

A Review on the Medicinal Plants for Tobacco Cessation

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Abstract

Tobacco use is one of the major causes of mortality due to non-communicable diseases. The chemicals present in tobacco affect almost all the parts of the body and cause various diseases. Although majority of the tobacco users are aware about the ill effects of tobacco, they are unable to quit because of the presence of highly addictive substance nicotine. Tobacco users experience various withdrawal symptoms in their attempt to quit which further discourages them from quitting. Despite the fact that Nicotine replacement therapy (NRT) is found to be effective, it is associated with several side effects. Natural products or herbal remedies are safer alternatives to NRT. Numerous herbs with antioxidant and antianxiety properties have been tried to combat nicotine withdrawal symptoms and thereby facilitate tobacco cessation. Alternative therapies those are easily available, with fewer side effects can be used to reduce the burden of tobacco in the world. In this review, we have enlisted the various herbs that have been used for tobacco cessation with their medicinal properties and effects on nicotine and tobacco.

Keywords: Medicinal plants; herbs; nicotine; tobacco cessation; NRT.

Background

Worldwide tobacco use is the major cause of mortality due to non-communicable diseases. The use of tobacco is associated with cardiovascular diseases, stroke, different cancers and neurological disorders. It has been anticipated that by 2030, each year tobacco will kill more than 8 million people worldwide, with 80% of these premature deaths occurring among people living in low- and middle-income countries. [1] The tobacco cessation interventions developed by Clinical practice guidelines mainly focus upon high-income countries. Tobacco cessation interventions that are administered in high-income countries may not be effective in low- and middle-income countries. Medications may not be affordable and easily accessible to the population. [2] Herbal products are economical and also have been found to reduce the addictive effects of nicotine with lesser side effects compared to Nicotine replacement therapy. This review is undertaken with the aim to highlight the various medicinal plants, their health benefits and role in tobacco cessation.

Medicinal plants used in tobacco cessation

Ashwagandha

Ashwagandha -*Withania somnifera* is a medicinal plant available over a vast area of the South East Asia, Mediterranean region and South Africa. In conventional systems of medicine, different parts of the plant and even the whole plant have been recommended for the treatment of various diseases like bronchitis, asthma, ulcers, emaciation, Parkinson's disease, insomnia and senile dementia etc.

Various research has supported the therapeutic use of ashwagandha for inflammation, anxiety, cognitive and neurological disorders. It has also been used in patients undergoing radiation and chemotherapy because of its chemo preventive properties. Ashwagandha is also used as an immune stimulant, aphrodisiac, anti-ageing, cardio protective and anti-carcinogenic agent. [3, 4]

In a study conducted by Dumore NG et al. the effect of withania somnifera extract (WSE) on nicotine mediated reinforcement effect and withdrawal symptoms was investigated in Swiss albino mice. It was found that WSE pretreatment reversed the anxiolytic effect of Nicotine withdrawal by inhibiting the nicotine induced development and expression of locomotor sensitization. They concluded that WSE could serve as an effective herbal medicine in reducing nicotine mediated reinforcement and withdrawal signs. [5]

Amla

Amla commonly known as Indian gooseberry is one of the routinely used plant in traditional medicine. *Emblica officinalis* Gaertn. or *Phyllanthus emblica* Linn, are the scientific names of Amla. In various ayurvedic preparations, all parts of the plants are used including the flowers, fruit, seed, root, leaves and bark. Amla has been found to have immunomodulatory, analgesic, anti-tussive, adaptogenic, antiatherogenic, cardioprotective, gastroprotective, nephroprotective, neuroprotective, chemopreventive and anticancer properties. Amla has been used in the treatment of various diseases like migraine, anemia, jaundice, gout, asthma, bronchitis, diarrhoea, dysentery, leprosy etc. [6, 7]

A study was done by Biswas TK et al. to evaluate the effects of *Emblica officinalis* fruit extract (EOE), in volunteers with a long smoking history to determine the cardio-respiratory and antioxidant status. The study was conducted in two groups – one treated with 250 mg BID of EOE and the other with a placebo. The study participants were aged between 20 and 60 years, with history of smoking more than 15 cigarettes/day for higher than 10 years. Subjective parameters associated with smokers and the objective parameters were evaluated. EOE showed improvement in smoking related subjective parameters such as shortness of breath on exertion, cough with expectoration, heart burn, oral hygiene, insomnia and tiredness when compared to baseline values. Objective parameters – hemogram, lipid profile, cardiovascular risk factors, genotoxicity, antioxidant status and pulmonary function showed a significant improvement when compared to the placebo group. [8]

