

PLANT-BASED THERAPIES: A COMPREHENSIVE REVIEW OF NATURAL APPROACHES TO RESPIRATORY HEALTH

Ameer Hamza Ahmed¹, Bilawal Rehman², Marium Ahsan³, Idrees Khan³, Nazar Abbasi³, Muhammad Usama³, Ahsan Zahid³

ABSTRACT: Respiratory disorders are the main cause of maladies and death over the world. They are the main problem in Pakistan due to the cold and harsh climate as well as remoteness and scared healthcare facilities. Mostly people rely upon natural resources such as plants for the treatment of these problems due to the effectiveness and easy availability of plants. Traditional medicine is considered the best treatment due to its high efficacy and low side effects. About 384 species of plants belonging to 85 families are used in the treatment of respiratory disorders. The most common species among them are Solanaceae, Asteraceae, Poaceae, Moraceae, etc. About 17 plants are used in the preparation of herbal formulation, and on 53 plants pharmacological studies have been conducted. Different parts of different plants are used for the treatment of various disorders such as flu, cold, cough, whooping cough, asthma, bronchitis, and all other respiratory disorders. In this article, we have described the main chemical constituents of plants that are used in the medical formulation and the treatment of respiratory disorders and also described their experimental pharmacology as such problems are still the main cause of many deaths per year and it is of the utmost importance to conduct clinical and experiment studies to explore the beneficial sides of most plant species.

1. Department of Research and Development, Herbion Pakistan Pvt. Ltd, Korangi Industrial Area, Karachi Pakistan
2. Faculty of Eastern Medicine, Hamdard University Karachi
3. Department of Eastern Medicine, Superior University Lahore

Correspondence Author Email:
mariumahsan1998@gmail.com

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INTRODUCTION

Respiratory system is very crucial for sustaining life because without it life would cease. Respiratory disorders and lung diseases are pathological conditions affecting respiratory tract. Respiratory conditions are main cause of illness and demise all over the world. In unites state, respiratory diseases are main leading cause of death. Among children, respiratory diseases were the main cause of staying at hospital in 2012. In Pakistan respiratory infections constitutes 30-60% outdoor patients in which 80% having upper respiratory tract infection and 20% having lower respiratory tract infection. In all over the world, lower respiratory tract infection increases 12 % mortality rate because it has killed 3.8 million people (1). Common

respiratory infections which are main cause of problem are asthma, bronchitis, whooping

cough, breathing problem, cold, cough and tuberculosis (2). It has been estimated by world health organization that over one billion people have suffered from chronic respiratory diseases worldwide, about 300 billion suffered from asthma and 210 billion suffered from COPD (chronic obstructive pulmonary diseases)(3). In united states one million people suffered from cold every year (4). The five respiratory syndrome which are COPD, pneumonia, tuberculosis, asthma and lung cancer cause lead 20% mortality rate worldwide (5,6). Prevalence of asthma in Pakistan about 12% Pakistani adult population already suffering from asthma. It was estimated that 7 million cases of pneumonia occur every year in Pakistan.

Sicknesses and other related infections are obvious for the duration of regular day-to-day existence and have driven man to find courses by which they could be dealt with. Plants have reliably been a compelling resource of treatment from nature. People usually rely on the indigenous plant resources for the treatment of many respiratory disorders. Herbal or natural medicine in the treatment of various respiratory conditions are common practice in many regions of the world. In all over the world plants are used for the treatment of diseases. Chemical constituents of plants and their use in medical formulation have great importance in respect to new drug and pharmacological research development. From ancient time, chemical constituents of plants are in use for the treatment of various diseases but their use has been greatly increased in the last decade. In the end of twentieth century, 170 herbal drugs got official recognition. According to world health organization it was estimated that 80 percent population of world blindly trust on the use of natural way of treatment for primary healthcare due to easy availability, less or no side effects, great effectiveness and low cost. It has been experimentally proven that chemical constituents of plants having therapeutic effective have different mode of action in the treatment of different diseases. Chemical constituents of plants are extracted from various parts of plants by different methods and use therapeutically after the clinical and experimental practices. Chemical constituents possessing anti-bacterial, anti-microbial, anti-oxidant, anti-inflammatory, anti-allergic, anti-viral, vasodilator activities are used in treatment of respiratory tract infection according to the cause of diseases.

