

# Parñayavānī [*Plectranthus amboinicus* (Lour.) Spreng.] - Pharmacological and Ethnomedicinal Uses – A Review

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**Abstract:** *Parñayavānī* or *Karpooravalli* [*Plectranthus amboinicus* (Lour.) Spreng.] is an aromatic, succulent perennial herb commonly cultivated in gardens throughout India. The drug possess *Kaṭu*, *Tikta rasa*, *laghu*, *rūkṣa*, *tīkṣṇa guṇa*, *uṣṇa vīrya* and *kaṭu vipāka* and is *Kaphavātahara* in action. It is indicated in the conditions like *Ādhmāna*, *Agnimāndya*, *Ajīrṇa*, *Aruci*, *Atisāra*, *Grahaṇi*, *Gulma*, *Hikkā*, *Hṛdayadaurbalya*, *Jīrṇāśvāsa*, *Kāsa*, *Kṛmi*, *Mūtrakṛchra*, *Mūtraroga*, *Mūtrāśmari*, *Śvāsa*, *Udararoga*, *Unmada*, *Viṣūcika*. Looking into the pharmacological profile, the drug *Parñayavānī* is scientifically proven to be antimicrobial, antiasthmatic, antiepileptic, antitumorigenic, anti-inflammatory, antioxidant, analgesic, antiuroliithiatic, anti clastogenic, larvicidal, anti-rheumatoid, diuretic, lactogenic, radioprotective, nephroprotective and has wound healing property too. It is widely used traditionally for various ethnomedicinal purposes and is a part of various home remedies in South India, particularly for respiratory conditions.

**Keywords:** *Parñayavānī*, *Plectranthus amboinicus*, ethnomedicinal uses

## 1. Introduction

Plant - based medicines are widely employed in various public health practices throughout the globe as they are known to be safe, cost - effective, and efficient to combat various deadly diseases and help in maintaining good health. One such medicinal plant is *Parñayavānī*, a nutritious medicinal plant which can be easily cultivated as a garden plant in every home. *Parñayavānī* or *Karpooravalli* [*Plectranthus amboinicus* (Lour.) Spreng.] belongs to the family Lamiaceae. The name has derived from the resemblance of the aroma of its leaves to that of *Yavāni* (*Trachyspermum ammi* Linn.).

The plant is a perennial succulent herb of 30 - 90 cm, (Fig.1) shrubby below, hispidly villous or tomentose with a fleshy stem. Leaves are simple, opposite, petioled, broadly ovate or cordate, crenate, fleshy, very aromatic and slightly hairy with reticulate venation. Flowers are pale purplish in densely many - flowered whorls. Leaves are the useful part.



**Figure 1:** *Plectranthus amboinicus* (Lour.) Spreng.

Various phytoconstituents like flavonoids, glycosides, phenols, tannins and steroids identified in it are responsible for its pharmacological properties like antimicrobial, antiasthmatic, antiepileptic, antitumorigenic, anti-

inflammatory, antioxidant, analgesic, antiuroliithiatic etc. Volatile oils like Calvacrol and Thymol, played a vital role in its pharmacological properties in respiratory system<sup>1</sup>.

