

Potential of “Tar Clean” in the Treatment of Air Pollution Related Disorders

Randhir Singh^{1*}, Krishan D. Arora², Manisha Arora², Harjinder Singh²¹MM College of Pharmacy, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India.²Le-Vanza food and Herbals, Punjab, India.

Received: 12th March, 2021; Revised: 27th April, 2021; Accepted: 22nd May, 2021; Available Online: 25th June, 2021

ABSTRACT

Air pollution is considered a significant factor responsible for many diseases related to the respiratory system. Several toxic chemicals are present in polluted air, leading to asthma, COPD, and several types of lung cancer. Among these pollutants, Tar, which is present in the air and cigarette smoke, is responsible for lung cancer and other respiratory disorders. Although several medicaments are available to treat respiratory disorders, herbal drugs are gaining much attention these days. In Ayurveda and ancient literature, several drugs are mentioned to treat respiratory diseases. Among these herbals, *Glycyrrhiza glabra*, *Ocimum sanctum*, *curcuma longa*, *Phyllanthus emblica*, *Terminalia chebula*, *Terminalia Bellirica*, *Allium sativum*, *Rabia cardifolia*, *Piper nigrum*, *Zingiber officinale*, *Piper longum*, *Cinnamomen Zeylenicum*, *Vitis vinifera*, *Sea Backthorn*, *Abies Webbiana*, *Cassia fistula*, and *Piper cubica* were found to have significant potential in the treatment of respiratory diseases. One such product named “Tar Clean” by Le-Vanza food and Herbals is available in Indian markets. In this formulation, 19 herbal drugs are present, and these drugs have significant activity against Tar and other pollution-related respiratory disorders. Based on the constituents present in “Tar Clean,” this review has been designed to explain the potential of “Tar Clean” in the management of disorders due to air pollution

Keywords: Air Pollution, Cost-effective Remedies, Herbal Drugs, Respiratory diseases

International Journal of Pharmaceutical Quality Assurance (2021); DOI: 10.25258/ijpqa.12.2.10

How to cite this article: Singh R, Arora KD, Arora M, Singh H. Potential of “Tar Clean” in the Treatment of Air Pollution Related Disorders. International Journal of Pharmaceutical Quality Assurance. 2021;12(2):65-75.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Air pollution has become a severe issue for public health globally and is considered a significant issue both in developed and developing countries.¹ As per the World Health Organization (WHO) report in 2008, 1.3 million deaths were found to increase air pollution worldwide. Moreover, the count of death increased approximately three times to 3.7 million in 2012. Two million deaths were related to household air pollution in 2008, and this number also increased more than double (4.3 million) as per WHO 2012 data.² Air pollution has become a very severe environmental problem in developed countries like USA, UK, Japan, and European countries. Moreover, developing countries face more severe air pollution because of intense energy consumption due to fossil fuel, large-scale construction activities, and increased emissions of pollutants due to transportation and urbanization.

Air pollution affects almost every organ and system in the body. It can induce or aggravate certain diseases like cardio-cerebral vascular disease, ischemic heart disease^{3,4} and also adversely affects the nervous system, digestive system,⁵ and urinary system [Biggeri *et al.*, 2004]. Air pollution is responsible for mortality due to respiratory diseases like

chronic obstructive pulmonary disease (COPD)⁶ asthma, and lung cancer.¹

Several pollutants are suspended in the air as smoke, dust particles, mists, Tar, fumes, gaseous pollutants, volatile organic compounds and hydrocarbons (VOCs), halogen derivatives in the air etc., High concentrations of pollutants are responsible for the susceptibility to various diseases like respiratory disorders and several types of cancers.^{7,8} Tar is a sticky substance found in tobacco leaves, and Tar is a compound term used for the particulate matter condensed from tobacco smoke. Tar includes most mutagenic and carcinogenic agents (more than 40 cancer-causing chemicals) in tobacco smoke.⁹ Tar is responsible for providing the taste and aroma to cigarette smoke which affects the behavior of smokers. Considering the association of harmful effects of Tar, it is measured along with nicotine in tobacco smoke. Tar is considered the most health-damaging component of tobacco.¹⁰ Tar envelops lungs and air sacs in smokers leading to lesser accessibility to oxygen. Moreover, Tar also results in the cilia neutralization in the windpipes, and as a result, smoke, dust particles, and pollen are not swept out of the air passages. Several organs, not only the mouth, vocal cords, throat, and lungs, but also the kidneys,

*Author for Correspondence: randhirsingh.dahiya@gmail.com

bladder, and uterus and ovaries in women are affected by Tar in the smoke.¹¹

Particle pollution, also called PM, vary in size ranging primarily from 2.5 to 10 µm (PM_{2.5} to PM₁₀) and found to be associated with several pulmonary and cardiac-associated morbidity and mortality.¹² The severity of illness depends on the level of exposure, and it may be from mild to moderate. Cough, difficulty in breathing during physical work, wheezing, cough, dry mouth, and limitation in activities due to breathing problems are some of the most prevalent symptoms associated with respiratory disease resulting from air pollution.¹³ Attenuated functions of lungs in children and adults result in asthma, bronchitis, and chronic obstructive pulmonary disease (COPD), which affects the quality of life and reduces life expectancy. Several cohort studies have proved the effect of long-term exposure of PM on cardiovascular and cardiopulmonary mortality.¹⁴