Turmeric

Turmeric is also known as *curcuma longa*. It belongs to the Zingiberaceae family. Turmeric is a polyphenolic compound having varieties of biological activities has achieved significant attentions of researchers all over the world (7-9). It is abundantly used as a spice in Pakistan and India. It is widely used and grown in Pakistan and India. For many diseases' turmeric is used in traditional medicine due to its activities. It is widely used for the treatment of respiratory disorders due to its anti-inflammatory, anti-tussive, anti-viral, anti-septic, anti-histamine and anti-asthmatic activity. Curcumin is active chemical constituents of turmeric used in diseases. Curcumin due to its anti-inflammatory activity it is used in the treatment of bronchitis. Curcumin by inhibiting phospholipase, cyclooxygenases, lipoxygenase, leukotriene, nitric oxide, thromboxane and all other molecules involving in the mechanism of inflammation reduce inflammation in case of bronchitis and clear the air passage (10). Turmeric possesses anti-asthmatic activity due to curcumin, turmerones, tetrahydro curcumin and curcuminoids (11). All these chemical constituents clear the airway by clearing the obstruction and help in the treatment of asthma. Turmeric has proven very useful in the treatment of cough and asthma occurring due to allergens in response of allergic reaction. It suppresses the compound 48, peritoneal mast cells degranulation and histamine. Turmeric has anti-histamine activity due to the chemical constituent curcumin. It has been proven experimentally and experiment has done on rat. Curcumin can also inhibit specific & non-specific allergic reactions depending on mast cells(12). It has been demonstrated that curcumin as an active chemical constituent has broad anti-viral activity against viruses.

Curcumin by inhibiting Inosine monophosphate dehydrogenase show potent anti-viral activity. Inosine monophosphate dehydrogenase is an enzyme which is used as rate-limiting in de-novo synthesis(13). Curcumin has many bioconjugates which are used against different viruses. Curcumin by inhibiting heme agglutination against influenza virus used for the treatment of flue (14).

Garlic

Allium sativum (garlic) belonging to liliaceae family is originally from Asia but also cultivated in china, Europe, North Africa and Mexico. From the ancient time it has been used in natural medicine in many regions of the world. It has both medicinal and condimental properties (15, 16). In pharmacological research there are many evidences about its broad spectrum of its pharmacological effects. Chemical constituents of garlic when are extracted or isolated show broad spectrum pharmacological properties such as they are used as an anti-inflammatory, anti-viral, anti-bacterial, anti-fungal, cardioprotective, anti-carcinogenic and many other therapeutic activities. Garlic has anti-viral activity. Allicin is an active constituent of garlic which has potent anti-viral activity against many viral diseases. This ingredient is used in the treatment of influenza virus due to its anti-viral activity. one study showed that allicin containing supplements also prevent attack from common cold virus. Allicin play strong anti-microbial activity due to the reaction with thiol groups of many enzymes such as alcohol dehydrogenase(17). In an in vivo research, administration of garlic in rat model protected them from intranasal inoculation with influenza virus and increase production of neutralized anti-bodies when ingested in the form of vaccine(18). Garlic by

enhancing natural killer cell destroys infected cells with viruses. It was supported that garlic's anti-viral activity in humans may be secondary to a direct toxic effects on viruses. Bronchitis usually occur due to viral infections so, garlic due to its strong anti-microbial activity considered best therapeutic agent in the treatment of bronchitis. Asthma is an inflammatory disease and garlic due to its anti-inflammatory activity can relieve the symptoms of asthma. Ethyl linoleate is that chemical constituent of garlic which play key role in reducing inflammation by decreasing the production of nitric oxides and prostaglandins by reducing the expression of nitric oxide synthase and cyclooxygenase in macrophages(19) . From another study it was stated that 14-kDa protein which is found in garlic inhibits inflammatory mediators such as nitric oxide, tumor necrosis factor & inter-leukins through the inhibition of transcription factors signaling pathway in macrophages(20).

