Phytochemicals, Pharmacological aspects of Medicinal herbs: *Leptadenia reticulata* (Retz.) Wight & Arn. and *Psoralea corylifolia* L.

Sadhana Rai[1], J. Anuradha[*1], R. Sanjeevi[2] and Madhvi Sharma[1]

[1]Department of Botany, NIMS Institute of Allied Medical Science and Technology, NIMS University, Rajasthan, Jaipur – 303121 (India)

[2]Department of Environmental Science, NIMS Institute of Allied Medical Scienceand Technology, NIMS University,
Rajasthan, Jaipur – 303121 (India)

Abstract

The traditional medicinal plants like *Leptadenia reticulata* (Retz.) Wight &Arn. (Apocynaceae) and *Psoralea corylifolia L.* (Leguminosae) is well known for its treatment against several health defects since ancient times. It is extensively used as a crucial component of Ayurvedic and Chinese medicine therapeutics. Most frequently, formulations of these medicinal plants were used to treat a wide range of illnesses, including cancer, diarrhoea, hematopoiesis, night blindness, cough, dyspnea and fever. The therapeutic prospects of *Leptadenia reticulata* is characterized due to the bioactive compounds like α-amyrin, β-amyrin, β-sitosterol, luteolin, diosmetin, ferulic acid, rutin,stigmasterol, hentricontanol, a triterpene alcohol simiarenol, deniculatin, apigenin, leptaculatin and reticulin.*Psoralea corylifolia* seeds and fruits contain about hundred bioactive chemicals. The present study includes the *state-of-the-art* knowledge on the recent research of the pharmacological and phytochemical activity of *P. corylifolia* and *L. reticulata*. This article includes the details in formulations of products containing *L. reticulata* and*P. corylifolia*. The study states that, there is a need for the isolation and identification of endophytic fungal association and their pharmacological, bioactive compounds analysis with these medicinal plants. Due to the overexploitation, extensive harvesting, and habitat loss, these plant species are under threat. Therefore, future research is required on the exploration of bioactive compounds activities and conservational aspects of these medicinal plants and endophytic fungal isolates.

Keywords: *Leptadenia reticulata, Psoralea corylifolia,*medicinal herb,pharmacological activity,bioactive compounds.

1. Introduction

Since the dawn of time, people have used plants for therapeutic purposes. This knowledge has been central to the development of many traditional medical practises, including Ayurveda, Homoeopathy, Siddha, Unani, Naturopathy, Chinese, Tibetan, and Native American medicine (Atanasov *et al*., 2015; Ekor 2014., Swamy *et al*., 2016). The World Health Organisation estimates that 80% of the world's population already uses herbal medicines for basic medical requirements (Atanasov *et al*., 2015). Since ancient times, phytochemicals found in therapeutic plants have been used in phytomedicines. The prevention and treatment of many diseases, as well as the majority of current preventative methods, depend heavily on medicinal plants.The use of medicinal plants is significant all throughout the world, both on their own and in addition to conventional medicine (Marmitt&Shahrajabian., 2021; Shahrajabian*et al*., 2019; Shahrajabian*et al*., 2022). Plants have long been used by humans as a source of nutrition, flavouring, and therapeutics (Marmitt et al., 2021; Sun et al., 2021). Bioactive chemicals are abundant in a number of medicinal plant components, including seeds, leaves, flowers, fruits, stems, and roots (Barragan *et al*., 2022).

The potential effectiveness and safety of several plant-based medications have already been established (Sofowora*et al*., 2013). Synthetic medications are widely utilised nowadays, but if they are taken excessively, they can have dangerous negative effects on the body that can occasionally be worse than the sickness itself. In order to create natural medicines that are both safe and effective, pharmaceutical corporations

are investing a lot of time and money in plants with potential medical characteristics (Gupta *et al*., 2017).

Psoralea corylifolia L. (Leguminosae), a species of significant plant, is one of these species. P. corylifolia is an annual herb that stands upright. This plant may grow anywhere between 30 and 180 cm tall, prefers a warm environment, and doesn't perform well in shadow.It has a warm character, tastes bitter and pungent, and affects the kidney and spleen meridians. According to the Chinese Pharmacopoeia Commission (2020), it supports the kidney and strengthens yang, promotes inspiration and calms asthma, warms the spleen and prevents diarrhoea, secures essence and lessens urine, and may be administered topically to remove wind and freckles. This plant needs soil types that are clay, sand, and loam. The plant can endure in environments that are basic, acidic, and neutral. The optimal time to grow this plant is from March to April. In November, seeds reach maturity. If given the right care, the plant might live for up to seven years (Vijnan1986). *Psoralea* produces perennial fruit. Fruit cannot endure frigid temperatures. *Psoralea* produces perennial fruit. Fruit cannot endure frigid temperatures. Although the fruit is generally odourless, chewing it releases a pungent flavour. The fruit has a harsh, bitter, and caustic flavour. The blooms are tiny and have a crimson clover-like form (Krishnamurthi 1969). Racemes make up the leaf arrangement. Simple leaves have wide, dented borders and are elliptic in shape. The flowers are purple with blue undertones when they bloom during rain. *Psoralea* only has one seed. The seed has an elongated form and a smooth exterior. The seed is compact, hairless, and densely pitted.