Since ancient times, herbal drugs have been used to manage and cure several diseases, but their use has dramatically increased in the last decade. By the end of the 20th century, 170 herbal drugs got official recognition to treat diseases. According to the WHO, 80% of the world's population depends on herbal drugs for their primary health-related needs, and 11% of drugs are of plant origin among the essential drugs.¹⁵ Approximately 70–95% of developing countries use herbal drugs for primary health care.¹⁶

Following are herbal drugs mentioned in the literature for their role in treating respiratory diseases.

1. *Glycyrrhiza glabra*

Synonym: Liquorice

Glycyrrhiza glabra Linn. (Fabaceae family) has been recognized since ancient times for its ethnopharmacological and medicinal values. The liquorice powder and extract have been used to treat sore throat, cough, and bronchial catarrh. Moreover, *Glycyrrhiza glabra* is also found to possess significant anti-tussive, demulcent, and expectorant properties. Glycyrrhizin is the main constituent present in the *Glycyrrhiza glabra* and responsible for the mentioned activities. Glycyrrhizin also relieves congestion in the upper respiratory tract and mobilizes tracheal mucus secretion.¹⁷ It has been recently found that liquiritin apioside is an active compound present in the methanolic extract of liquorice. The compound inhibits capsaicin-induced cough.¹⁸ Glycyrrhizin, the main active constituent of liquorice, comprises two molecules of glucuronic acid and one molecule of 18 β-glycyrrhetic acids.¹⁹ Glycyrrhizic acid produces its immunosuppressive response by attenuating IL-4, IL-5, and IL-13 levels and increasing IFN-γ cytokine levels.²⁰ Liquorice has been found to treat sore throat, and efficiency is found equal to codeine. It attenuates irritation and produces expectorant effects, but the mechanism is not apparent. Carbenoxolone, which is a semisynthetic compound derived from *Glycyrrhiza* was found to stimulate gastric mucus secretion. Likewise, liquorice extract also stimulates tracheal mucus secretions resulting in demulcent and expectorant effects.²¹

Glycyrrhizin is responsible for demulcent action of liquorice. Liquiritin apioside, inhibits capsaicin-induced cough⁸ Moreover, ethanolic extract of *G. glabra* inhibited 35.62% SO₂ gas-induced cough in mice.¹⁹

2. *Ocimum Sanctum*

Synonym: *Ocimum tenuiflorum*, Tulsi

Ocimum sanctum is an aromatic-medicinal plant of the genus *Ocimum* belonging to the family Lamiaceae or Labiatae. *O. santum* or Tulsi has been mentioned in the ancient literature for the treatment of several disorders like common cough and cold, demulcent, expectorant, chronic antiemetic fever, analgesic, gastrointestinal disorders, inflammation, anti-fertility cardiovascular disorders, anti-infective, anti-arthritis, eye problems, hepatoprotective, antispasmodic, bronchitis, catarrhal fever and several forms of poisoning and malaria.^{22,23} Traditionally, *O. sanctum* L. is absorbed in several forms like herbal tea, dried powder, or fresh leaf.²² Several chemical constituents are present in *O. sanctum*, such as linalool, eugenol, oleanolic acid, rosmarinic acid, ursolic acid, carvacrol, β elemene, β caryophyllene, and germacrene. Moreover, *O. sanctum* possesses significant diuretic and stimulant activity²⁻²⁵ *O. sanctum* is an active diaphoretic agent for treating the common cold and expel excessive cough from lungs and nasal pathways.

Moreover, in India, a decoction of Tulsi leaves is a trendy remedy for treating the common cold. Decoction of Tulsi leaves along with the clove is also used for the treatment of fever. Tulsi is an essential constituent of many cough syrups and expectorants and responsible for the mobilization of mucus in bronchitis and asthma.^{25,26} The steam distilled extract from the fresh leaves of OS produced a significant alteration in the humoral immune response in albino rats and increased antibody production, released mediators of hypersensitivity reactions, and altered the tissue responses to these mediators in the target organs. Oil for the seeds of *O. sanctum* was also found to modulate both humoral and cell-mediated immune reactions and GABAergic pathways.^{25,27,28} *O. sanctum* was found to possess significant antioxidant activity, and flavonoids (orientin and vicenin) were found to be responsible for significant attenuation in radiation-induced lipid peroxidation in mouse liver. OS extract has a significant ability to scavenge highly reactive free radicals.