Brahmi

Bacopa monnieri also called as Water hyssop and “Brahmi” is conventionally used as a brain tonic to strengthen memory and learning, and also for relief of anxiety or epileptic disorders. In India and the tropics, it grows naturally and the entire plant is used for medicinal purposes. It is used in the treatment of bronchitis, asthma, dermatitis, anaemia, diabetes, hoarseness, cardiac disorders, insanity, and epilepsy. It is also used as a blood purifier and management of cataract. Brahmi has anti-cancer, anti-inflammatory, antidepressant, anxiolytic, analgesic and potent antioxidant properties. [9]

A study done by Vani G et al., in rats, demonstrated that Bacoside A (BA), a neuroactive agent isolated from *Bacopa monnieri* was effective in combating the changes observed in rat brain. Significant changes in rat brain histologically and at the neurotransmitter level due to chronic exposure to cigarette smoke could be reduced by the use of Bacoside A. They concluded that BA may represent a future therapeutic means for secondary smoke. In addition to its neuroactive role, Bacoside A due to its anti-inflammatory and antioxidant properties may aid in improving conditions related to oxidative stress. [10]

Black pepper

Black pepper (*Piper nigrum*) is an aromatic spice native to India and has been widely in use since several years. The uses of black pepper in various fields have increased actively due to its natural antioxidant and anti-carcinogenic properties. It also has immune enhancer ability, anti-pyretic, antimicrobial, anti-inflammatory, bioavailability enhancement nature, carminative and cholesterol lowering property. It has been used in the treatment of insomnia, cold, cough, dyspnea, hoarseness, gangrene, oral abscesses, diseases of the throat and digestive system etc. [11, 12]

A study done by Rose EJ and Behm FM, to investigate the subjective effects of a cigarette substitute delivering a vapor of black pepper essential oil reported that the craving for cigarettes was significantly reduced. Forty-eight cigarette smokers after overnight smoking deprivation participated in a 3-h session. Subjects were randomly assigned into three groups; one group puffed on a device that delivered a vapor from essential oil of black pepper, a second group puffed on the device with a mint/menthol cartridge, and a third group a device containing an empty cartridge. Negative affect and somatic symptoms of anxiety were reduced in subjects who puffed on the vapor of black pepper. [13]

Cardamom

Cardamom (*Elettaria cardamomum* Maton) is an aromatic spice crop used as a flavoring agent in food preparations, confectioneries, cosmetics, and medicines. It is also known as the “queen of spices”. Cardamom has been used for improving digestion, as well as for flavoring sweets and hot beverages such as tea and coffee. Cardamom is known to have cardiac stimulant, diuretic, digestive, expectorant, antihelminthic, antibacterial, antiseptic and anti-inflammatory properties. It can be used as medicine for congestion of lungs, digestive disorders, antidote for snake venom, etc. [14]

In a study done by Cohen LM, to evaluate the effects of flavored chewing gum on the severity of acute nicotine withdrawal symptoms, they found that Vanilla and baked apple cardamom flavored gum resulted in lower levels of anxiety and dysphoria, while peppermint flavored gum was similar to the no gum control. These findings indicate that some flavors of gum may be effective in reducing the negative affect associated with nicotine withdrawal and can help smokers to quit the habit. [15]

Cinnamon

Cinnamomum zeylanicum, and Cinnamon cassia commonly known as Cinnamon is one of the most frequently used spices all over the world. Cinnamaldehyde, cinnamic acid, and cinnamate are some of the vital oils present in Cinnamon. It has anti-inflammatory, antioxidant, antimicrobial, antifungal, antidiabetic, insecticidal and anticancer activities. Cinnamon has conventionally been used as tooth powder to treat toothaches, periodontal problems, and halitosis. [16, 17]