The biological activity of the roots, leaves, and sensitive stalks of *Leptadenia reticulata (Robert Wight and George Arnott Walker Arnott)* is well-known. It's a member of the Asclepiadaceae family. The *L. reticulata* plant exhibits a variety of biological functions, including lactogenic activity, antifungal activity, antibacterial activity,anti-implantation activity, anticancer activity,antioxidant activity, anti-asthmatic activity, hepatoprotective activity, antidiabetic activity, anti-inflammatory activity, and modulating effect against Dalton's ascitic lymphoma (Dhalani and Nariya 2017). The therapeutic potential of this L. reticulata plant is due to the presence of varied bioactive compounds such as a triterpene alcohol simiarenol, apigenin, ferulic acid, β-sitosterol, hentricontanol, rutin, α-amyrin, β-amyrin, deniculatin, luteolin, diosmetin, stigmasterol, reticulin, and leptaculatin (Mohanty 2017). A well-known tonic and life-giving substance with renewing, restorative, antiabortificant, and lactogenic characteristics is *Leptadenia reticulataWight and Arn.* (Asclepiadaceae). Because it acts as a stimulant and is said to prevent miscarriage, it is a perennial woody climber known in Ayurveda as "Jeevanti," which means "life-giver" (Shekhawat 2006; Godara*et al*., 2015). Since 4500 BC, jeevanti has been employed in Ayurveda as a source of overall bodily vigour. This plant, in accordance with Atharva-Veda, fosters vigour and life. When there is moderate rainfall and relative humidity, *L. reticulata* may thrive in tropical and subtropical climates. Additionally, according to Mohanty *et al*. (2017), this plant may be found in dry areas with sandy soil, little organic matter, and scant rainfall.

2. Pharmacalogical and biochemical activites of *Leptadenia reticulata*

Leptadenia reticulata (Retz.) Wight. &Arn. (Family *Asclepiadaceae*), also known as Jivanti, Swarnjivanti, or Dodi, is a member of the genus *Leptadenia*. In ethanobotanical investigations, *Leptadeniareticulata* is discovered to be a significant plant. According to ayurveda, it is a tonic that offers the body overall vigour and has been utilised historically for a number of purposes. Since 4500 BC, it has been regarded as a significant medication in Ayurveda. This plant is referred to be a source of life and vigour in the Atharva Veda (Shekhawat *et al*., 2006).The leaves and roots of the plants *Leptadeniareticulata* are used in the treatment of asthma (Singh 2023).

2.1 Antimicrobial Activity

The antibacterial efficacy of several solvent extracts of *L. reticulata* leaves against five Gram-positive, seven Gram-negative, and three fungal strains was investigated by (Vaghasiya and Chanda 2007). They noticed that none of the tested Gram-positive bacterial strains were susceptible to

acetone extract. However, it successfully suppressed two strains of *Klebsiella pneumoniae, Proteus mirabilis*, and *Citrobacterfreundii*, all of which are Gram-negative. While *Klebsiella pneumoniae* and *Proteusmirabilis* were Gram-negative strains, *Staphylococcus* aureus and *S. epidermidis* and the methanol extract were efficient against both types of bacteria. Similarly, *Staphylococcus aureus, Escherichia coli, A. niger, Pseudomonas aeruginosa, Klebsiella pneumoniae, Aspergillus flavus,* and *Bacillus subtilis* were all significantly inhibited by ethanol extracts of *L. reticulata* leaves (Natarajan *et al*., 2014). Another research found that several solvent extracts of *L. reticulata's* aerial portions have antibacterial properties. Chloroform and alcoholic extracts greatly reduced the growth of *P. aeruginosa* and *E. coli* whereas petroleum ether was efficient against *K. pneumoniae*. (Dipankar and Murugan 2012) investigated the possible antibacterial activities of bio-synthesized silver nanoparticles (AgNPs) in methanolic leaf of *L. reticulata.* This research shown that the pathogenic bacteria *E. coli, S. pneumoniae, M. luteus,K. pneumoniae,* and *B. subtilis* could all be efficiently inhibited by AgNPs. In a similar vein (Mishra *et al*., 2010), shown the potential advantages of *L. reticulata'saerial* parts as a broad-spectrum anti-fungal agent. *A. ruantii, Trichoderma viride, A. flavus, Candida tropicalis, T. koningii,* and *Candida albicans* were evaluated against various solvent extracts. The various extracts' minimum inhibitory concentrations (MIC) for the tested bacteria were found to range between 150 and 300 g mL1. In comparison to other solvent extracts, the methanol extracts were successful on suppressing all of the tested fungal straining. *L. reticulata* leaf extracts in acetone and methanol both shown antifungal efficacy in contradiction of *C. tropicalis* or *C. tropicalalis*, respectively. For its anti-fungal action in contradiction of *A. flavus* in a rat animal model, the impact of an ethanolic extracts (50%) of *L. reticulata's* aerial component was investigated in vivo (Kumar 2008). The wound that had been infected with A. flavus was shown to be healing visibly and to be free of the fungal hyphae. The investigation revealed that *L. reticulata's* ethanolic extract had antifungal efficacy against *A. flavus.*

2.2 AntipyreticActivity

In order to assess the anti-inflammatory efficacy of entire plant flush excerpts of *L. reticulata.* In order to identify pro-inflammatory cytokines (TNF, IL-2, and IL-6,) in the blood of adult albino rats, (Mohanty *et al*., 2015) used a carrageenan-induced and formalin-paw edoema class.At a dosage of 600 mg kg1, the ethyl acetate extracts lowered edoema by 61.59%, whilst the ethyl-acetate fraction was sufficient to overpower edoema by 58.24%. The latent anti-inflammatory action of "*L. reticulata"* was shown by a substantial decrease in the levels of TNF, IL6, and IL2 in the blood of mice treated with "ethyl-acetate" extract (600 mg kg1). The aqueous entire plant extracts of "*L. reticulata"* was tested for its anti-inflammatory and anti-pyretic properties using animal models (Bherji*et al*., 2016). A substantial antipyretic and anti-inflammatory effect were shown in all physical models. These results pointed to a potential application of *L. reticulata* aqueous extract in the future for the effective therapy of inflammation and pyrexia.

2.3 Antibacterial activity

According to Kalidass *et al*., petroleum, alcohol, and chloroform extracts have the potential to be antibacterial against ten distinct types of microbes. Among all studied microorganisms, the reference antibiotic chloramphenicol had the greatest antibacterial action. The petroleum ether extract was most toxic to E. coli and Staphylococcus, whereas the chloroform extract was toxic to E. coli, Proteus bulgaris, Bacillus cereus, and Klebsiella pneumonae. The antibacterial action that alcohol extracts against *Pseudomonas aeruginosa, B. cereus, S. epidermidus,* and *P. vulgaris* is obviously crucial (Kalidas *et al*., 2009).