As per Ayurveda pharmacology, this drug possess *Kaṭu*, *Tikta rasa*, *laghu*, *rūkṣa*, *tīkṣṇa guṇa*, *uṣṇa vīrya* and *kaṭu vipāka* and is *Kaphavātahara* in action. It is indicated in conditions like *Ādhmāna*, *Agnimāndya*, *Ajīrṇa*, *Aruci*, *Atisāra*, *Kāsa*, *Kṛmi*, *Mūtrakṛchra*, *Mūtraroga*, *Mūtrāśmari*, *Śvāsa* etc<sup>2</sup>. There is no direct reference about *Parñayavānī* in Vedic and Samhita period. Acharya P. V. Sharma has mentioned the plant in Priya Nighantu, under the heading of *Śatapušpadi Varga* and given the name *Parñayavānī* for *Coleus aromaticus* Benth<sup>3</sup>. Probably the drug entered Ayurvedic Materia Medica in 9A. D after P. V. Sharma reported that a variety of *Yavani* (*Yavāniviṣeṣa*) mentioned in Dhanwantari Nighantu is *Parñayavānī*. Vṛnda Mādhava quoted it as *Kṛmighna* for the first time.<sup>4</sup>In Nighantu Ādarśa, Acharya Bapalal Vaidya mentioned *Coleus aromaticus* Benth. as one of the source of *Pāṣāṇabheda*<sup>5</sup>. According to him Kirtikar & Basu have considered *Coleus aromaticus* Benth. as *Pāṣāṇabheda*<sup>6</sup>. Even the Late Kaviraja Gananatha Sen was of the opinion that this is the *Pāṣāṇabheda* of Bengali Kavirajas<sup>7</sup>. *Coleus aromaticus* Benth. is the botanical identity for *Pāṣāṇabheda* by commentators in publications like Śaligrāma nighantu<sup>8</sup>, Bhāvaprakāśa nighantu<sup>9</sup>, Rāja nighantu<sup>10</sup> and Saraswatī nighantu<sup>11</sup> and Vanaśhadhi candrodya<sup>12</sup>.

*Coleus aromaticus* Benth. is generally known as *Kannikkoorkka* or *Panikkoorkka* throughout South India and is used for fever, cough, asthma and digestive disorders.<sup>13</sup> It is widely used traditionally for various ethnomedicinal purposes and is a part of various home remedies in South India, particularly for respiratory conditions. Plants of this genus are very important as they provide food, medicine and are ornamental. This work aimed to gather information

regarding the ethnobotanical uses and pharmacological actions of *Parṇayavānī* from available literature.

Kerala like *Cikitsa Manjari*, *Cikitsa Koutukam*, *Vaidya Tārakam*; other books like *Pharmacographia Indica*, *The wealth of India* and *The Ayurvedic Pharmacopoeia of India*; and also articles available from various e - journals.

## 2. Materials and methods

The ethnomedicinal uses and pharmacological action of *Parṇayavānī* was compiled from Traditional books of

### Ethno-medicinal uses

**Table 1:** Ethnomedicinal uses of *Parṇayavānī*

S. No.	Disease / condition	Ethno - medicinal claim	Mode of administration
1.	Decreased breast milk	Leaves given as soup after delivery in Indonesia. Batak tribes of North Sumatra eats the leaf after childbirth <sup>1</sup> .	Internal
2.	As food	Chopped leaves used as Sage in stuffing. Eaten raw with bread and butter. In Indonesia and Philippines used to mask the odour of fish and goat meat <sup>14</sup> Preparation of 'Bhajan' (chopped leaves made into pellets and dipped in a paste made of the flour of the chickpea, are fried in butter) <sup>15</sup>	Internal
3.	Urinary problems & Vaginal discharge	Leaves eaten raw <sup>16</sup>	Internal
4.	Epilepsy, convulsions, asthma, bronchitis, chronic coughs, sore throat and congestive heart failure	Infusion / decoction / syrups of leaf <sup>14</sup>	Internal
5.	Centipede and Scorpion bite	Poultice of bruised leaf application <sup>14</sup>	External
6.	Chapped lips and cracked corners of mouth	leaf juice application <sup>14</sup>	External
7.	Fever	A lotion from leaf massaged over the body <sup>14</sup>	External
8.	Colic	Expressed juice is prescribed mixed with sugar/ other suitable vehicle and given <sup>15</sup>	Internal
9.	Conjunctivitis	Expressed juice of the leaves applied around the orbit <sup>15</sup>	External
10.	Constipation	In Indonesia and Malaysia, juice from pounded leaf drank <sup>14</sup>	Internal
11.	Influenza, cough, bronchitis and throat problems	drink or a bath of <i>P. amboinicus</i> juice/decoction <sup>14</sup>	Internal/external
12.	Asthma	Decoction or juice made from leaves together with other herbs <sup>14</sup>	Internal
13.	Cuts & Burns	leaf paste is baked on a flame and applied <sup>17</sup>	External
14.	Acute edematous otitis	Seed oil <sup>18</sup>	External
15.	Pathogen induced diarrhoea	leaves consumed along with buttermilk, yogurt, or any other probiotic sources <sup>19</sup>	Internal

