Review of *Jatwadi Dhoom Agad* as a proposed fumigation product for mosquito repellent and antimicrobial action

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**Article History:**

Received on: 02 Sep 2021
Revised on: 05 Oct 2021
Accepted on: 07 Oct 2021

**Keywords:**

Jatwadi Dhoom Agad, Dhoopana, Mosquito Repellent, Antimicrobial, Antiviral, COVID-19

**ABSTRACT**

Ayurveda has given much importance to prevent the diseases by stating various measures. Medicated smoke fumigation (*Dhoopana*) is one of such measures described for disinfection as well as protection from poisonous animals and insects. Herbal, herbo-mineral and animal origin formulations containing volatile oil and having antimicrobial property are used for medicated smoke fumigation. Fumigation with such drugs is safe, natural and cost effective technique. Mosquito borne diseases are major human health problem in all tropical and subtropical countries by affecting millions of people each year. Commercial repellents like Allethrin, DEET have been reported many harmful effects for humans. There is a need for further standardised studies in order to develop new products that offer high repellency as well as good consumer safety. A review is planned to investigate ingredients of *Jatwadi Dhoom Agad* through analyzing published experimental research work. Out of eight ingredients of *Jatwadi Dhoom Agad*, two showed mosquito repellent effect and three have mosquito larvicidal effect. This paper is foot step in the efforts to establish probable mode of action of *Jatwadi Dhoom Agad* as insect repellent. The effect of smoke of these drugs may be repellent for mosquitoes. All drugs have shown antimicrobial activity in vitro. This product has potential to be used as fumigation product in current COVID 19 pandemic.

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ISSN: 0975-7538
DOI: [https://doi.org/10.26452/ijrps.v12i4.4889](https://doi.org/10.26452/ijrps.v12i4.4889)

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**INTRODUCTION**

Ayurveda is ancient system of health care deals with the curative as well as preventive aspects of diseases. Ayurveda mentions the treatment modalities as *Bahi-parimarjana Chikitsa* (topical), *Anta-parimarjana Chikitsa* (systemic) and by *Shastrapranidhoana* (surgical intervention) (*Brahmananda*, 2000). *Dhoopana* (Medicated smoke fumigation) comes under topical (*Bahi-parimarjana*) treatment, has been told as a treatment in all the ayurvedic classics but detail description is present only in *Kashyapsamhita*.
‘Dhoopakalpa’ chapter.

Dhoopana Chikitsa exists since ancient time. It is in practice in India since time of Vedas to sterilize house and environment and is widely used in Ayurveda. Dhoopana has also been mentioned for its antimicrobial and growth promoting activities for the healthy production of plants in Vrikshayurved (Nene, 2014). Medicinal drug or mixture of medicinal drugs is burnt in a specific way to produce smoke is called as Dhoopa (Ayurvedic Pharmacopoeia Committee, 2011). Dhoopana creates an aseptic environment by killing microbes and thus, prevents infection. In Dhoopana only natural substances are used which is safe for environment as well as human beings. Herbs, minerals, and sometimes animal products (hair, horn) are mixed and the combination is used. Ayurveda mentions Dhoopana as a part of raksha vidhi procedure to ensure protection against microbes (Sharma, 2010). Ample references of Dhoopana are found in Bhratrayi proving their vital role in disinfection and sterilization. It is necessary to undergo detailed study to identify the bioactive chemical compounds of the formulations and establish their safety and efficacy profiles. Standardizing, characterizing and marketing these Dhoopana formulations are the need of the hour to bring a natural eco-friendly and cheap solution. Such formulations of Ayurveda are worth investigation in COVID 19 pandemic times, with a potential to disinfect COVID ward, homes, home isolation rooms, cloths and related items. As the herbal combo is stated to be rodent-repellent, it can be used by fumigation method in grain storage units and agricultural units to protect the grains from microbial contamination and rodents. Use of harsh chemicals can be prevented by this method.