2.4 Anticancer activity

The DAL technique was used to conduct an assay to measure anticancer activity. The mice were separated into three groups, G1 (Control), G2 (L. reticulata leaf ethanol extract treatment-LELR), and G3 (Fluorouracil treated group) in accordance with the methodology (Sathiyanarayanan*et al*., 2007; Babu *et al*., 2002).

2.5 Antifungal Activity

In a rat animal model, the ethanolic extract of L. reticulata has in vivo antifungal efficacy against *Aspergillus flavus*. According to Sureshkumar

(2008), *Aspergillus flavus, Aspergillus ruantii, Candida tropicalis, Candida albicans, Trichodermataviride, Trichoderma takoningii,* and *Fusarium solani* have all been found to be susceptible to the aerial parts of *L. reticulata.*

2.6 Antioxidant activity

Adriamycin-induced cardiac degenerative alterations and cellular infiltrations were reduced by pre-treating with *Leptadenia reticulata* methanolic extract (LRM) in a dose-dependent manner. According to the findings, Adriamycin ADR administration significantly decreased cardiac function, whereas LRM avoided this toxicity, possibly as a result of its antioxidant effect (Wakade*et al*., 2007).

3. Pharmacalogical and biochemical activites of *Psoralea corylifolia*

P.corylifolia (Bakuchi) Medicinal plants are rich in natural sources of various alkaloids and chemical elements, including those from the "*Leguminosae"* family (Siva *et al*., 2014).There are 130 different species in all, the bulk of which are located in Australia, North and South America, and South Africa. Only a tiny portion of these species are native to temperate Europe and Asia. The word P is derived from the Greek word "*Psoraleos"*, which means "afflicted with the itch or with leprosy." It is also referred to as "Kushtanashini" (leprosy destroyer) because of its effectiveness in curing leprosy. It is also known as Babchi (Bakuchi) (Belge and Jeurkar, 2023),and it is a huge, widely dispersed genus of shrubs and plants with glandular compound leaves and spicate or breadroot-see racemose purple or white flowers (Bachmeier *et al*., 2019). The most outstanding aspect is that every part of the plant has a material that may heal a types of skin issues, skin rashes, such as infections, leukoderma, and etc. The biological activities of *P. Corylifolia* are found in a variety of plant components, including the stems, flowers, seeds, and fruits. They are the pharmacological characteristics' active components. Anti-cancer, anti-coagulant impact, anti-depressant, anti-obesity, anti-oxidant, anti-diabetic activity, anti-protozoal, antiviral, antibacterial, skin problems, antifungal, and anticancer activity are examples of biological functions.

3.1 Antimicrobial activity

The antimicrobial activity of *P. corylifolia L*. leaf extract against bacterial strains like "*Pseudomonas aeruginosa", "Escherichia coli", "Bacillus subtilis",and "Staphylococcus aureus",* as well as fungal strains like "*Aspergillus niger"* and "*Penicillium chrysogenum"* was investigated using chloroform, acetone, ethanol, and water. The anti-bacterial activity was assessed using the disc dispersion system. The four extracts examined were shown to be most efficient against "*Aspergillus niger", "Staphylococcus aureus", "Escherichia coli"*, and "*Bacillus subtilis"* in chloroform, acetone, and ethanol extracts (Pandey and Agrawal2019;Belge and Jeurkar 2023).

3.2 Anticancer Activity

P. species has exclusive pharmacological compounds with anticancer actions, making it the ideal candidate for an anti-cancer drug (Koul *et al*., 2019). Recent studies on breast cancer, mucoepidermoid carcinoma, and bladder cancer have shown that psoralen has anti-cancer properties (Wang *et al*., 2018). These leaves contain very high levels of the anti-cancer compound genistein, more than two grammes per kilogramme of dry weight (Chen *et al*., 2023). The pharmacological properties of psoralen and isopsoralen were selected because to their cytotoxicity against on cancer cell lines. KBv200vincristine resistance subline, K562/ADMdoxorubicin resistance subline, and K562 human erythroleukemia cell. Cancer is remains the maximum prevalent cause of cancer-related fatalities in Western civilization, despite having a median survival period of just 8 months for those with stage IV non-small cell carcinoma. Genistein, an anti-cancer compound, is present in P. corylifolia leaves in considerable concentrations (more than 2 g per Kg dry weight). The bioactivity of two furocoumarins, psoralen and isopsoralen, was examined for cytotoxicity on the human erythroleukemia cell lines K562 and K562/ADM, KB, KBv200, and KB and KBv200 carcinoma cell lines. Both compounds caused these cells to undergo apoptosis, demonstrating that they have anti-cancer effects. According to Wang *et al*. (2011), the IC50 values for psoralen were 88.1,

86.6, 24.4, and 62.6 g/ml, whereas those for isopsoralen were 61.9, 49.4, 49.6, and 72.0 g/ml.

3.3 Anti-oxidant activity

Some techniques have been used to test the "anti-oxidant" qualities of seeds and leaf extracts from the plants "*P. glandulosa", "P. corylifolia", "P. plicata", "P. glandulosa", "P. esculenta",* and *"P. bituminosa",* The phenolic compounds obtained from different extracts have been shown to keep cellular membranes against oxidative pressures. In research on "*P.corylifolia"*, a number of bioactive compounds, including psoralen-92, corylifolin 185, isopsoralen-2, bakuchiol-155, and psoralidin-228, were assessed for their "anti-oxidant" properties.Several Ayurvedic experts claim that bakuchi is a powerful rasayana medication. It has a great deal of revitalising qualities. A vast variety of antioxidant chemicals found in plants are also responsible for their anti-oxidant action. The anti-oxidant potential of several bioactive compounds, including bakuchiol, psoralen, isopsoralen, corylin, corylifolin, and psoralidin, has been studied. When compared to the conventional chemicals butylated hydroxytoluene and tocopherol, psoralidin showed the most anti-oxidant efficacy.