Peppermint

Mentha piperita is one of the world's oldest therapeutic herb being used in both western and eastern tradition. It is a common herb which is grown in north America, Europe, Pakistan and in many regions of the world. From the ancient time it has been used in cooking and medicinal purpose. Currently peppermint is one of the most important medicinal and aromatic plant used widely in medicinal purpose and cooking. In pharmaceutical products it is also used as a flavoring agent. In traditional medicine it is considered as an anti-septic, anti-spasmodic, astringent, anti-emetic, anti-puratic, anti-microbial, stimulant, anti-catarrhal, analgesic, carminative and diaphoretic (21). Oil of peppermint is the best remedy for the treatment of cough, inflammation of oral mucosa, inflammation of

throat and bronchitis. Menthol present in peppermint have significant anti-tussive activity and used widely in cough syrups (22). In few studies it was claimed that inhalation of menthol which is found in peppermint oil makes the surfactant of lungs more efficient which enable better pulmonary function. It was hypothesized after experiments that after the ingestion of *Mentha piperita* function of lungs increase and inspiratory muscle strength also increases after the intake of menthol (23). Menthol has remarkable anti-inflammatory effect by inhibiting cutaneous anaphylaxis, which is mediated by IgE antibodies and used in the treatment of asthma occurring due to the allergic reaction. Menthol also considered virucidal against influenza and other viruses. By its virucidal activity, it is widely used in the treatment of flu. From a study which was conducted in 2013 it was claimed that menthol give cooling sensation and numb the nerve endings to relieve and reduce the urge of cough. Additionally, menthol also relaxes the bronchial muscles. Bronchitis usually occur due to virus problems and menthol possessing anti-viral activity also used in the treatment of bronchitis.

Ginger

Ginger belonging to zingibraceae family is one of the most commonly used dietary condiments all over the world(24). Oleoresin obtained from the rhizome of ginger contain many biological active constituents mainly used in traditional medicine due to its remarkable physiological and pharmacological activities. For the thousands of years ginger has been used in the treatment of various ailments such as cold, bronchitis, nausea, vomiting, migraine, hypertension and arthritis. over the last few years, interest in ginger and its constituents as best prophylactic and curative agent has

markedly increased, and experimental studies focusing on verification of ginger's physiological and pharmacological actions have increases correspondingly 80 (25). Shogaols and gingerols possesses anti-histamine activity. These two chemical constituents used in the treatment of cough and asthma due to the allergy by inhibiting the activation of mast cells(26). It is used widely for the treatment of bronchitis and asthma by inhibiting inflammatory pathway and clearing the obstruction. Arachidonic acid is chemical constituents of ginger play key role in reducing inflammation of respiratory pathway by inhibiting the lipoxygenase and cyclooxygenase one and two(27). Arachidonic acid when given in high dose significantly decrease the prostaglandin and thromboxane-2 level in mice(28). By inhibiting 5-lipoxygenase ginger also, suppress the biosynthesis of leukotriene. Additionally, arachidonic acid inhibits thromboxane synthase(29) . Ginger is best anti-inflammatory in chronic inflammation by modulating biochemical pathway (30). Other chemical constituents of ginger such as gingerol, shogaols, gingerdiol, gingerenone and zingerone also possesses anti-inflammatory activity(31). It was hypothesized by researchers that active chemical constituents ginger is very beneficial in the treatment of asthma by inducing bronchodilation through modulating intracellular calcium in airway smooth muscles. Ginger induce significant relaxation of intracellular smooth muscles. Successful experimental studies were conducted on guinea pig and human trachea to test remarkable activities in chemical constituents in case of asthma and

bronchitis. Through studies it was proved that gingerol and shogaols induce relaxation of intracellular smooth muscles in case of asthma(26).