Mosquito borne diseases and infectious air borne diseases are major human health problems in all tropical and subtropical countries by affecting millions of people each year. Personal protection measures such as mosquito repellents are an important tool against mosquito nuisance. Commercial repellents like Allethrin, DEET have been reported adverse effects like skin and eye irritation, sneezing, running nose, anxiety, nervousness etc (Veltri et al., 1994).

Mosquitoes (Mashak) are included in Kita varga by Sushruta (Sharma, 2001). Dhoopana technique is stated in Ayurveda for protection from Aagantuj factors (external agents). This mode has been in use for centuries in India for prevention from mosquitoes. The presently used products for repellent action can be harmful. The allethrins from mosquito coil repellents can cause inflammation of trachea (Abdul-laziz et al., 2020). There have been reports of convulsions by local application of insect repellent in kids (Lipscomb et al., 1992; Centers for Disease Control (CDC), 1989).

The Jatwadi Dhoom Agad is stated in Charak Samhita for protection from snakes, rats, insects and lice (Brahmananda, 1999). The Ayurvedic herbal combination may be used widely for purpose of disinfection and repellent for insects and rodents.

**Aim**

To review ingredients of Jatwadi Dhoom Agad formulation for potential mosquito repellent action.

**Objectives**

**Primary**

To detect evidences of antimicrobial and insect repelling activity of ingredients of Jatwadi Dhoom Agad.

**Secondary**

To review physical properties, phytochemicals and pharmacological action of the ingredients of Jatwadi Dhoom Agad.

**MATERIAL AND METHODOLOGY**

This review includes experimental research articles and systematic review articles related to mosquito repellent and Dhoopana Chikitsa area. The electronic bibliographic databases like AYUSH Research Portal, PubMed, Science direct and Google Scholar were searched. Manual search includes postgraduate and doctor of philosophy dissertations in Ayurveda. Physical properties, phytochemicals and pharmacological properties of the ingredients of Jatwadi Dhoom Agad along with their mosquito repellent, mosquito larvicidal and antimicrobial effects have been noted.

The anti-microbial effects through in vitro researches have been included in this review paper. Of course, in vitro action cannot be directly correlated with potential anti bacterial, antiviral or insect repellent action of a medicated fumigation. But these actions are reviewed in the present paper as many of the ingredients of Jatwadi Dhoom Agad have been investigated previously for these in vitro actions.

Most of the drugs of this formulation are safe and edible. This product can be used safely for fumigation. Many of the chemical insect repellent are strong harmful chemicals like allethrin, trans-allethrin etc. These are known to be harmful for humans and entire eco-system (Narendra et al., 2008).
Observations

The Jatwadi Dhoom Agad is stated in Charak Samhita Chikitsasthan chapter 23 Visha Chikitsadyayya used as fumigation for protection from snakes, rats, insects and lice. It consists of seven plants and one animal originated drug.

Table 1 shows Ayurvedic attributes of ingredients of Jatwadi Dhoom Agad (Figure 1).

Table 2 summarizes the information of phytochemicals and pharmacological effects of ingredients. Information of chemical composition and biological effect of these plants would be helpful in exploring its use as mosquito repellent.

Laksha

Solvent wise variations in antimicrobial activity of lac were observed against different test microbes. Acetone extract of lac showed antimicrobial activity against five microbes i.e. Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Xanthomonas citri and Erwinia carotovora, the highest being against Escherichia coli. It showed moderate activity against Erwinia carotovora and Xanthomonas citri and lesser antimicrobial activity against Bacillus subtilis and Staphylococcus aureus (Dinesh and Sirsikar, 2016). This proves the antimicrobial activity of Laksha.

Ushir

Vetiveria zizanioides (vetiver) against Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli and Corynebacterium ovis were evaluated. Against Saureus, vetiver oil was superior to the other two oils in the pure state and diluted with dimethyl sulphoxide 1:10, 1:100, 1:1000 and 1:10000; inhibition by the pure oil was 60-70% that by penicillin or streptomycin (Singh et al., 2013). It was found that VZ3 sample (Bamboo fiber: Vetiver root -70:30) was good in all aspects. These forms of natural insect repellent pouches were very safe and eco-friendly and protect us from mosquitoes and other insects (Manokari and Meenu, 2014). The larval mortality of A. stephensi after the treatment of methanol extract of V. zizanioides root extract respectively was demonstrated (Aarthi and Murugan, 2010). This validates the mosquito repellent and larvicidal action of Ushir.