3.4 Anti-bacterial activity

The phytoconstituents that were isolated from the seeds, psoralen, angelicin, bakuchicin, and psoralidin, were shown to exhibit antibacterial action against both gram-positive and gram-negative bacteria. Of them, psoralen and angelicin mixes demonstrated the most effective anti-gram-positive bacterial effects. Compared to *Staphylococcus aureus, psoralidin* has shown better activity against gram-negative bacteria. *S. flexneri and S. sonnei* (Pandey and Agrawal 2019). The extract from the seeds includes bakuchiol, exhibiting its strong antibacterial activity by inhibiting Actinomyces viscosus and Staphylococcus mutans. 9.76-19.5 g/mL was found to be its MIC value (Koul *et al*., 2019).Both bakuchitaila and bakuchisikthataila show stronger inhibitory efficacy against S. aureus, whereas bakuchitaila inhibits Klebsiella pneumonia more potently. At extremely low concentrations, the bakuchi mouth rinse solution inhibits the development of S. mutans bacterium. The mouth washing effects of the ethanol extract of bakuchi were accompanied by a suppression of human gingival fibroblast (Singh *et al*., 2014).Two isolated compounds from P. corylifolia, corylifolinin and neobavaisoflavone, shown strong antibacterial action against methicillin-resistant Staphylococcus aureus, Staphylococcus aureus, and Staphylococcus aureus that was lactamase positive (Wang *et al*., 2013). While psoralen and angelicin inhibited Gram-negative bacteria Staphylococcus aureus in a different study, psoralidin and bakuchicin were demonstrated to exhibit antibacterial effect against Shigella sonnei and Shigella flexneri. Psoralidin demonstrated the greatest antibacterial effect in the disc diffusion testing against S. sonnei and S. flexneri (khatune*et al*., 2004).

3.5 Anti-inflammatory activity

In rat and human normal lung fibroblasts, psoralidin produced from the seeds inhibited ionising radiation (IR)-induced production of pro-inflammatory cytokines and ICAM-1. Additionally, it blocked the COX-2 and 5-lipoxygenase (5-LOX) pathways. Researchers have studied the anti-inflammatory characteristics of bavachinin to identify its potential use as a medication for treating inflammatory illnesses. In research, 12 phytoconstituents were found in the fruits of *P. corylifolia*, including psoralen, isopsoralen, psoralidin, bakuchiol, 12,13 dihydro- 12,13-epoxybakuchiol, p-hydroxybenzaldehyde, bavachalcone, and a mixture of b-sitosterol and stigmasterol (Pandey and Agrawal, 2019).According to Chunekar*et al*. (2013), bakuchi is used in Ayurveda to treat sotha (inflammation). By deactivating nuclear transcription factor-B, bakuchiol reduced the expression of the inducible nitric oxide synthase (NOS) gene in RAW 264.7 macrophages, which are generated from the Abelson leukaemia virus (Pae *et al*., 2001). It has been demonstrated that the extract of leaves, fruits, and seeds has anti-inflammatory and tumour necrosis factor-alpha (TNF-alpha) activity suppression capabilities.

3.6 Antifungal activity

By (Srinivasan and Sarada2012), Agar well diffusion experiment was used to assess the antifungal activity of *Psoralea corylifolia L.* seed extract against three different strains of Fusarium, namely *Fusarium oxysporum, Fusarium moniliforme*, and *Fusarium graminearum*. Traditional Chinese

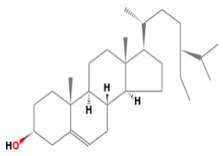
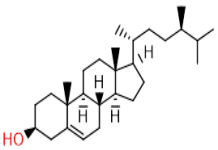
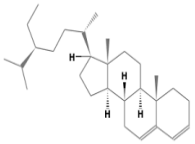
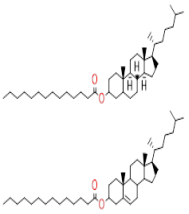
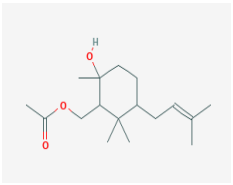
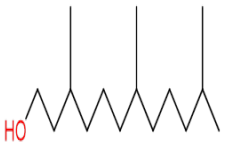
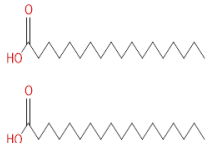
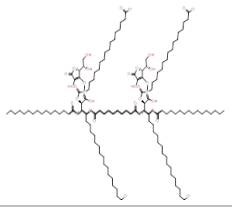
medicine "Buguzhi," also known as *Psoralea corylifolia L.* (Fabaceae) seed, is frequently used to treat a variety of human disorders and has beneficial antioxidative, antimicrobial, anti-inflammatory, anti-tumor, anti-mutagenic, and insect hormonal activities (Katsura *et al*., 2001).According to a study by McCormick *et al*. (2011), Tri101 acetylation was the main defence mechanism Fusarium sp. has against 3-hydroxylated trichothecenes. As a result, losing Tri101 would be fatal to the organism.P. corylifolia L. seed yielded an antifungal component that was isolated as a white, somewhat yellow-coloured substance. The presence of a brand-new phenyl derivative of pyranocoumarin was established by spectroscopic tests. C27H28O4 was found to be the molecular formula by GC-MS, m/z 414[M-2H] +. Pyranocoumarin was present, as shown by the fragmentation pattern (Bhat *et al*., 2005). With a 1 mg/mL minimum inhibitory concentration against the chosen pathogens, Fusarium graminearum, Fusarium oxysporum, Fusarium moniliforme, and, a novel antifungal chemical called PDP has been discovered (Srinivasan and Sarada 2012).