Moreover, some phenolic compounds like rosmarinic acid, cirsilineol, isothymusin, apigenin, cirsimaritin, and eugenol were found to possess significant antioxidant activity.^{26, 29-31} Chewing of leaves treats cold, flu, and hot decoction of tulsi leaves can treat sore throat. Tulsi is used to treat minor throat infections and coryza cough as an inhalation without any adverse effects in children.³²⁻³⁵

3. *Terminalia bellerica*

Synonym: Bahera

Terminalia bellerica belongs to the family Combretaceae. It is one of the most commonly used plants in Indian traditional systems of medicine. The rind of the fruit is used in different preparations. For example, fruit rind is used as

one of the ingredients of “Triphala” (three fruits), used in Ayurveda for the treatment of several disorders like fever, sore throat, pharyngitis, laryngitis, bronchitis, asthma, cough, dyspepsia, flatulence, chronic diarrhea and dysentery, hemorrhoids, constipation, hepatosplenomegaly, ophthalmia, alopecia, and premature greying, and skin diseases.³⁶ Several phytoconstituents are present in *T. bellerica*, i.e., several triterpenoids, including β -sitosterol, belleric acid, and saponin glycosides including bellericoside and bellericanin, polyphenols (gallic acid, ellagic acid, and chebulagic acid), lignans (termilignan, hydroxy-3',4'-[methylenedioxy] flavan, anolignan B), and fixed yellow oil.^{31,32} The fruit contains all the components of *Terminalia chebula*, except corilagin and chebulic acid. Fleshly fruit pulp contains 21.4 % tannin.³⁶⁻⁴⁰ Methanolic extract of *T. bellerica* fruit showed stimulation of macrophage phagocytosis through the production of superoxide and acid phosphatase. Fruit of *T. bellerica* mainly contain lignans, Tannins, terpenoid, saponin. Hence, the mouse immune system, specifically *in-vitro* cellular, and humoral immune response were affected by methanol extract of *T. bellerica*, making it helpful in treating human immune-mediated diseases.^{36,41}

4. *Phyllanthus emblica*

Synonyms: Amla

Amla or *Embllica officinalis* belonging to the family Euphorbiaceae and is an indispensable part of the Ayurvedic and Unani systems due to its impressive medicinal properties. It is also used in the “TRIPHALA” formulation rich in polyphenols, vitamin C, and flavonoids.⁴² In traditional folk medicine, several therapeutic activities are mentioned for the *Embllica officinalis*. Some of these activities include rejuvenative, diuretic, antipyretic and tonic, ophthalmic, digestive, laxative, and in the treatment of dyspepsia. Moreover, fruits of *Embllica officinalis* are also found to use in the treatment of other diseases like asthma, bronchitis, cough, peptic ulcer, skin disorders, diabetes leprosy, inflammations, diarrhea, hemorrhages, cardiac disorders, hair tonic, and some other disease conditions.^{42,43} The ethanol extract of the fruits of *E. officinalis* produced significant anti-tussive activity of *E. officinalis* in conscious cats by mechanical stimulation of the laryngopharyngeal and tracheobronchial mucous areas of airways. This anti-tussive activity is also due to antiphlogistic, antispasmodic, and antioxidant efficacy effects. Moreover, alcoholic extract *E. officinalis* also produced a dose-dependent anti-tussive effect comparable to dropropizine in cats, but less than codeine.⁴³⁻⁴⁵

5. *Terminalia chebula*

Synonym: Haritaki

Terminalia chebula (local name: haritaki, family Combretaceae) is a very commonly used medicinal plant used Unani, Ayurveda, and homeopathy medicinal system.⁴⁶ *T. chebula* is used in several folks to treat sore throat, high cough, asthma, ulcers, gout, heartburn, vomiting, diarrhea, bleeding piles, and bladder diseases. *T. chebula* is one of the main components of the Ayurvedic formula named ‘Triphala’.⁴⁷⁻⁴⁹ *T. chebula*

has several chemical constituents like phenolic compounds, especially hydrolyzable tannins, anthraquinone, flavonol tannic acid 20–40%, ellagic acid, carbohydrates, glucose, sorbitol, etc. Whereas some triterpenes (arjun glucoside-1, arjungenin, chebulosides-1 and chebulosides-2. Other constituents include tannins up to 30%, punicalagin, terflavin A, gallic acid, chebulic acid 3–5%, chebulinic acid 30%, 2,4-chebulyl- β -D-glucopyranose, some purgative of the nature of anthraquinone, flavonoids like luteolin, rutins, and quercetin, etc. Ellagitannin such as punicalagin, casuarinin, corilagin, and terchebulin and others such as chebulanin, neochebulinic acid, chebulagic acid, and chebulinic acid has been reported to be associated with the plant.⁵⁰⁻⁵³ It is suitable for chronic cough, coryza, sore throat, and asthma.⁵⁴