### Uses of *Parṇayavānī* in traditional books of Kerala

**Table 2:** *Parṇayavānī* Keralīya granthās

S. No.	Disease	Therapeutic use / name of the formulation	Kalpāna	Mode of administration	Reference
1.	<i>Sarva vātaroga, Sannipāta jvara, Bhūtāveśa</i>	<i>Indrāni tailam</i> <sup>20</sup>	<i>Taila</i>	Pana, nasya, lepa	C. M
2.	Fever with shivering	<i>Marica</i> pounded in <i>Parṇayavānī</i> and <i>Vanatūlasi</i> leaf juice <sup>21</sup>	<i>Gūḷika</i>	Internal	C. K
3.	<i>Jvaropadrava</i> in <i>bāla</i>	<i>Vaca</i> , <i>Pippali</i> , <i>Yaṣṭimadhu</i> and <i>Candana</i> paste made into porridge with buttermilk and <i>Parṇayavānī</i> leaf juice <sup>21</sup>	<i>Yavāgu</i>	Internal	C. K
4.	<i>Jvaropadrava</i> in <i>bāla</i>	<i>Tāḷam</i> done with the paste of <i>Kaṭurohini</i> , <i>Kuṣṭam</i> and <i>Kriṣṇajīrakam</i> pounded in <i>Parṇayavānī</i> leaf juice and breast milk <sup>21</sup>	<i>Kalka</i>	Talam	C. K
5.	<i>Vāyukṣobha</i> & <i>Nīrvīzcha</i>	Oil made from <i>Parṇayavānī</i> and <i>Nirgūṇḍi</i> leaf juices (2 <i>pala</i> ) and <i>tila taila</i> and half its quantity <i>eranda taila</i> <sup>21</sup>	<i>Taila</i>	Siro abhyanga	C. K
6.	<i>ŚvāsaKāsa</i> in <i>bāla</i>	Leaves of <i>Parṇayavānī</i> , <i>vāśa</i> , <i>brhati</i> , <i>kaṅṭakāri</i> , <i>puṣkaramūla</i> etc are steamed and the juice extracted is given with <i>karpūra</i> and sugar candy intermittently. <sup>21</sup>	<i>Svarasa</i>	Internal	C. K
7.	<i>Śvāsa</i> in children	<i>Putapāka svarasa</i> of <i>Parṇayavānī</i> , <i>Tripādi</i> , <i>Vāśa</i> , <i>Tāmbūla</i> leaves with 1/4 <sup>th</sup> breast milk and a pinch of <i>Karpūra</i> , <i>Jīraka</i> and <i>Lavanga</i> <sup>21</sup>	<i>Putapāka svarasa</i>	Internal	C. K
8.	<i>Śvāsa</i> & <i>Kāsa</i> in children	Decoction of <i>Parṇayavānī</i> leaves <sup>21</sup>	<i>Kvātha</i>	Internal	C. K
9.	<i>Śvāsa</i> & <i>Kāsa</i> in children	Oil with <i>Parṇayavānī</i> leaves <sup>21</sup>	<i>Taila</i>	Siro abhyanga	C. K
10.	<i>Jvara</i>	Decoction of leaves with <i>Jīraka</i> <sup>22</sup>	<i>Kvātha</i>	Internal	V. T
11.	<i>Jvara</i> , <i>Kāsa</i> , <i>Śvāsa</i>	Decoction of leaves with <i>Jīraka</i> and <i>Pippali</i> <sup>22</sup>	<i>Kvātha</i>	Internal	V. T
12.	<i>Villan chuma</i> or <i>Nilamkari chuma</i>	<i>Kāsamāhāri leha</i> <i>Kāsamārda avaleha</i> <sup>22</sup>	<i>Leha</i>	Internal	V. T

### 3. Pharmacological Screening

#### A. Toxicological evaluation

The aqueous extracts were tested for acute toxicity in mice and for sub - acute toxicity in Wistar rats according to the OECD guidelines No 425. In acute toxicity test, the dose of 5000 mg/kg was used as the limit dose test. The sub - acute toxicity test was evaluated through biochemical, hematological and histopathological indices and body weight of rats using daily doses of 2500 mg/kg, 1250 mg/kg and 625 mg/kg of the aqueous extract for 28 days. In acute toxicity, the extracts did not cause any mortality or evidence of adverse effects even after the oral administration of the highest dose of 10, 000 mg/kg of crude extract in both mice. In sub - acute study, normal body weight gains were observed during the study period compared to the control group. No mortalities were observed during acute and sub - acute toxicity study period<sup>23</sup>.