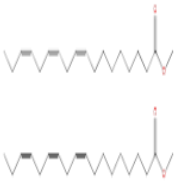
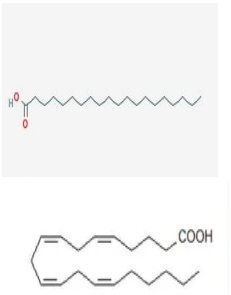
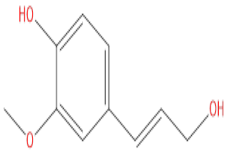
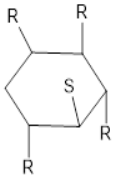
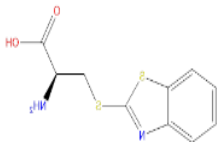
4. Bioactive compounds

Due to their significance in preventing a number of chronic illnesses, bioactive substances including polyphenols, vitamins, and fatty acids have garnered a lot of interest (Kamiloglu et al., 2021). Experts from all over the world have been interested in plant-derived medicinal drugs for a long time because of their positive benefits on human health and lack of negative side effects (Tukur et al., 2020). Plants have been used in medicine since the time of the Greek physician Dioscorides, whose De Materia Medica, which included 600 medicinal plants and served as the primary source on pharmacology until the Renaissance, was published in 28 A.D (Tukur et al., 2022). *Leptadenia reticulata* (Retz.) *Wight &Arn.* (Apocynaceae) is a conservative medicinal plant which is used to treat a number of diseases, including diarrhoea, cancer, night blindness, hematopoiesis, TB, cough, dyspnea, fever, and burning feeling. It is renowned in Ayurveda for its lactogenic and revitalising qualities. This plant is one of the primary ingredients in several commercial herbal remedies, including, Chyawanprash, Envirocare, Antisept, speman and Calshakti. The presence of several bioactive substances in this plant, including ferulic acid, apigenin,amyrin, stigmasterol, sitosterol, diosmetin, rutin, hentricontanol, leptaculatin, luteolin reticulin, deniculatin, and atriterpene alcohol called simiarenol contributes to its medicinal potential (Mohanty *et al*., 2017).To put the traditional applications of *L. reticulata* on solid scientific groundwork, many biological investigations on the plant have been limited to crude extracts, and many physiologically active chemicals have yet to be discovered (Anjariaand Gupta 1967; Krishna *et al*., 1975; Subramanian & Lakshman., 1977; Sastry *et al*., 1985). Different plant sections have different phytochemical compositions and bioactive component contents. The World Health Organisation (WHO) states that the use of medicinal plants extends beyond just enhancing flora and that they are also valued for their therapeutic properties (Gupta*et al*., 2019). Additional elements that affect the accumulation pattern of biochemical components in plants include geographical topographies, climate conditions, growth patterns, and harvesting length (Arumugam *et al*., 2016; Kumara *et al*., 2011; Sathyanarayana *et al*., 2008; Swamy *et al*., 2015).Some identified compounds from different parts of *L. reticulata*are shown in table 1.List of products containing *L. reticulata* as one of the major ingredients and their potential health benefits are shown in table 3.

The plant *psoralea corylifolia* is a source of a number of bioactive substances, including chalcones, terpenoids, furanocoumarins, coumarins, and flavonoids. Psoralen, isopsoralen (angelicin), bakuchiol, corylifol, psoralidin, bavachinin, corylifolinin, caryophyllene, -farnesene, -pinene, camphene, and germacrene D are a few of the medicinally significant chemicals isolated from Psoralea species (Li *et al*., 2016). *Psoralea* species have been used in folklore and indigenous system of medicine for a long time. Some bioactive compounds isolated from *P. corylifolia*with activity are shown in table 2.

TABLE 1- Some identified compounds from different parts of *L. reticulata* (Godara*et al*., 2019)

S. No.	Compound Name	Chemical Structure	Class of Compound	Plant part/ callus	Biological activity/ use
1	γ-sitosterol		Steroid	Leaf, Root, Stem	Anticancerous, hepatoprotective, antihyperglycemic activity, antidiabetic drug
2	Campesterol		Steroid	Leaf, Root, Stem	Anticancer, antioxidant, hypocholesterolemic
3	Stigmastan-3,5-diene		Steroid	Stem	No activity reported
4	Cholesterol Myristate, Cholest-5-en-3-ol (3beta)-tetradecanoate		Steroid	Stem	Brain and bone diseases (osteoporosis) therapies, stem-cell & bone-marrow transplantation, chemotherapy.
5	2R-Acetoxymethyl-1,3,3-trimethyl-4t-(3-methyl-2-buten-1-yl)-1t- cyclohexanol		Terpenoid	Leaf, Root	Anticancer, antiinflammatory
6	Pristane, 2,6,10,14-tetramethyl-Pentadecane		Terpene	Stem	Antiinflamatory, anti-leishmanial activity, used in human uveitis, diffuse pulmonary hemorrhage (DPH)
7	Hexahydrofarnesol		Terpenoid	Leaf, Root, Stem, Callus	Squalene synthatase inhibitor, anti-hyperlipidemic, anti-atherosclerotic
8	Stearic acid, Octadecanoic acid		Fatty acid, Vitamin C	Leaf, Root, Stem	Antibacterial and antifungal
9	Ascorbic acid dipalmitate, Ascorbic acid 2,6-dihexadecanoate		Fatty acid compound	Leaf, Root, Stem, Callus	Antioxidant, cardio protective, cancer preventive, anti-infertility agent

S. No.	Compound Name	Chemical Structure	Class of Compound	Plant part/ callus	Biological activity/ use
10	Linolenic acid methyl ester, (Z, Z, Z)9,12,15-Octadecatrienoic acid methyl ester		Fatty acid ester	Callus	Antibacterial, anticandidal, antiinflammatory, hypocholesterolemic, cancer preventive, hepatoprotective, nematicide, insectifuge antihistaminic, antiarthritic, anticoronary, antieczemic, antiacne, 5-Alpha reductase inhibitor and antiandrogenic activities.
11	Arachidic acid, Eicosanoid acid		Fatty acid	Leaf, Root	Improves lipid transport and lipid metabolism, anti-mutagenic properties
12	Coniferyl alcohol		Alcohol	Leaf	Antioxidant, antiprostaglandin, antiaggregant, fungicide, antiradicular and pesticidalactivity
13	Quercitol, 1-deoxy-Inositol		Alcohol	Root	Drought stress tolerance as osmolyte in plants, can be used in production of antidiabeticdrugs
14	n-Tetracosanol-1		Alcohol	Root	Antimutagenic, antibacterial activity, lowers cholesterol, enhancing immune functions,platelet aggregation and endothelial cell damage.
15	S-(2-Benzothiazolyl) cysteine		Cysteine compound	Leaf	No activity reported