6. *Curcuma longa*

Synonym: Haldi

Curcuma longa Linn. (Family: Zingiberaceae) has been an indispensable part of dietary components as a coloring agent in India for ages and used as an ethnomedicine in Ayurvedic.⁵⁵ Due to its significant antioxidant activities, it is also used to treat several pathological conditions such as inflammation, ulcer, and cancer. Moreover, *Curcuma longa* has been reported to possess significant anti-fungal, antimicrobial, renoprotective, hepatoprotective, anti-cancer, anti-diabetic, anti-allergic, anti-arthritic treatment of Alzheimer’s disease and several other chronic diseases.⁵⁶ Chemical analyses of turmeric have revealed the presence of several components like α -phellandrene (1%), sabinene (0.6%), cineol (1%), borneol (0.5%), zingiberene (25%), and sesquiterpenes (53%). Curcumin (3–6%) is responsible for the yellow color of turmeric.^{57,58} Turmeric has been used in Asia, particularly in ancient Indian medicine for allergy and asthma. Curcumin produces its anti-allergic effect via inhibiting the release of histamine from mast cells. The effectiveness of curcumin in allergy and asthma was further investigated using a murine model of allergy in which marked inhibition of allergic response was observed in animals treated with curcumin. It has also been used as an antioxidant and anti-inflammatory agent with diverse healing beneficial effects.⁵⁹ Turmeric powder has been used in traditional medicine against gastrointestinal diseases, especially biliary and hepatic disorders, diabetic wounds, rheumatism, inflammation, sinusitis, anorexia, coryza, and cough.⁶⁰ It can treat chronic and acute allergies and offers health benefits for asthma and eczema. It acts as a potent immunomodulator. Turmeric is anti-inflammatory to the mucous membrane that coats the throat, lungs, stomach, and intestine.⁶¹ Curcumin was also found to be effective in reducing nasal airflow resistance by alleviating sneezing and rhinorrhea. It also attenuated IL-4, IL-8, and TNF- α whereas IL-10 and soluble intercellular adhesion molecule levels were found to be increased. Moreover, the administration of curcumin via nasal route inhibited allergic airway inflammation and maintained structural integrity in the allergic asthma mice model.^{57,62}

7. *Allium sativum*

Synonym: Garlic

Allium sativum L. (family Alliaceae), is recognized as a special spice and a popular remedy for several ailments and physiological disorders.⁶³ Extracts of garlic are found to be very effective in treating hypercholesteremia and increasing blood coagulation time. The use of garlic is mentioned for the treatment of blood pressure and other diseases also. Garlic has been used as hepatoprotective, anti-helmentics, anti-inflammatory, antioxidant, anti-fungal, and wound healing. It is also used to treat asthma, bronchitis, chronic fever, tuberculosis, rhinitis, malaria, leprosy, leucoderma, discoloration of the skin and itches, indigestion, colic pain, arthritis, sciatica, and lumbag.

Moreover, many studies also indicated the beneficial effects of garlic in the treatment of enlargement of spleen, jaundice, diabetes, gout, fistula, urinary disorders, piles, kidney stones, epilepsy, cataract, and night blindness.⁶⁴ Several chemical compounds are found to be present in garlic and majorly contain sulfur. These chemical compounds include alliin, allicin, ajoene, sallylcysteine, S-allylmercaptocystein diallyl, trisulfide allylpropl, vinylthiines. Along with this, a significant number of peptides, steroids, terpenoids, flavonoids, and phenols are present in garlic. Besides sulfur-containing compounds, garlic also contains 17 amino acids and their glycosides, arginine, and others—minerals such as selenium and enzymes allinase, peroxidases and myrosinase. Garlic also contains arginine, oligosaccharides, flavonoids, and selenium, all of which may benefit health.⁶⁵ Garlic extract was found to inhibit Der p-induced asthmatic response via cytokine-mediated mechanism resulting in attenuation of inflammation in the reduced airway and modulating IgE and IgG_{1a} levels. Garlic extract also restored the balance of Th1 and Th2 (*helper T cells*) cytokines by decreasing Th2 and increasing Th1. Moreover, studies revealed that garlic extract exhibits its anti-asthmatic activity by regulating the Th1–Th2 balance and restoring the expression of IL-10.⁶⁶

8. *Rubia cordifolia*

Synonym: Manjishtha

Rubia cordifolia Linn (family Rubiaceae) is a well-known herbal medicine in traditional medicinal system in India.⁶⁷ *Rubia cordifolia* or Manjishtha is mentioned to treat several disorders like cough, pharyngitis, ophthalmopathy, otopathy diabetes, hepatopathy dysmenorrhoea, emmenagogue, general debility, neuralgia hemorrhoids, intermittent fever, jaundice, leucorrhoea, tuberculosis, and urethrorrhoea.⁶⁸ Moreover, different extracts of roots have been mentioned for their pharmacological activity as analgesic agents, laxatives, anti-rheumatic, treatment of paralysis, and intestinal ulcers. The dried stem is also used to treat blood and skin disorders and treat heart problems.⁶⁹ Different bioactive compounds are present in *Rubia cordifolia*, such as anthraquinones, glycosides, naphthoquinones and glycosides, terpenes, and bicyclic hexapeptides iridoids, and 11 carboxylic acids (malic, citric, quinic, rosmarinic acids). Several saccharides include glucose,

sucrose, ribose, xylose, fructose and primverose, munjistin and small amounts of xanthopurpurin and pseudopurpurin. 3, 6-trihydroxy-2-methyl-9, 10- anthra-quinone-3-O-(6'-Oacetyl)- α -L-rhamnosyl (1 \rightarrow 2)- β - D-glucoside, 1, 3, 6-trihydrozy-2-methyl-9,10-anthraquinone-3-O-(6'-O-acetyl)- β -D-glucoside, 2-carbomethoxy+++3-prenyl-1, 4-naphthohydroquinone di- β -D-glucoside, Alizarin (1, 3-dihydroxy-2-ethoxymethyl- 9, 10-anthraquinone), β -sitosterol and daucosterol are present in manjistha.⁶⁸⁻⁷⁰