Acute & Sub acute toxicity of the methanolic extract was evaluated in albino mice (Female) after ingestions of the extract on 1<sup>st</sup> day (acute model) and on 28<sup>th</sup> days (sub - acute model). The studies on sub - acute toxicity revealed that no mortalities or evidence of adverse effects have been observed in Albino mice following oral administration at the highest dose of 2000mg/kg crude extracts of *Plectranthus amboinicus* (Lour) Spreng. Similarly, in sub - acute toxicity study, methanolic extract 200, 400 mg/kg body wt. of *Plectranthus amboinicus* did not cause any changes in hematological and biochemical parameters. Studies on histopathological examination of vital organs showed normal architecture suggesting no morphological abnormalities. *Plectranthus amboinicus* (Lour) Spreng can be considered as safe as it did not cause either any lethality or adverse changes in the general behavior in mice<sup>24</sup>.

#### B. In - vitro studies

##### 1) Antimicrobial Activities

Phytochemicals in *P. amboinicus* extract, possess antimicrobial activity against a wide range of bacteria, yeast and mould, but vary in quantity and quality depending on the bioactive constituents<sup>25</sup>. The antimicrobial activity of *P. amboinicus* Spring. Leaf essential oil was investigated using a gargel diffusion. The results obtained showed that the essential oil of *P. amboinicus* (Lour.) Spring. exhibited more antimicrobial activity on Gram - positive (*Staphylococcus aureus*) than on Gram - negative (*Escherichia coli*) bacteria. The minimum inhibitory concentration was 0.2% and 0.1% for *E. coli* and *S. aureus*, respectively<sup>26</sup>.

##### a) Antibacterial Activities

Studies revealed that *P. amboinicus* is having anti - *Mycobacterium tuberculosis* activity<sup>27</sup>. Hot water extract of *P. amboinicus* leaves inhibited growth of pathogens, *Escherichia coli* and *Salmonella typhimurium* while stimulating the growth of *Lactobacillus plantarum*<sup>19</sup>. Further, it was shown that unsterilized ethanolic leaf extract of *P. amboinicus* exhibits antibacterial activity against diabetic wound pathogens, *E. coli*, *S. aureus*, *P. mirabilis*, *P. aeruginosa* and *K. pneumonia*<sup>28</sup>. Essential oil of *P. amboinicus* was reported to have a synergistic effect on the

antibiotic toxicity toward resistant bacterial strains when combined with aminoglycosides. This makes *P. amboinicus* essential oil a possible source of a natural product with bacterial resistance - modifying activity<sup>29</sup>. In another study, Vijayakumar *et al*<sup>30</sup> used leaf extract of *P. amboinicus* to biologically synthesize zinc oxide nanoparticles. These Pam - ZnO NPs successfully controlled the growth of methicillin - resistant *Staphylococcus aureus* biofilms.

##### b) Antifungal Activities

In evaluating the interference of *P. amboinicus* essential oil on the anti - *Candida* activity of some clinically used antifungals (itraconazole, ketoconazole and amphotericin B), it showed a diverse level of interference<sup>31</sup>. In another research, antifungal activity of the volatile oil was studied against various fungi by an agar well diffusion susceptibility test. In that, growth of *Aspergillus ochraceus*, *Aspergillus niger* and *Penicillium* sp. was inhibited by 60%, 64% and 60%, respectively, with 10  $\mu$ L of volatile oil<sup>32</sup>.

##### c) Antiviral Activities

Extracts of *P. amboinicus* were tested and reported to have antiviral activity against Herpes Simplex Virus - 1 (HSV1)<sup>33</sup> and anti - HIV inhibition activity<sup>34</sup>. Besides that, ethanolic extract of *P. amboinicus* was reported to have selective antiviral activity on Vero cell lines at 0.1 mg/mL minimum inhibitory concentration when tested against HSV1 and Vesicular Stomatitis viruses<sup>35</sup>.