Tejpatra

In-vitro antimicrobial potential of Cinnamomum tamala leaves extracts showed variable degree of inhibition zones against the selected six gram negative, three gram-positive bacterial strains and a fungus. All the extracts showed their best inhibitory activity against B. atrophaeus, amongst which the aqueous extract recorded the highest zone of inhibition measuring 38 mm (Hassan and Kazmi, 2016). Cinnamomum tamala essential oil and its major constituent, eugenol was evaluated for repellent, insecticidal, feeding inhibitory, oviposition inhibitory and acetylcholinesterase enzyme inhibitory activities in insect known as rice weevil, Sitophilus oryzae. In repellency assay, C. tamala oil and eugenol repelled S. oryzae adults significantly at 0.2% concentration. Essential oil of C. tamala and eugenol caused fumigant and contact toxicity in S. oryzae adults (Mukesh, 2016). The aqueous extracts of tamalpatra exhibited larvicidal activity against the 4th instar larvae of C. quinquefasciatus. Mortalities were reported to be directly proportional with concentration of aqueous extract of the plant (Iqbal et al., 2018). This validates the mosquito repelling and mosquito larvicidal action of Tamalpatra.

Guggul

Extract of Guggul gum possesses significant antibacterial activity against gram-positive bacteria and moderate activity against gram-negative once. S. aureus and S. aglactiae were found to be most susceptible organisms whereas E. coli was shown resistance and no inhibition reported for the Paeruginus (Kumara et al., 2017). This validates the antimicrobial activity of Guggul.

Bhallatak

Phytochemicals such as flavonoids, phenolics, saponins, alkaloids and glycosides possess anti microbial activity. Phenolic compounds are thought to be toxic to micro organisms, inhibiting the enzymes which are essential for the growth of microorganism (Bagewadi et al., 2012). This validates the antimicrobial activity of Bhallatak.

Arjun

The water and methanol extracts of T. arjuna bark produced significant zones of inhibition against twenty-two tested bacteria including eight uropathogens. MIC values against the bacteria were found in the range of 0.16 to 2.56 mg/mL. The polar extracts of T. arjuna also demonstrated strong antifungal effect against eight species of Candida, with MIC between 0.16 and 0.64 mg/mL (Debnath et al., 2013). This validates the antifungal activity of Arjun.

Sarja

Shorea robusta resin has a stronger and broader spectrum of antimicrobial activity against a number of pathogenic microorganisms. Aqueous extracts of Shorea robusta exhibits significant activity against Bacillus coagulans, Escherichia coli, Bacillus cereus and moderate inhibition on Salmonella typhi and

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Table 1: The ingredients of *Jatwadi Dhoom Agad* and their ayurvedic properties