Rubia cordifolia possesses excellent expectorant properties; therefore, it is used to treat several disorders like cough, cold, and respiratory congestion, specifically in infants.⁶⁸ Moreover, several phytoconstituents like flavonoids, tannins, cardiac glycosides, alkaloids, and phenols are also responsible for the significant immunomodulatory activity of *R. cordifolia*. Administration of ethanol extract of the whole plant of *Rubia cordifolia* showed enhanced cell-mediated and humoral immuno-potentiating activity.^{69,71}

9. *Valeriana wallichii*

Synonym: Tagar, *V. jatanamansi*

Valeriana wallichii is a member of the *Valerianaceae* family that includes up to 250 species, commonly called as Indian valerian.⁷² The phytoconstituents present in *Valeriana wallichii* are Iridoid valepotriates (0.5%–2.0%): didrovaltrate, valeranal, isovaleric, valerenic, valeranine, chatinine, isovaltrate, isovalerenate valeric, alpha-methyl pyrrolketone, valeranone, valerosidate, bornyl and bornyl acetate, valtrates and acetoxyvalerenic acids, aphthyritylmethylketon and cryptofaurinol. Along with this, several monoterpenes and sesquiterpenes are found to be present in the *Valeriana wallichii*.⁷³ Several pharmacological activities like antimicrobial, antipsychotic, anti-inflammatory, antioxidant, antispasmodic, and cytoprotective are mentioned for *Valeriana Wallachia*. Moreover, different extract of plant parts has been found beneficial in treating insomnia, nervous disorders, snake-bite, hysteria and algesia.⁷⁴ The roots are utilized for the treatment of dry cough, asthma, blood disorders, liver diseases, headache, splenomegaly, kidney disorders, cardiac debility, ulcers, chronic fever, and intermittent fever.⁷⁵

10. *Piper longum*

Synonym: Long pepper

Long pepper is a flowering vine in the family “Piperaceae” cultivated for its fruit, usually dried and used as a spice.⁷⁶ *P. longum* is an important component of a number of widely used Ayurvedic formulations.⁷⁷ Piperine is the major and most active constituent present in long pepper. Several alkaloids and related compounds are found in the *P. longum*, and piperine is the most abundant of all the phytoconstituents. Other chemical constituents which are present in the roots of *P. longum* include methyl piperine, tetrahydropiperine, terahydropiperlongumine, piperlonguminine, piperlongumine, iperonaline, brachystamide, refractomide A, brachystamide-A, asarinine, piperettine, piperundecalidine, pellitorine, pregumidiene, brachystine, and trimethoxy cinnamoyl-piperidine.⁷⁸⁻⁸⁰ Due to the presence of abundant active phytoconstituents, several pharmacological

properties of this plant has been mentioned by several researchers. These pharmacological properties include hepatoprotective activity, cardio-protective, anti-obesity, analgesic, immunomodulatory, anti-cancer activity, anti-inflammatory, antimicrobial, antiplatelet, antioxidant anti-hyperlipidemic, antidepressant, radio-protective and anti-fungal activities.^{76,81,82} An extract of the fruits in milk reduced passive cutaneous anaphylaxis in rats and protected guinea pigs against antigen-induced bronchospasm.⁸³ Moreover, the extract of *P. Longum* was found to be effective in antagonizing morphine or pentobarbitone-induced respiratory depression in anesthetized dogs. Similarly, petroleum ether extract of the fruits *P. Longum* antagonized morphine-induced respiratory depression in mice. The crude extract of *P. longum* and piperazine suppressed the ciliary movements of esophagus of frog, which may be due to the suppression of cough reflex.⁸⁴⁻⁸⁶