Echinacea

Echinacea, otherwise called the purple coneflower, is a home-grown medication that has been utilized for a considerable length of time, usually as a treatment for the normal cold, hacks, bronchitis, upper respiratory contaminations, and some provocative conditions. Research on echinacea, including clinical preliminaries, is constrained and generally in German. It was first used by north Americans for wide range of diseases as a remedy. In Europe and America extract and chemical constituents of echinacea are currently sold under the hundreds of brands. *Echinacea purpurea*, *Echinacea angustifolia*, and *Echinacea pallida* are common species of echinacea which are widely used from infections to snakebite. In the early 20th century, it was used as a remedy for cold and flu, and as an anti-infective until the invention of modern antibiotics. Various in vitro and creature contemplations have demonstrated that echinacea seems to increment immunologic movement by expanding levels of interferon and may build phagocytosis, cell respiratory action, and lymphocyte enactment through arrival of tumor putrefaction factor, interleukin-1, and interferon beta-2. The dynamic segments accepted to be liable for this safe invigorating impact are the high-sub-atomic weight polysaccharides, for example, heteroxylan and arabinoglactan. The best logical proof about echinacea concerns its capacity to assist you with recuperating from colds and minor flus all the

more rapidly. The well-known axiom goes that "a virus endures 7 days, yet on the off chance that you treat it, it will be over in seven days." However, great, if not so much predictable, proof reveals to us that echinacea can really assist you with getting over colds a lot quicker. It likewise appears to fundamentally decrease side effects while you are wiped out. Echinacea may likewise have the option to "prematurely end" a cold, whenever taken whenever there's any hint of side effects. As of not long ago, it was accepted that echinacea acted by invigorating the insusceptible framework. It is currently stated that polysaccharides, glycoproteins, flavonoids and alkaloids are immunostimulant chemical constituent of Echinacea (27). All these chemical constituents mainly act on non-specific immunity of call. They show their immunostimulant activity by the activation of macrophages and stimulation of phagocytosis. It has been suggested from some studies that by stimulating natural killer cell T cells, B cells and leukocytes. From in vivo testing, it was demonstrated that echinacea has anti-inflammatory activity. Alkaloids are specifically responsible for anti-inflammatory activity found in this plant. Echinacea's alkaloids specially inhibit both cyclooxygenase and cyclooxygenase 2. Recent studies further identified that alkaloids modulate tumor necrosis factor alpha through cannabinoid type 2 receptors. Alkaloids also inhibit polysaccharides. Modulation of cytokines was also observed by Echinacea. Due to its anti-oxidant and anti-inflammatory properties Echinacea is used widely in the treatment of asthma, bronchitis and other

inflammatory conditions of respiratory tract. Echinacea also use in the treatment of flu due to its anti-viral activity. Overall clinical research and studies demonstrated the use of Echinacea in the treatment of upper respiratory tract infection. The problem of upper respiratory tracts in which Echinacea is beneficial are cold, flu, and sinusitis.

Thyme

Thymus vulgaris is a therapeutic herb having around hundred species all over the world. *Thymus vulgaris* has pungent taste and contain thymol, protein, fats and micronutrients. Thyme is also a rich source of vitamins in which vitamin B-complex, vitamin A, K, E and vitamin C are common. *Thymus vulgaris* is widely used for culinary and medicinal purposes. This is highly recommended medicinal plants due to the broad-spectrum activities. Thyme is considered best medicinal herb due to its biological and pharmacological properties. Thymol and carvacrol are the main chemical constituent of *thymus vulgaris* having potent therapeutic properties. Carvacrol and thymol mostly used in the treatment of bronchopulmonary disorders. *Thymus vulgaris* possesses strong anti-microbial, anti-oxidant and gastro protective activities. Vitamin c by acting as an immune stimulant help human body to develop resistance against infectious diseases and protect from influenza virus. Vitamin C is that chemical constituent of *thymus vulgaris* which is used in the treatment of common cold and flu. Vitamin A is a fat-soluble vitamin, vitamin A and flavonoids protect from oral and lung cancer. Thyme is also used as a flavoring agent. *Thymus vulgaris* used in the treatment of infectious diseases of airway, expel mucus from tract and proved very useful in the treatment of cough due to anti-tussive and expectorant activities of

