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# UNLOCKING THE THERAPEUTIC POTENTIAL OF *PIPER BETLE*: AN IN-DEPTH EXPLORATION OF ITS HEALTH BENEFITS

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## ABSTRACT

*Piper betle*, also known as betel leaf, has a long history in traditional medicine. This review highlights its various health benefits, including its antioxidant, anti-inflammatory, and antimicrobial properties. It has shown promise in preclinical studies against cardiovascular diseases, infections, and neurodegenerative disorders. Furthermore, it has antiplatelet and immunomodulatory effects and may be beneficial in dermatological care. This study emphasizes the therapeutic potential of *Piper betle* and encourages further research.

**Keywords: *Piper betle,* pharmacological benefits, cardiovascular diseases, anti-acne effects**

## INTRODUCTION

*Piper betle*, a plant from the Piperaceae family, is grown in East Asia for various products like toothpaste, shampoo, herbal supplements, and drinks. It has cultural significance in Malay and Hindu traditions and is used for mouth freshening, hair care, and wound healing due to its bioactive compounds. Its pharmacological properties include antimicrobial, antioxidant, antidiabetic, and anticancer activities, making it popular in traditional medicine **[1]**.

**Figure 1:** ***Piper Betle***

**Chemical Constituents**

*Betel* leaves, containing *Betel* oil, are rich in phenols like betelphenol and chavicol, along with an alkaloid called arakene. The oil content ranges from 0.8% to 1.8% and includes compounds like eugenol and terpenes. Safrole is found in leaves, stalks, stems, and roots, while ß-phellandrene is present in the fruit. Younger leaves yield more oil. Essential oil constituents include chavibetol and its acetate, with safrole dominating in various plant parts. Composition varies with leaf maturity **[1]**.

**Pharmacological Benefits of *Piper betle***

**1. Immunomodulatory effects**

Research has shown that *Piper betle(P. betle*) has promising immunomodulatory properties. In vitro studies demonstrated that betel leaf extract increased lymphocyte proliferation while suppressing phytohaemagglutinin. In mice, the extract suppressed T-cell and B-cell activities and decreased antibody titers. It also had immunosuppressive effects similar to a known drug. These findings suggest that *P. betle* could be used as a therapeutic agent for autoimmune and immune disorders **[2]**.

**2. Anti-Proliferative/anti tumor/ anti-cancer benefits**

Plant-derived agents that promote apoptosis are being studied as potential alternatives to current anti-apoptotic drugs in cancer research. Piper betle extract has shown promise in inhibiting tumor growth and preventing preneoplastic and neoplastic changes in hamster buccal pouch tumors, as well as inhibiting carcinogenesis in rat mammary glands **[3, 4]**.

**3. Analgesics/antinociceptive/anti-inflammatory benefits**

Inflammation is a tissue response to harmful stimuli, resulting in swelling, redness, and pain. Finding safe drugs to treat pain and inflammation is important. Food supplements can act as natural analgesics, and extracts from *P. betle* showed antinociceptive benefits and anti-inflammatory effects in animal experiments **[5]**.

**4. Neuropharmacological benefits**

Neurological and psychiatric disorders, including Alzheimer's, Parkinson's, epilepsy, migraine, and essential tremors, cause significant harm. Depression, anxiety, and cognitive issues commonly occur alongside these disorders. Current treatments include medications, therapy, and electroconvulsive therapy. Researchers are studying natural compounds from plants as potential alternative treatments **[6, 7]**.

**5.Anti-oxidant benefits**

Reactive oxygen species (ROS) play a crucial role in diseases. Antioxidants combat ROS and can help alleviate chronic and degenerative conditions like cancer, cardiovascular diseases, Alzheimer's, and neurodegenerative disorders. Extracts from P. betle possess antioxidant properties,

which may be beneficial in oxidative stress-related disorders **[8, 9]**.

**6. Hepatoprotective benefits**

A study on Wistar rats found that betel leaf extract effectively protected the liver from ethanol-induced damage. Administering 300 mg/kg of the extract reduced liver damage markers and increased antioxidant levels. Another study showed that a dose of 200 mg/kg of the extract improved antioxidant levels and reduced liver enzyme levels in rats with D-galactosamine-induced toxicity **[10]**.

**7.Antiulcer benefits**

Prolonged use of NSAIDs, alcohol abuse, and stress can cause peptic ulcers. Majumder et al. found that betel leaf extract protected against gastric lesions, increased antioxidants, promoted mucus production, reduced oxidative damage, and protected against NSAID-induced ulcers. It also healed indomethacin-induced ulcers in rats **[2]**.