11. *Zingiber officinale*

Synonym: Ginger

Rhizome of *Zingiber officinale* is one of the most commonly used herbal medicine globally. Its rhizomes are widely used for medicinal and culinary practice globally due to their medicinal and nutritional value.⁸⁷ The use of ginger is mentioned in several ancient and traditional medicinal systems for the treatment of cough and cold, asthma, stroke, diabetes mellitus, menstrual cramps, catarrh, gingivitis, motion sickness, dyspepsia, diarrhea, nausea, toothache, rheumatism, nervous diseases, constipation, cancer and arthritis.⁸⁸⁻⁹¹ The decoction of ginger is beneficial in coryza, cough, headache, and asthma.⁹² Ginger root has several phytoconstituents like essential oil (zingiberone, zingiberole, camphen, cineole, borneol) and volatile oils (linalool, zingiberol, limeonene, camphene, citronellol, bisabolene, cineole, citral, borneol, geranial, zingiberene), gingerols, zingibain, bisabolene, oleoresins, starch, mucilage, and protein, oleoresin (gingerol, shogaol), phenol (gingeol, zingerone), proteolytic enzyme (zingibain), vitamin B6, Vitamin C, calcium, magnesium, phosphorus, potassium, acetic acid, and sulfur.^{93,94} Moreover, a recent study has revealed that solution containing the herb marshmallow and ginger reduced cough and chest pain in patients with tracheitis and possessed an anti-inflammatory effect.^{95,96} Due to significant immunomodulatory properties, ginger is used to treat sore throat, cough, cough, and flu.^{93,97}

12. *Piper nigrum*

Synonym: Black pepper

Piper nigrum L., most commonly known as pepper, is considered to be the "king of spices" belonging to the family Piperaceae because of its massive trade share in the global market.^{98,99} Piperine, a major constituent of *Piper nigrum* found to possess several pharmacological activities like anti-asthmatics antihypertensive, antispasmodic, antiplatelets, antioxidant, hepatoprotective, antidepressant antitumor, immunomodulatory, antipyretic, anxiolytic, analgesic, anti-inflammatory, anti-diarrheal, antimicrobial, anti-cancer, antispermatic, insecticidal and larvicidal. In Ayurvedic practices, pepper is added in formulations used to treat cold and

cough. Due to expectorant property, *Piper nigrum* lyse mucus and phlegm deposited in the respiratory tract.¹⁰⁰ It is one of the constituents of trikatu and has been used to treat asthma and chronic bronchitis in Ayurveda and Unani medicine.¹⁰¹⁻¹⁰² Anti-asthmatic property of piperine was observed when mice treated with piperine showed less infiltration of eosinophil, hyperresponsiveness, and reduced synthesis of histamine, IL-5, IgE, and IL-4.^{103,104} Several chemical compounds have been isolated from the by investigators like Piperidine, Piperamide, Piperamine, Brachyamide B, pentadienoyl as piperidine, Dihydro-piperidine, Piperettine, Piperine, (2E,4E)-N-Eicosadienoyl-piperidine, Piperolein B, Tricholein, Trichostachine, isobutyl-eicosatrienamide, Isobutyl-octadienamide, Sarmentine.^{105,106}

13. *Myrica esculenta*

Synonym: Kaiphal

Myrica esculenta, belonging to the family Myricaceae, is known traditionally in Ayurveda to treat asthma and bronchitis.^{107,108} The phytoconstituents present in *M. esculenta* are myricetin, myricitrin, arjunolic acid, arjunglucoside, myricanol, 8-cineole- β -D-glucopyranoside, 3-epi-ursonic acid, myricanol, 5-O- β -D-glucopyranosyl 4-hydroxy-1,8-cineole, (1S,2S,4R)-2-hydroxyl. Gas chromatography-mass spectrometry of volatile oil revealed the presence of α -pinene (13.46%), α -Selinene (12.28), α - Caryophyllene (8.94%), α -cadinol (5.32%), Linalool (4.06%), Nerolidol (13.46%), β -Caryophyllene (11.66%) and β - Selenin (9.71%).¹⁰⁹⁻¹¹¹ *Myrica esculenta* is widely used to cure various diseases like weakness, respiratory illness (asthma, bronchitis), fever, liver problems, rhinitis (nasal catarrh), injuries, throat problems, tumors, ulcers, urinary releases, appetizer, typhoid, dysentery, and cough. It is ruinous to the liver, spleen and the oil extricated from the blossoms act as a tonic, and has been utilized in the prophylaxis of ear infection, migraine, loose bowels, and paralysis.¹¹²⁻¹¹⁴ *M. esculenta* attenuated bronchial hyper-responsiveness and bronchoconstriction induced by acetylcholine and histamine-induced bronchospasm in guinea pigs.^{107,115,116} Oral administration of ethanolic extract of bark (75 mg/kg) exhibited significant anti-asthmatic activity. Several mechanisms were proposed for this activity: anti-anaphylactic activity or spasmolytic activity via relaxation of smooth muscle in histamine and acetylcholine-induced contraction or bronchodilatory activity by attenuating bronchospasm, inhibition of total and differential leucocytes in bronchoalveolar lavage fluid. Moreover, administration of 150 mg/kg *p.o.* of ethanol extract of the bark produced a more significant anti-allergic effect via inhibition of eosinophil accumulation and plasma exudation in acetic acid-induced vascular permeability. However, lower doses of aqueous extract (27 and 54 mg/kg, *p.o.*) of the bark produced more significant anti-asthmatic activity as compared to ethanol extract via inhibiting histamine aerosol-induced bronchospasm in guinea pigs and by relaxing histamine-induced guinea pig tracheal chain contraction indication the use of *M. esculenta* bark for treatment of allergic reactions including asthma and bronchitis in traditional medicine.¹¹⁷⁻¹¹⁹