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Drug</th>
<th>Botanical Name with family</th>
<th>Part Used</th>
<th>Rasa (Taste)</th>
<th>Guna (Physical properties)</th>
<th>Veerya (Potency)</th>
<th>Vipak (Post digestive effect)</th>
<th>Karma (Pharmacological action)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Laksha</td>
<td>Laccifer lacca Lacciferidae</td>
<td>Resin</td>
<td>Tikta, Kashaya</td>
<td>Snigdha, Laghu</td>
<td>Ushna</td>
<td>Katu</td>
<td>Pacify Kapha and Pitta, Vishaghna, Krimighna, Bhutaghna</td>
</tr>
<tr>
<td>2</td>
<td>Ushir</td>
<td>Vetiveria zizanioides Poaceae</td>
<td>Root</td>
<td>Tikta, Madhura</td>
<td>Ruksha, Laghu, Sugandhi</td>
<td>Sheeta</td>
<td>Katu</td>
<td>Pacify Pitta, Vishaghna</td>
</tr>
<tr>
<td>3</td>
<td>Tejpatra</td>
<td>Cinnamomum tamala Lauraceae</td>
<td>Leaf</td>
<td>Katu</td>
<td>Teekshna, Laghu, Sugandhi</td>
<td>Ushna</td>
<td>Katu</td>
<td>Pacify Kapha, Vata, Vishaghna</td>
</tr>
<tr>
<td>4</td>
<td>Guggul</td>
<td>Commiphora mukul Burseraceae</td>
<td>Resin</td>
<td>Tikta</td>
<td>Laghu, Ruksha, Teekshna, Sugandhi</td>
<td>Ushna</td>
<td>Katu</td>
<td>Pacify Kapha, Vata, Krimighna, Bhutaghna</td>
</tr>
<tr>
<td>5</td>
<td>Bhallatak</td>
<td>Semecarpus anacardium Anacardiaceae</td>
<td>Fruit</td>
<td>Katu</td>
<td>Laghu, Teekshna</td>
<td>Ushna</td>
<td>Madhura</td>
<td>Pacify Kapha, Vata, Krimighna</td>
</tr>
<tr>
<td>6</td>
<td>Arjun</td>
<td>Terminalia arjuna Combretaceae</td>
<td>Flower</td>
<td>Kashaya</td>
<td>Laghu, Ruksha</td>
<td>Sheeta</td>
<td>Katu</td>
<td>Pacify Kapha, Hrudya</td>
</tr>
<tr>
<td>7</td>
<td>Sarja</td>
<td>Shorea robusta Dipterocarpaceae</td>
<td>Resin</td>
<td>Katu</td>
<td>Gur, Ushna, Snigdha</td>
<td>Ushna</td>
<td>Katu</td>
<td>Pacify Kapha, Vata, Vishaghna, Bhutaghna, Grahaghna</td>
</tr>
<tr>
<td>8</td>
<td>Aparajita</td>
<td>Clitoria Ternatea Fabaceae</td>
<td>Root</td>
<td>Katu, Tikta</td>
<td>Laghu, Ruksha</td>
<td>Ushna</td>
<td>Katu</td>
<td>Pacify Kapha, Vata, Vishaghna, Grahaghna</td>
</tr>
</tbody>
</table>

Bacillus subtilis and less activity against Proteus vulgaris and Pseudomonas fluorescence. However, ethanolic extracts also exhibited significant activity against Staphylococcus aureus, S. epidermidis and Escherichia coli, moderate inhibition on Candida albicans and Bacillus coagulans. The petroleum ether extract showed activity against Escherichia coli, Aspergillus flavus and Candida albicans and whereas benzene extracts worked against Bacillus licheniformis, Bacillus cereus and Aspergillus flavus (Kumar et al., 2014). This proves the antimicrobial activity of Sarja.

Aparajita

The antimicrobial activities of methanol extracts using leaf, stems, seed and roots of C. ternatea against 12 bacterial species, two yeast species and three filamentous fungi. The tested microorganisms consist of B. cereus, B. subtilis, Bacillus thuringiensis, S. aureus, Streptococcus faecalis, E. coli, K. pneumoniae, P. aeruginosa, S. typhi, Enterobacter aerogenes, Proteus mirabilis, Herbaspirillum spp., Candida albicans, Saccharomyces cerevisiae, Rhizopus spp., Penicillium spp., and Aspergillus niger. The antimicrobial activities using disc diffusion assay of leaf and root extracts C. ternatea showed the most effective against all of the tested organisms with a zone of inhibition 10 mm to 25 mm (Jamil and Pa‘ee, 2018). Among the methanol extracts of C. ternatea leaves, roots, flowers, and seeds, the seed extract was effective against the larvae of all the three species with LC50 values 65.2, 154.5, and 54.4 ppm, respectively, for A.stephensi, A. aegypti, and C. quinquefasciatus. C. ternatea shows the most promising mosquito larvicidal activity (Mathew et al., 2009).