##### 2) Antitumorigenic Activities

*P. amboinicus* ethanolic extract showed significant anticancer activity through inducing apoptosis in the A549 (human lung cancer) cell line<sup>36</sup>. Anticancer activity of the essential oil of *P. amboinicus* (Lour) on B16F - 10 melanoma cell line injected C57BL/6 mice was evaluated by simultaneously treating them with the essential oil of *P. amboinicus* (Lour) (50  $\mu$ g/dose) through i.e. for 21 days. The present investigation exhibited the potent chemotherapeutic/chemopreventive effect of the essential oil of *P. amboinicus* (Lour) over lung metastasis that developed<sup>37</sup>.

##### 3) Anti - Inflammatory Activities

*In vitro* and *in vivo* studies have revealed the potent anti - inflammatory activity of aqueous extract of *P. amboinicus*<sup>38</sup>.

##### 4) Antioxidant Activities

The essential oil in *P. amboinicus* possessed significant antioxidant property against stress - created in cell line - induced lung cancer in both (*in vitro* and *in vivo*) models which could be due to the presence of phytochemical compounds such as Carvocrol and Thymol. Non - enzymatic antioxidant - reduced glutathione was found to be increased in the *P. amboinicus* essential oil treated mice<sup>39</sup>. For the first time, the aqueous leaf extract of *P. amboinicus* was reported to possess higher superoxide - scavenging, nitric oxide - scavenging and ferrous ion - chelating capacity by employing in - vitro system like  $\beta$  - carotene - linoleate model<sup>40</sup>. A report by Bhatt and Negi<sup>41</sup> showed that ethyl acetate had the highest polyphenolic content with appreciable total antioxidant and 1, 1 - diphenyl - 2 - picrylhydrazyl (DPPH) free radical - scavenging properties compared to the hexane, acetone, methanol, hydroalcohol and freeze dried form of extracts of *P. amboinicus* leaves.



Similarly, Khanum *et al.*<sup>2</sup> found lower content of total flavonoids and total phenolics and antioxidant activity in an ethanolic leaf extract of *P. amboinicus*.

### 5) Larvicidal Potential

Senthilkumar and Venkatesalu<sup>43</sup> reported the possible use of *P. amboinicus* essential oil as a low cost eco - friendly resource for inhibiting the malarial vector mosquito population. The LC<sub>50</sub> values of the oil were found to be 33.5 and 28.3 ppm after 12 and 24 h, respectively. Likewise, Lima *et al.*<sup>44</sup> reported larvicidal activity (LC<sub>50</sub> value: 58.9 ± 0.4 µg/mL) of the essential oil of *P. amboinicus* against the mosquito (*Aedes aegypti*) which is a chief vector of dengue, yellow fever and dengue hemorrhagic fever. In another study, the essential oil of *P. amboinicus* was shown to act as a good larvicidal agent against the mosquito, *Anopheles gambiae* after 48 hr<sup>45</sup>. In an investigation by Baranitharan *et al.*<sup>6</sup>, the highest larvicidal activity against *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus* was found in the ethyl acetate leaf extracts of *P. amboinicus*. Jayaraman *et al.*<sup>7</sup> have reported the larvicidal potential of different solvent extracts of *P. amboinicus* leaves against *Aedes aegypti*, *Culex quinquefasciatus*, and *Anopheles stephensi*. *P. amboinicus* zinc oxide nanoparticles (Pam - ZnO NPs) showed 100% mortality of fourth instar mosquito larvae of *Anopheles stephensi*, *Culex quinquefasciatus* and *Culex tritaeniorhynchus* at the concentration of 8 and 10 g/mL.<sup>8</sup> This biological control could be slow, but a long - lasting, inexpensive alternative and harmless to the ecosystem.

### 6) Radioprotective activity

Radioprotective potential of CAE were studied using micronucleus assay after irradiating Chinese hamster fibroblast (V79) cells<sup>49</sup>.