carvacrol and thymol. Thymol has remarkable therapeutic effect in respiratory problems such as asthma, and bronchitis and in the treatment of other pathologies (28-30). *Thymus vulgaris* has anti-viral, anti-microbial, anti-fungal, anti-oxidant and many other medicinal effects in the treatment of various ailments. Anti-microbial activity of thymol has been reported in vitro. Due to spasmolytic and anti-tussive properties, carvacrol and thymol relax smooth muscles of trachea, inhibit the contraction, relieve urge of cough and trachea from reflex and helpful in easy breathing. Flavonoid extract from *thymus vulgaris* possesses strong anti-oxidant activity and prevent from oxidative damage to respiratory tract (31). It was demonstrated from the studies, which was conducted on mice that thymol and carvacrol have strong anti-inflammatory activity by inhibiting the synthesis of prostaglandin, cyclooxygenase and lipoxygenase. They also inhibit the pro-inflammatory mediators by blocking the signaling pathway.

Marshmallow

Althea officinalis is scientific name of marshmallow. It belongs to Malvaceae family. In common name it is called khatmi. This perennial herb is native to North Africa, Europe and western Asia. From the ancient time, it has been used in the treatment of various ailments. Marshmallow (*Althea officinalis*) - the herb, not the white puffy sweet simmered over a pit fire - has been utilized for over 2,000 years as both a nourishment and a medication. The Romans, Chinese, Egyptians, and Syrians utilized marshmallow as a wellspring of nourishment. The Arabs made poultices from its leaves and applied them to the skin to decrease aggravation. Both the root and leaves contain a sticky substance called adhesive Mucilage is an active chemical constituent of plant, which possesses

therapeutic activities and has been used in cough syrup and widely used for the healing purposes. *Althea officinale* is recommended mostly for tuberculosis, pneumonia, cough, hemoptysis and asthma. Anti-tussive activity of *althea officinale* has been tested from cat and after that research study, it was claimed that extract and mucilage from marshmallow have strong anti-tussive activity. From extract, mucilage is obtained and both polysaccharides and mucilage are given in intense cough because polysaccharides have cough suppressing property. Broncho dilatory and adrenergic activity of *althea officinale* was tested on smooth muscle of rat and it was seen that mucilage increase Broncho-dilation and due to this activity mucilage used in the treatment of asthma. By inhibiting the contraction of smooth muscles of trachea *althea officinale* used in the treatment of chronic obstruction pulmonary disease (32-34). Mucilage and polysaccharides are used in the treatment of dry cough and irritation of throat. Marshmallow has a long history of utilization for treating hacks and has been appeared in one investigation to hack soothing capacities. Various herbs have a rich history of utilization for treating hacks because of colds, bronchitis, or other mellow conditions. Just a couple of studies have inspected the viability of these herbs. Nevertheless, their adequacy is notable by specialists of natural medication the world over. Among those herbs that have been appeared to have some level of hack calming action is marshmallow. Marshmallow has been found very effective in the treatment of cough due to bronchitis and cold. Marshmallow by giving soothing effect on bronchioles has therapeutic been used in the treatment of asthma and mucilage is that phytoconstituent which has soothing effect on bronchioles.