A study was conducted by Taha M et al., on morphological changes in the prefrontal cortex of adult male albino rats induced by nicotine to investigate the antioxidant effects of ginger, cinnamon oils, and their combination. They observed a lesser degree of oxidative stress, reduced neuronal cell degeneration and pyknosis, and a reduction in the inflammatory marker TNF- α in rats who received nicotine plus cinnamon and nicotine plus ginger, when compared to the control and nicotine group of rats. There was a significant improvement by the combined usage of cinnamon and ginger oils. They concluded that Ginger and cinnamon are powerful antioxidants which improve the degenerative and oxidative effects of nicotine on a rat's prefrontal cortex. [18]

Ginger

Ginger also known as Sunthi and by the scientific name *Zingiber officinale*. It is cultivated throughout India and has been used in the management of various diseases like rheumatoid arthritis, neuromuscular disorder, cardiac and gastrointestinal diseases. It has antiplatelets, anti-fungal, anti-inflammatory, antibacterial and anti-oxidant activity. Apart from these it has hypolipidemic, anticarcinogenic and anti-thrombolytic activity. [19]

According to de Mesquita MF et al., a significant increase in salivary flow rate of smokers was noted after the ingestion of 0.5g of ginger infusion three times a day for 28 days. Ginger infusion exhibited a high level of antioxidant activity. They collected the non-stimulated and stimulated saliva before and after the intervention and reported that there was a difference between the average salivary flow rate before and after the ingestion of ginger infusion. A statistically significant increase was observed in non-stimulated and stimulated salivary flow rate after 28 days of ginger infusion intervention. [20]

Ginseng

Panax ginseng also known as Asian ginseng, Chinese ginseng, or Korean ginseng is a perennial plant that is found in the mountains of East Asia. A common name for ginseng is ‘man-root’ because of its resemblance to the human body. The name also implies that it has benefits for the whole body. Ginseng has been used as an adaptogen to augment the resistance to stress in an individual. It has anti-bacterial, anti-viral, anti-carcinogenic, anti-inflammatory, anti-allergic, immunostimulant, antioxidant and hypoglycemic effects. It has been used in the treatment of various diseases like Alzheimer's, Parkinsonism, immune deficiency, cardiovascular diseases, obesity and hepatotoxicity. [21, 22]

A study was done by Lin H et al., to evaluate the protective effect of total Saponins from American ginseng against cigarette smoke induced Chronic Obstructive Pulmonary Disease (COPD) in mice. They found that the biological activity test showed both total saponins from wild-simulated American ginseng (TSW) and the total saponins from field-grown American ginseng (TSF) could relieve the weight loss, improve the lung function, prevent the COPD progression, regulate the pro-inflammatory factors and oxidative stress index in cigarette smoke induced COPD in mice. TSW was found to be more effective than TSF. [23]

Guduchi

Guduchi or Giloya, scientific name *Tinospora cordifolia* is one of the commonly used herbs in Ayurvedic medicine. It has been referred as the “nectar of immortality” and “heavenly elixir”. It grows as a vine usually on Mango or Neem trees. It is native to India, Myanmar, and Sri Lanka. Guduchi typically grows in deciduous forest areas. The parts of the plant used in medicine formulations are the stems, leaves, and roots. It has antihelmenthic, anti-inflammatory, antipyretic, aphrodisiac, hepatoprotective, anti-diabetic, anti-cancer, antioxidant and immunity boosting properties. [24, 25]

Singh R and Singh K conducted a study to evaluate the protective activity of guduchi and green tea extract on nicotine induced toxicity and to determine the effects of nicotine on various hematological parameters in adult male mice. They found that nicotine administration resulted in toxic effects on various hematological parameters in mice and suggested that green tea and guduchi could help trigger the immune system and boost the body of person who regularly consumed nicotine. [26] A review conducted by Suvitha SV et al., to determine the role of guduchi in prevention of oxidative stress. It was concluded that the phenolic content of guduchi is responsible for the antioxidant activity and that it can be used in the prevention of oxidative stress. [27]