### 7) Antiplatelet aggregation activity

The stem extract of *P. amboinicus* was evaluated for the determination of activity against platelet aggregation using different concentrations (50–250 g/ml, platelet - rich plasma), and adenosine triphosphate is the agonist used for this study; after the study, the findings said that capacity of platelets to aggregate depends on dosage, meaning that higher is the concentration, higher is the ability<sup>50</sup>.

### 8) Antibiofilm efficacy

The methanol and ethylacetate extract of *P. amboinicus* showed a dose – dependent inhibition on film – forming pyrogens which causes inflammatory conditions such as pharyngitis. From both the extracts, methanolic extract gives good results against test pathogen at minimal concentration.<sup>51</sup>

### C. In - vivo studies

#### 1) Anti - asthmatic activity

Leaves of *P. amboinicus* had positive bronchodilator activity when tested on guinea pigs<sup>52</sup>. Kumar *et al.* (2007) studied the mast cell stabilization property of the aqueous and hydroalcoholic extracts at a dose of 10 and 100 µg/ml in rat mast cells and came to the conclusion that *Plectranthus amboinicus* (Lour.) Spreng. stabilizes mast cells in the rat

mesenteric tissue throwing light upon its usage in type 1 hypersensitivity mediated diseases like allergic asthma<sup>53</sup>.

#### 2) Antiepileptic Activity

Bhattacharjee and Manjumder<sup>54</sup>, tested the anticonvulsant activity of the leaf, stem and root alcoholic extract separately at a dose of 100mg/kg body weight administered through intra - peritoneal route on Swiss albino mouse models by maximal electric shock - induced seizures and pentylenetetrazole - induced seizures. They found significant anticonvulsant activity in both the models with alcoholic leaf extract recording the highest activity. They also predicted that the presence of alkaloids, flavonoids and saponins in these extracts might be responsible for this activity.

#### 3) Antitumorogenic Activities

The antitumor activity of hexane extracts of *P. amboinicus* has been reported<sup>55</sup>. The results showed a significant inhibition on the growth of Sarcoma - 180 tumor in mice treated with the hexane extracts of *P. amboinicus*. A dose of 350 mg/kg of hexane extracts of *P. amboinicus* significantly reduced the growth of S - 180 tumor with 66% inhibition, while doses of 100, 150 and 250 mg/kg reduced the inhibition to 44%, 45% and 47%, respectively.

#### 4) Anti - Inflammatory Activities

The hexane extract (HE) of *P. amboinicus* was also shown to exhibit anti - inflammatory activity<sup>63</sup>. A significant reduction of the paw edema was observed at doses of 150, 250 and 350 mg/kg of the HE of *P. amboinicus*. The active constituents of *P. amboinicus* were shown to possess AP - 1 and TNF - α inhibitory activities<sup>56</sup>. Treatment of leaf methanolic extracts of *P. amboinicus* resulted with moderate to high anti - inflammatory activity in experimental mice<sup>47</sup>. *In vitro* and *in vivo* studies have revealed the potent anti - inflammatory activity of aqueous extract of *P. amboinicus*<sup>46</sup>. Silitonga *et al.*<sup>57</sup> reported the significant improvement of immunoglobulin levels (IgG, IgM) and lysozyme activity in rats when treated with ethanolic leaf extract of *P. amboinicus*.

#### 5) Wound Healing Activities

Application of a paste prepared using *P. amboinicus* showed an enhanced wound healing ability by immune - stimulation in diseased giant murels<sup>58</sup>. Likewise, *P. amboinicus* leaves and root derived paste (10%) had shown to exhibit thorough epithelialization on the excision wound in albino rats after 12 days of application<sup>59</sup>. The use of polyherbal suspension prepared from *P. amboinicus* and *Punica granatum* was shown to exhibit good wound healing properties in laboratory mice<sup>60</sup>. It was observed that the aqueous and alcoholic extracts of leaves and root of the plant at a dose of 100mg/kg body weight promoted wound healing in Monosodium Glutamate induced diabetic mice, by increased wound contraction, enhancing collagen deposition and reducing the wound epithelialization period. Further, ethanolic extract of *P. amboinicus* reduced the wound area by up to 76.6% in diabetic mice induced by monosodium glutamate.<sup>4</sup>

#### 6) Antioxidant Activities

The essential oil *P. amboinicus* possesses a significant antioxidant property against stress - created in cell line -

induced lung cancer in both (*in vitro* and *in vivo*) models which could be due to the presence of phytochemical compounds such as Carvocrol and Thymol. Non - enzymatic antioxidant - reduced glutathione was found to be increased in the *P. amboinicus* essential oil treated mice<sup>55</sup>.