14. *Cinnamomum zeylanicum*

Synonym: Cinnamon, dalchini

Cinnamomum (Family Lauraceae) is a traditional flavoring agent in food and pharmaceutical preparations against several ailments. In addition to its culinary uses, cinnamon is used to treat respiratory, digestive, and gynecological ailments in the Ayurvedic system of medicine.¹²⁰ Cinnamon is a beneficial home remedy for common or severe colds, chronic coughs, colds, and sinuses.¹²¹ The phytoconstituents present in cinnamon are Cinnamaldehyde, Cinnamic acid, Oxygenated terpenoids, α -Bergamotene, innamyl alcohol Eugenol, Hydroxyl cinnamaldehyde, Trans-alphabergamotene, Camphor, Trans-cinnamyl acetate, β -caryophyllene, Terpene hydrocarbons, α -Copaene, (E)-Cinnamyl acetate, borneol etc.¹²¹ Along with being used as spice and flavoring agent, cinnamon also works as a coagulant to stop bleeding. Cinnamon also increases blood circulation in the uterus and advances tissue regeneration. It also acts as an anti-inflammatory, insecticidal, antimicrobial, antioxidant, anti-diabetic, mycotic, and anti-cancer agent (Singh *et al.*, 2008). Cinnamon has also been traditionally used as tooth powder to treat toothaches, dental problems, oral microbiota, and bad breath.¹²²

15. *Vitis vinifera*

Synonym: Draksha, Grape Vine

Grape (Family: Vitaceae) is cultivated worldwide, and it is the world's largest fruit crop, with an annual production of more than 67 million tons.^{124, 125} The chemical constituents present in the grape vine are: flavonoids like quercetin and myricetin, quercetin-3-O-glucosides, kaempferol-3-O-glucosides, polyphenols, (+)-catechins, (-)-epicatechin, (-)-epicatechin-3-O-gallate, procyanidin C1, and procyanidin B5-3'-gallate. Grape seeds contain procyanidins or proanthocyanidins (mostly hexamers), 3-caffeoyl-5-diglucosides of cyanidin, 3-coumaroyl-5diglucosides, 3-coumaroylglucosides, 3-caffeoylglucosides, 3-glucosides, 3-acetylglucosides, and delphinidin, peonidin, petunidin, and malvidin, trans-Resveratrol (trans-3, 5, 4-trihydroxystilbene).¹²⁶⁻¹²⁸ Several studies have indicated that seeds of *Vitis vinifera* possess significant activities like cardioprotective, hypolipidemic, cytotoxic, anti-aging, anti-diabetic antioxidant, anti-inflammatory.¹²⁹

16. *Hippophae rhamnoides*

Synonym: Sea Buckthorn

Sea buckthorn (*Hippophae rhamnoides* L., family: Elaeagnaceae). It has also been domesticated and used in traditional medicine in several countries to treat cough, indigestion, blood circulation, and as an analgesic since ancient times.^{130,131} Several other studies have indicated the use of *Hippophae rhamnoides* for treating burns, gastric ulcers, chilblains, scales, oral and rectal mucosities, cervical erosion and skin ulcers, and other damage relating to the skin, anti-inflammatory, antibacterial, analgesic, and promoting regeneration of tissue.¹³² 14 vitamins have been found in sea buckthorn berries, including vitamin A, C, D, E, F, K, P, and B complex vitamins (B₁, B₂, B₆). The level of carotenoids is high

where beta-carotene (40–100 mg%) while other carotenoids lycopene, cryptoxanthin, physalene, and zeaxanthin may reach 180–250 mg%. The fruits contain phenolic (gallic acid, p-hydroxyphenyl p-coumaric, lactic acid, salicylic, m-coumaric) and amino acids, sugars, numerous minerals, and flavonoids (kaempferol, rutin, myricetin, epigallocatechin flavan-3-ols, gallic acid, catechin, quercetin, epicatechin, isorhamnetin, and proanthocyanidins).¹³³⁻¹³⁶

17. *Abies webbiana*

Synonym: Talispatra

Abies webbiana belongs to family Pinaceae and commonly known as Talispatra. Talispatra leaves have been reported to act as central nervous system depressant, antispasmodic, febrifuge, antimicrobial anti-tussive, female anti-fertility, antitumour, mast cell stabilizer, anxiolytic and anti-rheumatic effective against hyperglycemia, conception, chronic obstructive pulmonary diseases, cough, carminative, stomachic, tonic, ast ringent, expectorant and digestive and rheumatism.^{137,138} In phytochemical screening certain chemical constituents are considered such as monoterpenes, flavonoids, biflavonoid glycosides, phytosterols, amino acids, saponins, tannins, alkaloids, lipids, triterpenoids, steroids, diterpene glycosides, 1-(4'-methoxyphenyl)-aziridine, biflavonoid, abiesin, (+)-pinitol, (1-(4'-methoxyphenyl)-aziridine), benzenepropanol, 4-hydroxy- α -methyl, 2-furancarboxaldehyde, and 5-(hydroxymethyl).^{137,139} Based upon the traditional uses of *A. webbiana* in the treatment of respiratory diseases, the extract of *A. webbiana* was further screened for its relaxant activity in isolated rabbit tracheal preparation and it was found that extract of *A. webbiana* antagonised the Ca⁺⁺ induced contraction in isolated tracheal preparation justifying the use of *A. webbiana* in respiratory ailments.¹⁴⁰⁻¹⁴²