**8. Anti-hyperlipidemic benefits**

Ethanol exposure in Wistar rats caused increased lipid peroxidation and antioxidants disruption. Leaf extract of *P. betle* in different doses improved toxicity symptoms, with highest efficacy at 300 mg/kg. The extract reduced lipid levels and markers of lipid peroxidation, while boosting antioxidant defenses and lowering cholesterol levels in hyperlipidemic rats on a high-fat diet **[11]**.

**9. Anti-atherogenic benefits**

found that *betel* leaf extract and eugenol reduced hypercholesterolemia-induced effects in rats, lowering cholesterol, triglyceride, LDL, and VLDL levels, restoring antioxidant levels, and decreasing lipid-related enzymes and liver damage markers. This suggests potential for reducing cardiovascular disease risk **[12]**.

**10. Anti-hyperglycemic benefits**

*P. betle* was effective in managing hyperglycemia in rats with diabetes. Leaf suspension at doses of 75 and 150 mg/kg reduced blood glucose levels, glycosylated hemoglobin, and liver enzyme activities, while increasing liver hexokinase activity. The aqueous extract improved lipid levels and antioxidants, and the methanolic extract had hypolipidemic effects in hyperlipidemic rats **[13]**.

**11. Cardioprotective benefits**

*P. betle* extract improved hemodynamic parameters, antioxidant enzyme levels, and reduced oxidative damage in rat hearts. In vitro studies showed it protected cardiac cells from oxidative injury. *P. betle* has potential as a protective agent against myocardial infarction **[14]**.

**12. Antifertility effects**

*P. betle* has potential antifertility effects observed in male and female rats, rabbits, and mice. Betel stalk extract reduced pup numbers and had anti-estrogenic properties. It caused complete infertility in male mice

after 60 days, but these effects were reversible without impacting hormonal balance **[15]**.

**13. Antimicrobial Benefits:** This section highlights the antibacterial and antifungal benefits of *P. betle*.

**Antibacterial Benefits**: *Betle* leaf extracts are effective against bacteria like Staphylococcus aureus and Vibrio cholerae. Ethyl acetate and ethanol extracts outperform standard drugs, and essential oils from betel leaf varieties have antibacterial benefits **[16]**.

**Antifungal Benefits**: *P. betle* has strong antifungal properties against Candida albicans. Betel leaf extracts, including essential oils and ethanolic extracts, show significant antifungal benefits against various fungi. Hydrodistillation produces an extract with antifungal effects against Saccharomyces cerevisiae and Candida albicans. P. betle is a potential natural source for effective antimicrobial agents **[17]**.

.**14. Antiparasitic Benefits**

This section explores the antiparasitic benefits of *P. betle*, encompassing anthelmintic, anti-protozoan, and antifilarial properties.

**Anthelmintic Benefits:** *P. betle* has anthelmintic properties, being effective against earthworms. Its extracts exhibit faster paralysis and death rates than albendazole. *Betel* leaf essential oil is highly effective against Ascaridia galli in poultry **[18]**.

**Anti-protozoan Benefit:** *P. betle* has potential as a treatment for giardiasis and leishmaniasis. *Betel* leaf extracts show anti-giardial and antileishmanial activity through various mechanisms.

**Antifilarial Benefits:***P. betle* extracts show antifilarial activity in mice, boosting immunity, reducing worms, and sterilizing females **[19]**.

**Insecticidal Benefits**: *P. betle* has insecticidal benefits against several pests and also combats helminths, protozoans, and filarial infections, providing a natural solution for parasitic challenges **[20]**.

**15. Larvicidal Benefits**

The essential oil from *P. betle* leaves showed high effectiveness against Aedes aegypti mosquitoes, with LD50 values of 86 ppm and 48 ppm at 2 and 24 hours. The extract also had larvicidal benefits, with LD50 values of 153 ppm and 125 ppm. P. betle has potential as a natural agent for controlling mosquito larvae and other pests **[21]**.

**16. Cognitive Enhancement Benefits**

*P. betle* leaf extract exhibits cognitive enhancement effects, potentially acting as a nootropic. It improved object recognition and reduced memory impairment in tests on mice and rats, indicating its promising nootropic properties that warrant further investigation **[22]**.

## CONCLUSION

*Piper betle* is a botanical treasure with numerous pharmacological benefits. Its bioactive compounds offer antioxidative, anti-inflammatory, cardioprotective, and neuroprotective effects. The plant effectively combats infections, has antiplatelet and immunomodulatory actions, and shows potential in dermatological care and anti-acne treatments. More research is needed to utilize these benefits in human health.

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