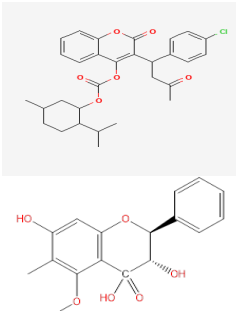
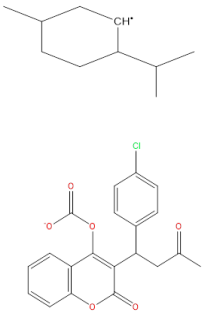
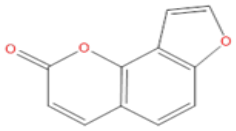
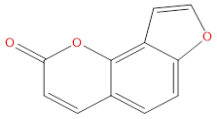
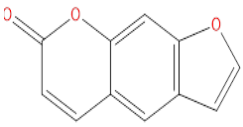
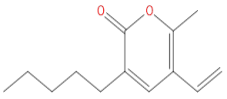
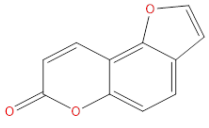
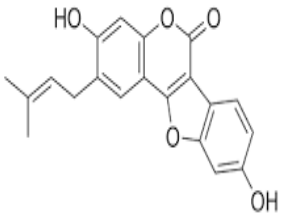
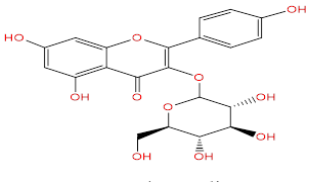
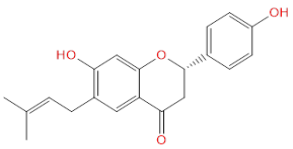
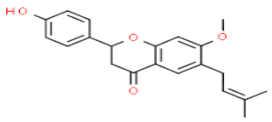
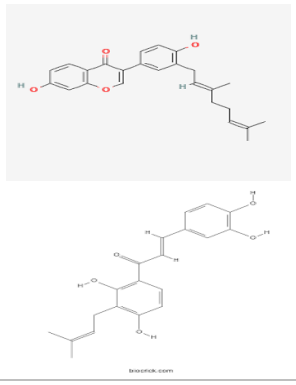
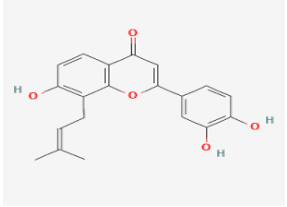
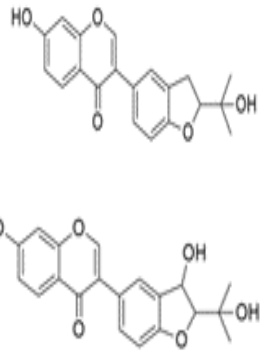
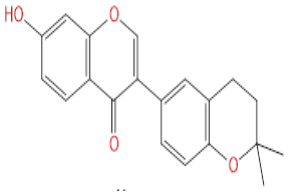
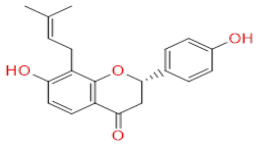
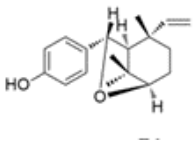
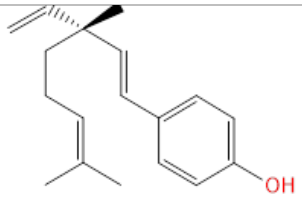
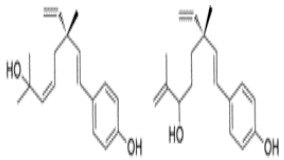
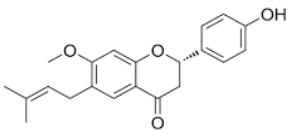
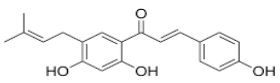
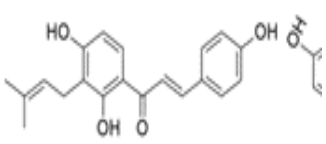
S. No.	Compound Name	Chemical Structure	Class of Compound	Plant part/ callus	Biological activity/ use
16	(2S,3S)-3,7,4'-Trihydroxy-5-methoxy-6-methylflavanone		Flavanoidal compound	Stem	No activity reported
17	2-Isopropyl-5-methylcyclohexyl, 3-(1-(4-chlorophenyl)-3-oxobutyl)-coumarin-4-yl carbonate		Coumarin compound	Leaf, Root, Stem	No activity reported

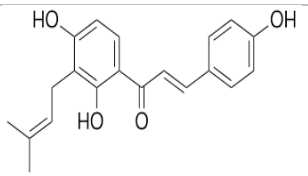
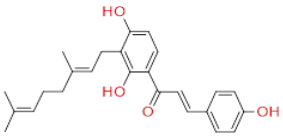
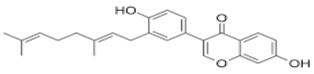
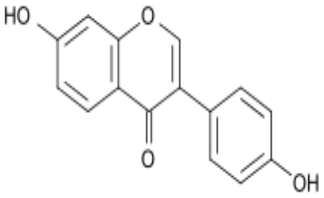
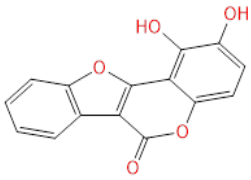
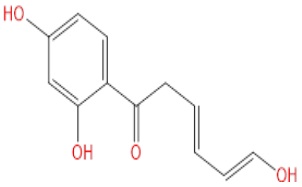
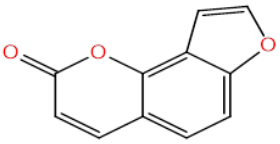
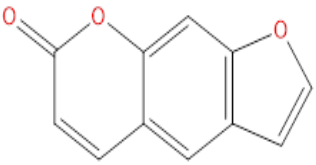
TABLE 2 - The bioactive compounds isolated from *P. corylifolia* with activity.