Eucalyptus

Eucalyptus globus belong to myrtaceae family. It as an evergreen plant native to Australia but its other species are also found in neighboring countries. This tall tree includes 900 species & subspecies. It is widely cultivated plant all over the world and it grows over wide range of soil and climate. From ancient time, it has been used for therapeutic and commercial purposes. *Eucalyptus globus* has drawn the attention of researcher's world widely due to its use in many purposes. Nine species of *eucalyptus* are used for medicinal purposes and among them *eucalyptus Globus* is widely used worldwide. The chemical constituents of *eucalyptus* show anti-inflammatory, anti-bacterial, anti-oxidant, anti-cancer activities and due to these activities it is widely used for the treatment of respiratory problems such as flu, common cold, congestion, and sinusitis (33-36). In vitro and clinical studies suggested that aromatic herbs have strong therapeutic potential for the treatment of respiratory diseases. Herbs containing aromatic compounds have broad-spectrum pharmacological activities and used widely as a remedy. Cineole is an active chemical constituent responsible for therapeutic purposes in the treatment of respiratory ailments. The main reported activities of *eucalyptus* after research and experiments are anti-tussive, expectorant, analgesic, nasal decongestant, anti-spasmodic, anti-inflammatory and anti-microbial. Researchers had tested anti-tussive activity of *eucalyptus* constituents on guinea pig and it has been demonstrated that inhalation of its constituents reduce the symptoms of nasal congestion. Anti-microbial activity of *eucalyptus* also had reported via in vitro studies by researchers. It was demonstrated that *eucalyptus* oil has best potential in the treatment of respiratory diseases.

Phytoconstituents of eucalypts uses as a symptomatic treatment of obstructive respiratory problems such as catarrh, asthma and bronchitis. Cineole by inducing its anti-inflammatory effect used in the treatment of chronic bronchitis and inhibits the hypersecretions of airway mucins. Cineole having anti-microbial activity against streptococcus pneumonia, influenza and para influenza used in the treatment of flu, common cold and pneumonia. Due to its broad-spectrum anti-inflammatory activity cineole also used in the treatment of tonsillitis, sinusitis and sore throat. In rat model, immune stimulant activity of eucalyptus demonstrates that it enhances immunity against pathogens, increase the immune response of body in fighting against virus, and prevent from common cold and flu.

Chili pepper

Human utilization of bean stew peppers goes back to ancient occasions. Saved peppers have given proof that South Americans ate and developed aji, (stew in English), in 2500 B.C. The peppers turned out to be progressively normal and coordinated into the eating regimen of specific societies. Be that as it may, bean stew peppers and comparable flavors stayed confined in these societies until the thirteenth century, when they opened up to civic establishments all through the world. The pungent taste of chili pepper is due to the presence of capsaicinoid. Chili pepper belongs to Solanaceae family. It has been used for culinary and therapeutic functions since the ancient time. It was reported that chili peppers are used in the treatment of respiratory problem, as an analgesic, for the treatment of gastrointestinal problems and many other pathological conditions. Capsaicin is an active ingredient of chili pepper and used for therapeutic purposes.

Capsaicin by inhibiting the mucus production and effectively help in sore throat and coughing. Due to the decongestant property capsaicin help in clearing congestion. Vitamin A and beta-carotene are other constituents of chili pepper which have immunostimulant and anti-infective properties. Vitamin helps in the formation of healthy mucus membrane which lines the respiratory tract and give defense against pathogens.

Ephedra

Ephedra is evergreen plant of central Asia. It belongs to Ephedraceae family. Commonly it is called ma hung or chines ephedra. It has been used in chines traditional medicines from ancient time. In chines pharmacopeia it has been used for the treatment of bronchitis, asthma and hay fever. It is also used for the treatment of common cold and flu. Ephedrine is an active chemical constituent of this plant. Ephedrine and pseudoephedrine widely used in the treatment of respiratory tract ailments. Due to the decongestant activity ephedrine used in treating nasal congestion. It also shows broad spectrum activities in the treatment of bronchospasm, flu and swine flu and clearing the obstruction present in airway. Ephedrine and pseudoephedrine are alkaloids of *Ephedra sinica* dilate bronchial tube in treating asthma, bronchitis and bronchospasm through their Broncho-dilatory activity. Ephedrine and pseudoephedrine both act as a prototypical alpha & beta receptor agonist. The stimulate CNS through their agonist effect on adrenergic receptors and also increase the release of nor-epinephrine. They have potential to effect on methyl xanthine which is used in the treatment of asthma(37).