DISCUSSION

Mosquitos are known as Mashak in Ayurveda. These are nuisance to human health. They get attracted to humans through sense of warm and humid convection arising from human body and that of concentration of carbon dioxide. According to action, the mosquito repellent agents can be divided into two types viz. acting on olfactory senses and tactile senses. Olfactory mode is known as transpiration repellency in which repellent works by blocking humidity sensing holes of mosquitoes so they cannot locate humans. Tactile mode also known as direct contact repellency affects mosquito’s peripheral nervous system which leads them in a confused state and inhibits their behavior at sub-lethal doses, before knockdown. This drives the insects away off the surface before they can suck blood (Lalit et al.,...
Table 2: Phytochemical constituents of *Jatwadi Dhoom Agad* and their pharmacological properties

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Plant Name</th>
<th>Phytochemicals present</th>
<th>Pharmacological properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Laccifer lacca</em></td>
<td>Alkaloids, steroids, tannins, quinine, carbohydrates, saponins, flavonoids, phenol, triterpenoids, carboxylic acid (<a href="#">Shankar and Pradeep, 2017</a>)</td>
<td>Antimicrobial Activity (<a href="#">Dinesh and Sirsikar, 2016</a>)</td>
</tr>
<tr>
<td>2</td>
<td><em>Vetiveria zizanioides</em></td>
<td>Vetiverol, Vetivone, Khusimone, alkaloid, sterols, triterpenoids, saponins, tannins and flavonoids (<a href="#">Singh et al., 2013</a>)</td>
<td>Antibacterial (<a href="#">Singh et al., 2013</a>), Mosquito Repellent (<a href="#">Manokari and Meenu, 2014</a>), Larvicidal (<a href="#">Aarthi and Murugan, 2010</a>)</td>
</tr>
<tr>
<td>3</td>
<td><em>Cinnamomum tamala</em></td>
<td>Tannins, alkaloids, flavonoids and terpenoids (<a href="#">Hassan and Kazmi, 2016</a>)</td>
<td>Antimicrobial Activity (<a href="#">Hassan and Kazmi, 2016</a>), Insecticidal (<a href="#">Mukesh, 2016</a>), Mosquito Repellent (<a href="#">Mukesh, 2016</a>), Larvicidal (<a href="#">Iqbal et al., 2018</a>)</td>
</tr>
<tr>
<td>4</td>
<td><em>Commiphora mukul</em></td>
<td>Steroids, diterpenoids, aliphatic esters, carbohydrates, amino acids and triglycerides (<a href="#">Jasuja et al., 2012</a>)</td>
<td>Antibacterial (<a href="#">Kumara et al., 2017</a>)</td>
</tr>
<tr>
<td>5</td>
<td><em>Semecarpus anacardium</em></td>
<td>Bioflavonoids, phenolic compounds, bhalawans, minerals, vitamins and amino acids (<a href="#">Paras et al., 2014</a>)</td>
<td>Antimicrobial (<a href="#">Bagewadi et al., 2012</a>)</td>
</tr>
<tr>
<td>6</td>
<td><em>Terminalia arjuna</em></td>
<td>Flavonoids, tannins, phenols, phytosterols, saponins and alkaloids (<a href="#">Mandal et al., 2013</a>)</td>
<td>Antibacterial and antifungal activity (<a href="#">Debnath et al., 2013</a>)</td>
</tr>
<tr>
<td>7</td>
<td><em>Shorea robusta</em></td>
<td>Carbohydrates, alkaloids, tannins, glycosides, phenols, saponins, terpenoids, flavonoids (<a href="#">Marandi et al., 2016</a>)</td>
<td>Antimicrobial (<a href="#">Kumar et al., 2014</a>)</td>
</tr>
<tr>
<td>8</td>
<td><em>Clitoria ternatea</em></td>
<td>Tannins, Resins, Alkaloids, Glycosides, Steroids, Saponins, Flavonoids and Phenols (<a href="#">Manjula et al., 2013</a>)</td>
<td>Antimicrobial (<a href="#">Jamil and Pa’ee, 2018</a>), Larvicidal (<a href="#">Mathew et al., 2009</a>)</td>
</tr>
</tbody>
</table>

2015). The chemical agents used for this can be harmful to humans also.