Bioactive compound	Chemical form	Chemical Structure	Plant part used	Potential activity	Reference
Furanocoumarin	Angelicin		Seed	Antibacterial	Khatune *et al*., 2004
	Isopsoralen		Whole plant	Antiprotozoal	Song *et al*., 2015
	Psoralen		Whole plant	Leukoderma, psoriasis	Kim *et al*., 2013
				Anticancer	Hao *et al*., 2014
				Antioxidant	chen *et al*., 2011
Caumarin	Aryl coumarin		Seeds	Anticancer	Limper *et al*., 2013
	Bakuchicin		Seeds	Topoisomerase inhibitor	Sun *et al*., 2003
	Psoralidin		Whole plant	Estrogen receptor modulator	Lim *et al*., 2011; Liu *et al*., 2014
				antibacterial	Khatune *et al*., 2004

Bioactive compound	Chemical form	Chemical Structure	Plant part used	Potential activity	Reference
				Anti-diabetic	Behloul & Wu, 2013
				Anticancer	Limper *et al*., 2013; Hao *et al*., 2014
				anti-depressant	Farahani *et al*., 2015; Lim *et al*., 2011
				antiprotozoal	Song *et al*., 2015, Yang *et al*., 1996
Flavonoid	Astragalin		Seeds	Antioxidant	Zhang *et al*., 2016
	Bavachin		Seeds/ Fruit	Osteoblast	Miura & Nishida, 1996
	Bavachinine A, B, C		Fruit	Antibacterial	Won *et al*., 2015
	Corylifol A, B		Seeds	Carboxylesterase inhibitors	Li *et al*., 2015
	Corylifol C		Seeds	Protein kinase inhibition, Anticancer	Limper *et al*., 2013

Bioactive compound	Chemical form	Chemical Structure	Plant part used	Potential activity	Reference
	Corylifol D, E		Seeds	Anticancer	Yang *et al*., 1996; Teschke *et al*., 2014
	Corylin		Whole plant	Osteoblast	Miura & Nishida, 1996; Wang *et al*., 2001
				Anticancer	Shan *et al*., 2014
				Carboxylesterase inhibitors	Sun *et al*., 2016
	Isobavachin		Seed/fruit	Osteoblast	Li *et al*., 2014
	Psoracorylifol D		Seed	Lymphangiogenesis inhibition	Jeong *et al*., 2013
Meroterpene	Bakuchiol		Seeds/ Fruit	Anti-acne	Iwamura *et al*., 1989
				Antibacterial	Katsura *et al*., 2001; Newton *et al*., 2002
				Antifungal	Newton *et al*., 2002; Hosamani *et al*., 2012; Lau *et al*., 2010; Lau *et al*., 2014; Prasad *et al*., 2004; Savoia, 2012; Srinivasan & Sarada, 2012; Yang

Bioactive compound	Chemical form	Chemical Structure	Plant part used	Potential activity	Reference
					*et al*., 2006
				Retinal regeneration	Seo *et al*., 2013
				Anti-aging	Seo *et al*., 2013
				Estrogen receptor agonist, Postmenopausal symptoms	Lim *et al*., 2011
				Anti-diabetic	Behloul & Wu, 2013
				Lymphangiogenesis inhibition	Jeong *et al*., 2013
				Anticancer	Chen *et al*., 2010; Li *et al*., 2016
	Hydroxy bukuchiol		Seeds	Lymphangiogenisis inhibition	Jeong *et al*., 2013
Flavone	Bavachinin		Seeds	Antibacterial	Khatune *et al*., 2004
				Estrogen receptor agonist	Lim *et al*., 2011
				Lymphangiogenesis inhibition	Jeong *et al*., 2013
				osteoporosis	Liu *et al*., 2014
				Anti-Alzheimer	Chen *et al*., 2013
				Carboxylesterase inhibitors	Li *et al*., 2015
Chalcone	Bavachalcone		Seeds	Anticancer	Shan *et al*., 2014
				CVS protective effect	Dang *et al*., 2015
	Corylifolinin		Seeds	Antibacterial	Khatune *et al*., 2004
				Carboxylesterase inhibitors	Sun *et al*., 2016
	Isobavachalcone		Seeds	Estrogen receptor agonist	Lim *et al*., 2011
				Neuroprotective	Lee *et al*., 2015
				Lymphangiogene	Jeong *et al*.,

Bioactive compound	Chemical form	Chemical Structure	Plant part used	Potential activity	Reference
				sis inhibition	2013
				Anti-Alzheimer	Chen *et al.*, 2013
				Carboxylesterase inhibitors	Li *et al.*, 2015
	Xanthoangelol		Seeds	Anticancer	Limper *et al.*, 2013
Prenyl flavonoid	Corylifols		Seeds	Antibacterial	Yin *et al.*, 2004
Isoflavonoid	Daidzein		Fruit	Antioxidant	Shinde *et al.*, 2010
				Antidiabetic	Behloul & Wu, 2013
				Topoisomerase inhibitor	Sun *et al.*, 2003
Essential oil component	Dihydroxy coumestan		Seeds	Insecticidal, genotoxic	Khatune *et al.*, 2002; Dua *et al.*, 2013
Isoflavone	Genistein		Fruit	Ani-diabetic, anti-obesity	Behloul & Wu, 2013
				antioxidant	Shinde *et al.*, 2010
Furanocoumarin	Isopsoralen		Whole plant	Antiprotozoal	Song *et al.*, 2015
	Psoralen		Whole plant	Leukoderma, psoriasis	Kim *et al.*, 2013
				Anticancer	Hao *et al.*, 2014
				antioxidant	Chen *et al.*, 2011

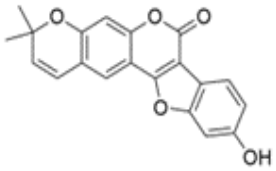
Bioactive compound	Chemical form	Chemical Structure	Plant part used	Potential activity	Reference
Coumestans	Psoracoumestan		Seeds essential oil	Anti- cancer	Limper *et al*., 2013

TABLE 3List of some products containing *L. reticulata* as one of the major ingredients and their potential health benefits (Mohanty *et al*., 2017).