#### 7) Analgesic Activity

The aqueous extract of *P. amboinicus* leaves showed an analgesic and anti - inflammatory property, mainly modulated by controlling inhibition of pro - inflammatory mediators<sup>54</sup>.

#### 8) Anti - urolithiatic property

Baskar R *et al.*, (1992) administered *Coleus aromaticus* leaf aqueous extract (at the rate of 1ml/rat/day) for 10 - 30 days in experimental urolithiatic rats. Reduction in the deposition of Ca and oxalate in the kidney tissue has been reported<sup>61</sup>.

#### 9) Anti clastogenic property

Shyama Prasad S *et al.*, (2002) investigated the anticlastogenic potency of the ethanolic extract of *Coleus aromaticus* with different doses 10, 15, 25, 50 and 100mg/kg body weight, fed orally, by taking bone marrow chromosomal aberration assay and micronucleus test as test parameters and the results indicate the protective effect against cyclophosphamide and mitomycin - c induced cytogenetic damage. Lower doses of the extract were found more effective than higher doses<sup>62</sup>.

#### 10) Anti - rheumatoid effect

Chang JM *et al.*, (2007) investigated therapeutic efficacy of *Plectranthus amboinicus* in treating rheumatoid arthritis using collagen - induced arthritis in animal model. Aqueous extract of the plant was used at a dose of 75mg/kg and 375 mg/kg. High dosage of extract showed significant inhibitory activity in footpad swelling. Low dosage also had inhibitory effect with moderate effectiveness<sup>63</sup>.

#### 11) Diuretic potential and nephroprotective effect

Patel R *et al.*, (2010) evaluated the diuretic properties of ethanolic and aqueous extracts of leaves of *Plectranthus amboinicus* in male albino rats at a dose of 500mg/kg body weight. Both extracts have shown significant increase in the volume of urine and urinary concentration of Na, K, Cl ions; thus explaining its diuretic potential<sup>64</sup>. Palani S *et al.*, (2010) investigated the nephroprotective, diuretic and antioxidant activities of the ethanol extract of *Plectranthus amboinicus* at two dose 250 and 500 mg/kg on APAP - induced toxicity in rats<sup>65</sup>.

#### 12) Lactogenic activity

Santosa CM (2002) reported that *Coleus amboinicus* leaves exhibited increasing milk secretion of lactating animals and seemed to be superior to other treatment groups on milk secretion and also containing iron and potassium composition<sup>66</sup>.

#### 13) Antidiabetic activity

Viswanathaswamy *et al.* investigated the antidiabetic and antihyperglycemic effects of ethanol extract of *Plectranthus amboinicus* in normal and alloxan - induced diabetic rats. Diabetes was induced in Wistar rats by single intraperitoneal administration of alloxan monohydrate (150 mg/kg). Normal

as well as diabetic rats were divided into groups (n=6) receiving different treatments. Graded doses (200 and 400mg/kg) of the ethanol extract of *Plectranthus amboinicus* were studied in both the normal and alloxan - induced diabetic rats for 15 days. Glibenclamide (600µg/kg) was used as a reference drug. Oral administration with graded doses of the ethanol extract of *Plectranthus amboinicus* exhibited hypoglycemic effect in normal rats and significantly reduced the peak glucose levels after 120 minutes of glucose loading. In alloxan - induced diabetic rats, the daily oral treatment with the ethanol extract of *P. amboinicus* showed a significant reduction in blood glucose<sup>67</sup>.