Adhatoda

Scientific name of Adhatoda is *Adhatoda vasica* ness. It belongs to Acanthaceae family. Adhatoda is an evergreen plant having average height of three meter. Commonly it is known as adosa. It founds in many regions of world especially in India. Due to the particular beneficial, therapeutic in the treatment of respiratory ailments, Adhatoda is well known herb in indigenous medicinal system. From ancient time all parts of Adhatoda used for medicinal purposes(38). For the treatment of respiratory ailment, it is equally used for children and adults. In India, Germany, Europe, Sweden and Pakistan it is widely used in medicine. In some products, whole plant is used as a remedy while in other formulations and purposes some parts or chemical constituent used. Leaves. Roots, bark, flower and fruit of Adhatoda containing chemical constituent used in the treatment of cough, cold, whooping cough, asthma and chronic bronchitis. Chemical constituent of Adhatoda also possesses anti-spasmodic and expectorant activity (24). Chemical constituents present in the leaves of Adhatoda possesses anti-inflammatory, blood purifier, anti-cancer, anti-viral and anti-inflammatory activity. Adhatoda also used in the treatment of bleeding, rheumatic arthritis, gastrointestinal problems and tuberculosis. By normalizing kapha and pitta it improves voice. Vasicine & vasaicinone are active chemical constituents of Adhatoda having therapeutic respiratory purpose. From 2002 review research in vivo and in vitro it was proved that Vasicine & vasaicinone induce Broncho-dilation through their Broncho-dilatory activity to the bronchial obstruction. By reducing phlegm Vasicine & vasaicinone show anti-tussive activity and also used in the treatment of common cold and asthma. Through their anti-viral activity and immune stimulant activity of vitamin C present in Adhatoda, it is used for enhancing immunity and provide ability to body for defense

against viral infection and has best therapeutic potential in treating flu and bronchitis. Anti-tussive activity of Vasicine & vasaicinone has been tested on guinea pig and rabbits and it was stated that both of these have good anti-tussive property(39). Broncho-dilatory activity of vasicine had tested by both in vivo and in vitro tested (40). Chemical constituents of Adhatoda vasica show considerable anti-cancer activity when was tested on rat model. Vasicine also show potent anti-inflammatory activity by inhibiting the production of lipooxygenase, cyclooxygenase, prostaglandins and proinflammatory mediators. Thus, vasicine used for the treatment of inflammatory conditions present in airway passage. bromhexine and ambroxol are mucolytic semi-synthetic derivative of vasaicine from Adhatoda have growth inhibitory effect on *Mycobacterium tuberculosis* (41). Both of these derivatives of vasaicine increase rifampicine and lysozyme level in bronchial lung tissues and play a key adjunctive role for the treatment of tuberculosis(16).

Elderberry

Scientific name of elder berry is *sambucus nigra*. It belongs to adoxaceae family. Commonly it is known as black berry or European berry. Elderberry is native to Europe but it is also cultivated in many other regions of world. It has been used for culinary and therapeutic purposes from ancient time. Many parts of elderberry used in medicinal purpose and cooking. In traditional medicine *Sambucus nigra* used to treat common cold and influenza, as a diuretic, anti-inflammatory, anti-emetic, analgesic, immunostimulant, laxative, anti-septic and strong anti-oxidant. From centuries, elderberries are well known supportive agents against flu and common cold. Elderberry showed in vitro anti-viral and anti-bacterial activity. Due to its anti-viral activity elderberry used in the treatment of flu caused by influenza virus. A pilot trial with

elderberry confirmed beneficial activity of elderberry for flu and common cold(42-44). Due to their anti-inflammatory, anti-oxidant, immunostimulant, anti-diabetic and anti-depressant activities elderberries have gained popularity in the field of research. Elderberries are rich source of vitamin B complex, vitamin C, A and E which play strong anti-oxidant activity and prevent from cancer. They also enhance immunity of the body(45). Chemical constituents which are present in elderberry other than vitamins are micronutrient, polyphenols, phytosterols, carotenoids and bioflavonoids. These chemical constituents give beneficial nutrition and are good supplementary agents for respiratory system. Upper respiratory tract ailments are usually treated with anti-septic and anti-viral medicine. Elderberry contains strong potential of anti-septic and anti-viral activities. The 2019 study on elderberry for both cold and flu suggested that the chemical constituent present in fruit substantially reduced upper-airway symptom. However, a 2012 study suggested that elderberries could help in preventing influenza virus via stimulating an immune response.

