Backhuys Publishers, Leiden, the Netherlands. 389 pp.

35. Alam MH, Murshid GMM, Bokshi B, Suma SA, Sathi SI, Rahman A. Assessment of Anntioxidant, Antibacterial and Anthelmintic Activities of Ethanol extract of leaves of Crotalaria pallida (Aiton). Int. J. of Pharmacognosy 2014; 1(7):438-444.

36. Govindappa M, Bharath N, Shruthi HB, Sadananda TS, Sharanappa P (a). Antimicrobial, antioxidant and in vitro anti-inflammatory activity and phytochemical screening of Crotalaria pallida Aiton. African J. of Pharmacy and Pharmacology 2011; 5(21):2359-237 https://doi.org/10.5897/AJPP11.038

37. Kiruthiga R, Rakkimuthu R, Aravinthan KM. Comparative antioxidant studies of in vivo leaves and in vitro callus of Crotalaria pallida Aiton (Fabaceae). Res. In Pharmacy 2014; 4(2):01-15. https://doi.org/10.30750/ijpbr.2.1.13

38. Islam MZ, Hossain MT, Hossen F, Mukharjee SK, Sultana N, Paul SC. Evaluation of antioxidant and antibacterial activities of Crotalaria pallid stem extract. Clinical Phytoscience 2018; 4:8. https://doi.org/10.1186/s40816-018-0066-y

39. Pelegrini PB, Farias LR, Saude ACM, Costa FT, Bloch Jr C, Silva LP, Oliveria AS, Gomes CEM, Sales MP, Franco OL. A Novel Antimicrobial Peptide from Crotalaria pallida Seeds with Activity against Human and Phytopathogens. Curr. Microbiol. 2009. https://doi.org/10.1007/s00284-009-9451-6 PMid:19641962

40. Ukil S, Laskar S, Roy RN. Physicochemical characterization and antibacterial activity of the leaf oil of Crotalaria pallida Aiton. Journal of Taibah University for Science 2016; 10:490-496 https://doi.org/10.1016/j.jtusci.2015.07.001

41. Bulbul IJ, Fashiuddin SB, Haque MR, Sultan MZ, Rashid MA. Anti-nociceptive and Antiinflammatory Activities of Crotalaria pallida

Aiton (Fam: Fabaceae) Leaves. Bangladesh Pharmaceutical Journal 2017; 20(2):165-171. https://doi.org/10.3329/bpj.v20i2.37870

42. Panda SK, Das D, Tripthathy NK (a). Phytochemical Investigation and Anthelmintic activity of various leaf extracts of Crotalaria pallida Aiton. World Journal of Pharmacy and Pharmaceutical Science 2015; 4(2):336-342.

43. Dinakar MS, Govindappa M. In vitro Assay of Antimitotic and Apoptosis Effect of Low Molecular Weight Proteins. Int. J. of Inovative Res. in Sci, Engineering and Technology 2017; 6(6):10898-10905. DOI:10.15680/IJIRSET.2017.0606139

44. Umashanakr T, Govindappa M, yarappa LR, Padmalatha RS, Channabasava. Isolation and Characterization of Coumarin Isolated from Endophyte, Alternaria Species -1 of Crotalaria pallida and Its Apoptotic Action on HeLa Cancer Cell Line. Metabolomics 2015; 5:158. doi:10.4172/2153-0769.1000158 https://doi.org/10.4172/2153-0769.1000158

45. Govindappa M, Umashankar T, Ramachandra YL, Chen CCJ. In vitro anti-HIV properties of coumarins from Crotalaria pallida Aiton. Biochemistry an Indian Journal 2013; 7(3):114-121.

46. Govindappa M, Kumar ANV, Santoyo G (b). Crotalaria pallida extracts as a putative HIV-protease inhibitors. Journal of research in Biology 2011; 4:285-291.

47. Panda SK, Das D, Tripathy NJ (b). Screening of antidiabetic activity of leaf extracts of Crotalaria Pallida in alloxan induced diabetic rats. Der Pharmacia Sinica 2015; 6(2):41-44.

48. Panda SK, Das D, Tripathy NJ (c). Evaluation of the analgesic and antipyretic activity of various leaf extracts of Crotalaria pallida Aiton. Der Pharmacia Letters 2015; 7(1):35-39.

49. Rumondor EM, Moektiwardoyo M, Barliana ML. Anti-proliferative Activity of Crotalaria pallida Aiton on MCF-7 Breast Cancer Cells. Pharmacology and Clinical Pharmacy Research 2017; 2:63-65. https://doi.org/10.15416/pcpr.v2i3.16218

50. Kabir MSH, Murad MAH, Hasan A, Abdul M. Evaluation of total Flavols, total Proanthocyanidins content and Thrombolytic activity of Methanol extracts of three Bangladeshi plants. Int. J of pharmacy 2015; 5(3):747-751.

51. CROTALARIA PALLIDA Aiton, var. OBOVATA (G. Don) Polhill, Kew Bull. 22: 265. 1968.