Neem

Azadirachta indica is the botanical name for neem which is endemic to India and Burma. It grows in parts of southeast Asia and West Africa, and more recently Caribbean and south and Central America. The various medicinal properties of neem include analgesic, anthelmintic, antibacterial, antiulcer, antifungal, antihyperglycemic, anti-inflammatory, antiviral, antimalarial, antioxidant, diuretic, antipyretic, antitumor, immunomodulatory etc. All parts of the tree have been used for medicinal application. It has been used in Ayurveda from more than 4000 years. It has also been used to reduce dental plaque and oral bacteria. It has also been reported that neem may inhibit *Streptococcus mutans* and prevent initial dental caries. [28]

A study was done by Lee J-W et al., to investigate the protective effects of neem leaf extract (NLE) against lipopolysaccharide and cigarette smoke induced pulmonary inflammation. Treatment with NLE markedly reduced the infiltration of inflammatory cells in bronchoalveolar lavage fluid (BALF). NLE also minimized the production of reactive oxygen species and neutrophil elastase in BALF. Based on these findings they suggested that NLE could be used in the treatment of chronic obstructive pulmonary disease. [29] In a letter to the editor by Dwivedi S and Chopra D, they reported a case of 55-year-old male chronic tobacco chewer who was able to quit the habit by chewing tender neem leaves. He used about 5-gram neem leaves daily for one month which had completely eliminated his tobacco urge. [30]

Oats

Avena sativa is the scientific name of oats which is a species of cereal grain grown for its seeds. Oats have been cultivated from two thousand years in different regions throughout the world. Oats originated in England, France, Poland, Germany, and Russia and presently cultivated worldwide. The various health benefits of oats include anti-hyperlipidaemia, anti-diabetic, anti-tumor effect, anti-inflammatory, Cognitive function improvement, anti-depressant activity, anxiolytic effect, antifungal, hepatoprotective action, promotes wound healing, antioxidant, etc. [31]

A study was conducted by K Schmidt and K Geckeler, on 100 smokers with an average consumption of 20 cigarettes per day using an alcoholic extract of *Avena sativa* for disaccustoming. The first result was a placebo-effect of 35% for disaccustoming and there was no statistically significant effect of the extract of *Avena sativa*. The second result was that the rate of habit reduction or disaccustoming was higher for light smokers than for heavy smokers. [32] Anand CL in 1971 conducted a study on 26 cigarette smokers. By random allocation, thirteen patients received the alcoholic extract of *Avena sativa* and the others received placebo for 28 days. In the *Avena sativa* group various degrees of loss of craving for cigarettes was reported. It was also found to reduce the number of cigarettes smoked per day, along with diminished craving for smoking. Moreover, the reduction in smoking continued even 2 months after the termination of the drug. [33]

Plantago major

Plantago major is a species of flowering plant in the family Plantaginaceae. The plant is found in most of Europe, northern and central Asia. All parts of the plant have been used as herbal medicine. *Plantago major* has been found to possess anti-inflammatory, antitumor, antimicrobial, anti-ulcerogenic, anti-nociceptive, antioxidant, immune enhancing and hepatoprotective properties.

It has been used in the therapy of various diseases like asthma, bronchitis, cystitis, urinary tract infections, stomatitis, etc. [34]

Shukla I conducted a study to evaluate therapeutic effects of *Plantago major* in reducing tobacco cravings. 30 tobacco users were selected for the study of which 27(90%) patients showed a change in their tobacco dependence whereas 3 (10%) patients did not show any variation in tobacco craving. The change in tobacco dependence was assessed using Fagerstrom test. The traditional use of *Plantago major* in homeopathic medicine to reduce tobacco dependence was confirmed. [35]

Tulsi

Tulsi also called as Holy Basil is an aromatic shrub with scientific name *Ocimum sanctum*. In Ayurveda it is also described as “The incomparable one,” “Mother medicine of nature” and “The queen of herbs”. Tulsi has antimicrobial (including antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, anthelmintic), analgesic, antioxidant, anti-cataract, anti-inflammatory, chemopreventive, radioprotective, hepatoprotective, neuroprotective, cardioprotective, anti-diabetic, anti-hypercholesterolemia, anti-carcinogenic, antipyretic, anti-allergic, immunomodulatory, central nervous system depressant, memory enhancement, antiasthmatic, antitussive, adaptogenic, anti-stress activities etc. Tulsi helps in the prevention of cancers by reducing DNA damage caused by toxic compounds. It also enables the body to more efficiently transform and eliminate the toxic compounds. [36, 37]