18. *Cassia Fistula*

Synonym: Amaltus

Cassia fistula L. belongs to the family of Caesalpinaceae, commonly known Amaltash, has been used in different systems of medicines since ancient times.¹⁴³ Traditionally, *Cassia fistula* L. is used to treat heart disorders, pruritic, leukoderma, laxative, purgative, abdominal lump, metabolic disorders, tuberculosis, antimicrobial, hematemeses, uterine and menstrual disorder, thoracic obstructions, cure of burns, depression, dysuria, remedy for fever, retained excretions, biliousness, joints pain, chest pain, dysentery, migraine, hyperglycemia, black wart fever, rheumatism, ring worms, eczema, anti-tussive, wound healer, hypoglycemic activity, erysipelas, jaundice, swollen throats and oral sores, carminative, skin diseases, anti-inflammatory, an antioxidant and anti-diabetic drug, antiviral, anticandidal, leprosy, diabetes, abdominal, urinary disorders, obstruction and hepatoprotective, tuberculosis.¹⁴⁴⁻¹⁴⁶ Chemical constituents present in the amaltash are anthraquinone glycosides, sennosides A & B, rhein and its glucoside, barbaloin, aloin, formic acid, butyric acid, and their ethyl esters and oxalic acid, presence of pectin and tannin, galactomannan free sugars and free amino acids; flowers gave ceryl alcohol, kaempferol, rhein, and a bianthraquinone

glycoside, fistulin, rhein, its glycosides- sennosides A & Bsugar, tannic matter, albuminous starchanthraquinone, tannin, oxyanthraquinone, rhein, phlobaphenes and oxyanthraquinone, β sitosterol (0.006) and its β D glucoside (0.02%), 5,7,3',4'-tetrahydroxy-6, 8- dimethoxyflavone-3-O- α -arabinopyranoside, 5,7,4'-trihydroxy-6,8,3'- trimethoxyflavone-3-O- α -L-rhamnosyl (1 \rightarrow 2)-O- β -D-glucopyranoside, 1,8-dihydroxy-3, 7-dimethoxyxanthone-4-O- α -L-rhamnosyl(1 \rightarrow 2)-O- β -D-glucopyranoside.¹⁴⁵ The methanol extract of *Cassia fistula* also exhibited significant, dose-dependent anti-tussive activity in sulfur dioxide gas in mice. Moreover, anti-tussive activity was found to be comparable with that of codeine phosphate. Different doses (400 and 600 mg/kg, p.o.) of *C. fistula* extract inhibited coughing by 44.44 and 51.85%, respectively, concerning the control group.^{147,148}

19. Piper cubeba

Synonym: Kabab Chini

Piper cubeba, known as Kabab Chini in Unani Medicine, belongs to the family Piperaceae, widely distributed in tropical and subtropical regions, and this herb is mentioned in traditional Unani texts as an effective remedy for the renal disorder, gonorrhoea, leucorrhoea, fever, rheumatism, diabetes, septic gingivitis, stomatitis, uro-genital ulcer, jaundice, inflammation, palpitation, headache, hepatic obstruction, cystitis, dysentery, cough retention of urine, etc. It contains monoterpenes (sabinene 50%, α -thujene, and carene), and sesquiterpenes (caryophyllene, copaene, α - and β -cubebene, δ - cadinene, germacrene), the oxides 1,4- and 1,8-cineole, cubebol, Cubebene, (-)Clusin, (-) Cubebin, (-) dihydrocubebin, (-)hinokinin and (2R, 3R)-2-(3'', 4'', 5''-trimethoxybenzyl)-3-(3', 4'-methylenedioxybenzyl)-1,4-butanediol isolated from fruit α -ethoxycubebin, beta-ethoxycubebin, dihydrocubebin monoacetate, hetrotropan, magnosalin, 5''-methoxyhinokinin and 2,4,5-trimethoxybenzaldehyde.^{150,151} In addition, immature dried fruits are used in the treatment of coughs, bronchitis.

CONCLUSION

A number of herbal drugs are mentioned in Ayurveda, Unani and Homeopathy for the treatment of respiratory disorders. All these herbal drugs are found to have significant activity against respiratory disorders due to allergy and pollution. Formulation composed of all these herbals is believed to have very significant potential in treating air pollution-related problems. Tar Clean is a unique formulation for reverse pharmacology, and it has 19 ingredients that have been proved for their activity in treating respiratory diseases and air pollution-related diseases. Moreover, these ingredients have an addictive and synergistic effect of treating smoke and pollution-related problems.

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