NameoftheProduct	*Uses*	*Company*
Confido(Spemanforte)	Usefulinoligospermia	*HimalayaDrugHouse,Bengaluru,India*
Speman	HelpsinSpermatogenesis	*HimalayaDrugHouse,Bengaluru,India*
GalactinVet(bolus)	Stimulateactivityofalveolartissue,stimulatelactogenesis,improvefatpercentage	*HimalayaDrugHouse,Bengaluru,India*
Spemanfortevet	Spermatogenicandincreaseslibido	*HimalayaDrugHouse,Bengaluru,India*
Spemanvet	Promotesspermatogenesis	*HimalayaDrugHouse,Bengaluru,India*
Himalaya^{TM}Chyavanprasha	Usefulindebilitatingdisorderslikecough,cold,infection.Boost immunity of the body	*HimalayaDrugHouse,Bengaluru,India*
Calshakti	Feedsuppliments(Animalhealth)	*IntasPharmaceuticalsLtd.,Ahmedabad,India*
Safeherbs	Improveslactation(Womencare)	*VASUHealthcarePvt.Ltd.,Hyderabad,India*
JivantiPowder/capsule	Usedinallergicresponse,constipation,cardiac andbleedingdisorders,possessdiureticproperty	*EvaidyajiWellnessPvt.Ltd.,Jaipur,India*
EnviroCare	Used as antioxidants, immunobuilder, rejuvenating and vitalizing tonic.	*Satveda, India/Herbs Forever, Los Angeles, CA, USA*
Antisept	Possess antiseptic andantibacterial properties	*ZydusCadilaHealthcareLtd.,Ahmedabad,India*
Praas™(Chyawan prash)	Enhancegeneralhealth,increasementaland physical energy, increase resistance to disease.	*KomalHerbals,Inc.,Sewickley, PA,USA*

5. Potential benefits of *Psoralea corylifolia* and *Leptadenia reticulata*

The investigation and analysis of *Psoralea corylifolia* and *Leptadenia reticulata* have demonstrated great pharmacological potential. These plants are known for their large variety of bioactive substances, which support a variety of pharmacological actions. These investigated bioactive components show promise in a range of therapeutic uses and have been shown to be useful in treating a wide range of health issues. The therapeutic qualities of both plants which include anti-inflammatory, antioxidant, antibacterial, and anti-cancer activity, among others, have been well investigated. These multipurpose herbs can be used in contemporary treatment methods to address a number of human

maladies since it has multiple potential medicinal properties. *L. reticulata* can be the primary ingredient in many herbal preparations thanks to its revitalising, reviving, and lactogenic characteristics. In order to further develop their understanding of the mechanisms behind these plants' pharmacological actions, scientists have been able to identify and isolate particular bioactive chemicals from these plants. This understanding may eventually result in the creation of novel medications or complementary treatments that make use of the potency of these organic substances. The plants *Leptadenia reticulata* and *Psoralea corylifolia* are excellent examples of the useful resources that nature offers since they contain a variety of bioactive substances that may have a favourable effect on human health.

6. Endophytic fungal association with medicinal plants

Endophytic fungus can increase their host plant's resilience to various stressors or create phytohormones to stimulate plant development. They can also manufacture insecticides to shield plants from herbivores (Badaway et al., 2021; Abdelaziz et al., 2022). A reliable source of novel bioactive chemicals is thought to be endophytic fungus (Ancheeva et al., 2020). The fact that these fungi are chemical factories within the plant and that their metabolites can serve as alternatives to synthetic chemicals and antibiotics—to which microorganisms become more resistant over time—as well as their buildup in the environment without decomposition and potentially harmful effects on human and/or animal health—has been noted by many researchers (Dufossé et al., 2021).Numerous techniques, including optimisation, co-culture, epigenetic, and molecular technologies, are used to increase the synthesis of bioactive substances by endophytic fungus (Hewage et al., 2014). Endophytic fungus has been more well-known in recent years as a rich source of organic compounds with intriguing medicinal properties (Omomowo et al., 2023). Therefore, there are several chances to find novel compounds with potential bioactivity by studying endophytic fungi that live on medicinal plants (Silva et al., 2021). The use of crude extracts from endophytic fungi may be a promising alternative because these microorganisms are an endless source of new metabolites and because their bioactive compounds can be produced on an industrial scale, which helps to lower the cost of the finished product and preserve plant species (Ribeiro et al., 2018). In this regard, it is possible that endophytes from plants that thrive in unique ecological niches, such as the Amazon biome, are capable of producing a wide range of secondary metabolites. The bioactive compounds generated by these microbes' secondary metabolism, which are frequently produced in stressful circumstances, directly contribute to the adaptability of species and their survival (Elawady et al., 2023).

7. Summary and Conclusion

In the last few decades, there has been intense interest in the study of plantspotential as medicinal formulations. In the present study, two medicinal plants *L. reticulata* and *P. corylifolia*have been extensively reckoned for their medicinal uses, pharmacological applications and bioactive compounds. The study demonstrates the wide use of bioactive compounds as potential medicine to treat a variety of illnesses and enhance human health. Further, advancement in analytical instrumentation enabled us to comprehend the mechanisms of action of many substances produced from these plants, which has resulted in the generation of pharmaceuticals with natural

inspiration. *Leptadenia reticulata* and *Psoralea corylifolia* are medicinal plants that have ability to promote human health care. The continued study of both these plants and their pharmacological effects has the potential to progress medicine and expand the range of available treatments.The study states that, there is a need for the isolation and identification of endophytic fungal association and their pharmacological, bioactive compounds analysis with these medicinal plants. The in-vitro generation of bioactive compounds from *L. reticulata, P. corylifolia*and endophytic fungal isolates associated with them by use plant tissue culture and culture broths adds generation of value-added products for the benefit of mankind sustainably.

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Conflict of Interest

The authors declare that they have no known competing financial interests ora1SQ personal relationships that could have appeared to influence the work reported in this paper.

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