A study was conducted by Sudha GS and Jagadeesh G to evaluate the effect of *Ocimum santum* oil in dyslipidemia treatment in cigarette smoke induced Albino mice. They divided the mice into four groups, each consisting of six mice. Group-I normal, did not receive any treatment. Group-II exposed to cigarette smoke, Group-III mice administered with *Ocimum sanctum* oil orally and Group-IV mice co treated with oil and smoke for 20 days. Biochemical estimations such as Total Cholesterol, HDL, LDL, VLDL, Triglycerides levels were estimated and it was found that Group-I mice showed no change in lipid metabolism but experimental mice that is treated with *Ocimum sanctum* oil showed low levels of serum and tissue cholesterol and triglycerides. *Ocimum sanctum* oil demonstrated to have blood lipid level reducing properties. [38]

Turmeric

Turmeric is a spice that belongs to the ginger family. Also known as *Curcuma longa* has been used widely because of its various medicinal properties and health benefits. It is cultivated on a large scale in tropical areas of Asia. The rhizome of the plant is the part that is most widely used. Turmeric is used due to its numerous biological effects including anti-inflammatory, antimicrobial, anticancer activity, antioxidant, and neuroprotective properties. It is also used in the management of dyslipidemia, anxiety, stomach disorders, arthritis, and hepatic diseases. Turmeric has been used as a spice, dye, food coloring agent, medicine and dietary supplement. [39, 40]

Wilar G et.al conducted a study to determine the mechanism of inhibition of nicotine dependence by curcuminoid in mouse brain. They found that curcuminoid, the anti-inflammatory agent present in Turmeric prevents nicotine dependence and relapse. Curcuminoid dose-dependently inhibited nicotine dependence and enhanced nicotine elimination when given 30 minutes before nicotine administration for 7 days. It was concluded that curcuminoid relieves nicotine dependence and relapse by inhibiting the Acetylcholine esterase activity in brain. [41] A study was done by Vijayalakshmi N et al., to evaluate the usefulness of curcumin on the palatal changes associated with reverse smoking. The study sample consisted of two groups with ten reverse smoking patients each. Group A patients were advised to use curcumin oral gel on an acrylic palatal plate and group B patients were advised about the benefits of smoking cessation. Clinical and cytological smear examinations were conducted at the first and at the end of the third visit. Statistically significant improvement was noted at both first and third visits with reduction in size and severity of the clinical lesion in group A patients when compared to the group B. [42]

Conclusion

Although various studies have found the beneficial effects of herbal products in tobacco cessation, these herbs are not being fully utilized and promoted for use in tobacco cessation interventions. Majority of the studies are animal experimentation showing the beneficial effects of different herbs in tobacco cessation. There is a need to carry out clinical trials in humans based on the safety and efficacy of the herbal agents determined by animal experimentation.

A combination of herbs with antioxidant, anti-anxiety, immunomodulatory and anti-cancer activities can be valuable in promoting tobacco cessation and also reducing the tobacco withdrawal symptoms. Herbal agents are less expensive with fewer side effects which can be used in medicine formulations to reduce nicotine withdrawal symptoms and thereby promote quitting of tobacco. Reducing the tobacco burden will minimize the financial strain of the society as well as save millions of lives lost due to tobacco consumption.

List of Abbreviations

BALF – bronch oalveolar lavage fluid

BA – Bacoside A

BID – “bis in die” – meaning twice a day

COPD – Chronic Obstructive Pulmonary Disease

DNA – Deoxyribo nucleic acid

EOE – Emblica officinalis fruit extract

HDL – High-density lipoprotein

LDL – Low-density lipoprotein

NLE – Neem Leaf Extract

NRT – Nicotine Replacement Therapy

TNF- α – Tumor Necrosis Factor – α

TSW – total saponins from wild-simulated American ginseng

TSF – total saponins from field-grown American ginseng

VLDL – Very-low-density lipoprotein

WSE – Withania somnifera extract

Ethics Approval

Not applicable

Competing Interests

The authors declare that they have no competing interests.

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