#### 14) Anxiolytic activity

Anxiolytic effects of the alcoholic extract of *P. amboinicus* in mice was performed using the elevated plus maze model, light-dark model, and hole - board test. The extract administered orally in three different doses of 250, 500, and 750mg/kg was able to increase the time spent and the number of arm entries in the open arms of the elevated plus - maze and also to increase the time spent by mice in the illuminated side of the light-dark test; a dose of 500 and 750mg/kg showed more significant increase in nose poking and decrease loco motion in hole - board test, in comparison with control animals. This effect was comparable to that of the diazepam (1.0mg/kg). These results indicate that alcoholic extract of *Plectranthus amboinicus* is an effective anxiolytic agent<sup>68</sup>.

#### D. Clinical trials

- 1) In a clinical trial performed by Binu B *et al* (2012) *Plectranthus amboinicus* (Lour.) Spreng. was found to be very effective in *Kaphaja kása*. It was done in 40 subjects assigned in 2 groups of 20 each. The patients were treated with Ambrodil syrup and *arka* of the drug in group A and B respectively. Duration of treatment was 10 days and patients were assessed on 5<sup>th</sup> and 10<sup>th</sup> day and followed up for 20 days. Treatment was assessed based on the gradation of cardinal signs and symptoms. The study showed the drug is a good choice in *Kaphaja kása* associated with *Aruci* and more cough bouts.<sup>69</sup>
- 2) A clinical trial to assess the efficacy of *Plectranthus amboinicus* (Lour.) Spreng. *arka* nebulization in the management of *Tamaka śvāsa* w. s. r to acute exacerbation of Bronchial asthma was performed by Gauthama P A *et al* (2018) as a comparative trial consisting of 2 groups of 30 subjects each. Trial group received single dose of 5ml *Parṇayavānī arka* nebulization and the standard group single dose of 5ml Theophylline nebulization. Before and after administration assessments were done using subjective parameters as per GINA criteria and objective parameters by peak expiratory flow rate, both within and between groups. The study showed that *Parṇayavānī arka* nebulization showed equivalent action to Theophylline immediately after nebulization.<sup>70</sup>

#### 4. Discussion

The drug *Plectranthus amboinicus* (Lour.) Spreng. has multiple therapeutic potential like anti - microbial, anti - tumour, anti - inflammatory, larvicidal, anti - oxidant, analgesic, anti - asthmatic, anti - epileptic, anti - rheumatoid,

lactogenic, anti - urolithiatic, diuretic, anti - diabetic, anxiolytic etc. In Ayurveda, it is indicated in conditions like *Ādhmāna*, *Agnimāndya*, *Ajīrṇa*, *Aruci*, *Atisāra*, *Grahaṇi*, *Gulma*, *Hikkā*, *Hṛdayadaurbalya*, *Jīrṇāśvāsa*, *Kāsa*, *Kṛmi*, *Mūtrakṛchra*, *Mūtraroga*, *Mūtrāśmari*, *Śvāsa*, *Udararoga*, *Unmada*, *Viṣūcika*. These properties are attributed by the *Kaṭu*, *Tikta rasa*, *laghu*, *rūkṣa*, *tīkṣṇa guṇa*, *uṣṇa vīrya* and *kaṭu vipāka*. The drug is found to be *Kaphavātahara* in action. Out of these actions of the drug, *Kṛmighna*, *Śvāsa-hara*, *Mūtrala*, *Asmarīhara*, *Vedanāsthapana* and *Ākṣhepahara* are supported by scientific evidences. More and more clinical studies and studies in animal models are required to validate its unexplored potential. This article allows researchers to further explore the potential of this multi - utility herb for various biomedical applications.

## 5. Conclusion

The results from this review show that, this plant can be used for the treatment of various diseases. As the plant was successfully used traditionally, extensive researches on the ethno - botanical uses are required to validate its use, so that it can be effectively used therapeutically. One of the important things about this plant is that it shows more effect when given in combination with other medicinal plants. A safe and nutritious medicinal plant like *Parṇayavānī* which can be easily cultivated as a garden plant in every home, if proved effective in various diseases via clinical trials, would be a great relief in the aspects of economic burden and adverse effects of the current treatment options of numerous diseases.

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## 7. Conflict of interest

The authors declare no conflict of interest.

## Abbreviations

C. M - Cikitsa Manjari

C. K – Cikitsa Koutukam

V. T – Vaidya Tarakam.

*P. amboinicus* - *Plectranthus amboinicus*

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