The fumigation therapy is practiced all over the world across various cultures and civiliza-
tions ([Mohagheghzadeh et al., 2006](#)). Fumigation referred as *Dhoopana* in Ayurved classics is pre-
scribed for treatment of various ailments and disinfection of environment and inanimate objects. The effectiveness of fumes which emanate by burning plants products in rituals (yagnas or havan-offering of various material including plants products through fire) to reduce airborne bacteria and as a part of prescribed procedure for treatment of bacterial infections has been reported ([Nautiyal et al., 2007](#)). Generally *Dhoopana yoga* contains aromatic plants as well as resins to bind it together. In *Jatwadi Dhoom Agad, Tamalpatra, Guggul, Sarja, Ushir* etc are aromatic while *Laksha, Guggul, Sarja* contains binding resins.
Most of the ingredients of Jatwadi Dhoom Agad are having Katu, Tikta and Kashayarasa, Teekshna guna with Ushna veerya. They have predominance of Vayumahabhoot along with Agni, Akash and Prithvimahabhoot respectively. Vayu and Akash are responsible for quicker combustion and rapid spread of smoke. These all are having resins, oleoresins, phenolic compounds, flavonoids, volatile oils and essential oils. After burning the Dhoom agad, volatile principles are released in air. Due to predominance of Vayu, Agni and Akash, the smoke has tendency to move upward and spreads quickly everywhere. Being very subtle, smoke can reach in the minute space and carry all the properties of all its ingredients. Due to hot property of ingredients the temperature of atmosphere increases which is opposite to damp and humid conditions. The formulations consist of drugs that show a synergetic effect and help in propagating the activity of the main repellent drugs. So collectively this is useful to generate smoke (Dhoom) which exerts its action.

The ingredient Bhallatak contains fixed oil which is irritant. Ushir, Tamalpatra and Aparajita already showed mosquito repellent and larvicidal activity. Hence all these properties synergistically may act for obtaining the mosquito repellent effect of Jatwadi Dhoom Agad.

As an effect of combustion of Jatwadi Dhoom Agad, aromatic and irritant volatile oil vapors are released this may block the olfactory receptors of mosquitoes stimulating the biochemical changes in the CNS. As mosquitoes sense these irritant vapors faster with the chemoreceptors than tactile so they don’t attract towards the humans. Also mosquitoes are kept away as they may not like produced gases due to burning of drug. Due to oil containing drugs the smoke may remain for a longer time in atmosphere so generally we get more protection time.

One of the ingredients Bhallatak is reported under Upavisha Dravya in classical ayurvedic texts. It is observed that Shodhana (purification procedures) of the fruits should be carried out before its internal administration to reduce the irritation (Kashinath, 2012). A systematic study can be planned further to assess activity and safety of smoke of raw and purified Bhallatak to humans.

CONCLUSION

Jatwadi Dhoom Agad is Dhoopana formulation stated in Charak samhita for protection from poisonous animals and insects. This literature review suggested that out of eight ingredients of Jatwadi Dhoom Agad all are having antimicrobial activity, two showed mosquito repellent effect and three showed mosquito larvicidal effect. This formulation can be used to get relief from mosquito nuisance and for prevention from vector borne diseases. This also may be effective for sanitizing COVID wards, hospital beddings, curtains, related things. It can be used for fumigation to repel insects and for antiviral action. Further research is necessary for validation and wide use of this formulation as fumigation product.

ACKNOWLEDGEMENT

The corresponding author expresses sincere gratitude to Dr Reena Kulkarni, Professor and Head, Dept of Kaumarabhritiya, SDM college of ayurveda & hospital from Hassan, Karnataka.

Future Challenges

There is need of further experimental studies to determine the effective dose of repellency and average protection time of the Jatwadi Dhoom Agad; as such studies were not found during the review. How drug works in reference to change in humidity and temperature, identification of bioactive compounds, human safety evaluation of this drug is also needs to be studied.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding Support

The authors declare that they have no funding support for this study.

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