Oregano

Biological name of oregano is *Origanum vulgare*. This aromatic perennial herb belongs to lamiaceae family. Commonly it is known as wild marjoram. *Origanum vulgare* is native to Mexico, Asia, United States and Mediterranean hills but it is also cultivated in many other regions of world. It has been used for culinary and therapeutic purposes from thousands of years. Many parts of oregano used in medicinal purpose and cooking. By researchers it was demonstrated it oregano is good for cold and respiratory ailments. Phenol is a chemical constituent of oregano found in the leaves has strong anti-oxidant activity and help in preventing from lung cancer. In another research studies it was confirmed that

chemical constituents found in the leaves of oregano are effective against respiratory problems such as cold, bronchitis, asthma, chronic cough and viral infections. Oregano also possesses anti-spasmodic, anti-septic, anti-inflammatory, expectorant, and stimulant activity. Phytoconstituents of oregano such as carvacrol, terpene and flavonoids having decongestant and anti-histamine activity used for clearing congestion in airway passage and clear airway. Due to anti-histamine activity carvacrol, terpene and flavonoids release chemical histamine which causes allergic reactions such as asthma and cough due to allergens. Rosmarinic acid is another chemical constituent of oregano having anti-histamine activity inhibit allergic irritation. Anti-histamine activity of rosmarinic acid was discovered in 2004 by research and experimental study. Rosmarinic acid is naturally histamine inhibiting compound(46). Oregano also have iron, calcium, zinc, potassium, magnesium & niacin., all of these are required by the systems within the body, including the immune system. Adequate vitamin and mineral intake are paramount for maintaining a healthy body that can fight off concerns, such as upper respiratory issues, before they start(47).

Red clover

Scientific name of red clover is *Trifolium pratense*. Commonly it is known as cow clover and mild clover. It belongs to fabaceae family. This herbaceous flowering plant is native to Europe, north west Africa and western Asia but also cultivated in many other regions of world. This perennial plant is variable in size. It is an ornamental plant used for therapeutic and culinary purposes. Isoflavones are the active chemical constituents of red clover used for therapeutic purposes. In traditional medicine red clover is commonly used for the treatment of asthma, cough, whooping cough, bronchitis, cancer prevention,

premenstrual syndrome, cholesterol lowering, osteoporosis, eczema and psoriasis. Red clover also possesses anti-inflammatory, expectorant, anti-spasmodic, sedative and deobstruent activity. Due to its best therapeutic potential it is widely used for the treatment of respiratory ailment in many regions of world especially India. Due to its anti-tussive activity is considered best remedy for children. Due to its anti-inflammatory activity it helps in lowering the inflammation in airway by inhibiting all factors responsible for inflammation. Having expectorant activity isoflavones considered best therapeutic agents in treatment of respiratory tract ailments (48-50).

Ginseng

Panax ginseng commonly known as Asian ginseng, Korean ginseng or chinees ginseng belongs to Araliaceae family. This perennial plant is native to eastern Asia. Traditionally it is used for the treatment and prevention of chronic infections and diseases. It is also used as a tonic. *Panax ginseng* used in the treatment of chronic obstructive pulmonary disease (COPD). Chronic obstructive pulmonary disease is characterized by coughing, excessive mucus or sputum formation and breathlessness. Usually this respiratory problem is treated with Bronchodilators. From various systematic studies, it was indicated that ginseng improves quality of life & function of lungs. By two studies conducted by Scaglione & colleagues it was evaluated that ginseng is an effective treatment for bronchitis and chronic obstructive pulmonary disease. Due to Immunomodulator, activity ginseng has preventive activity against ARI (acute respiratory illness) (51-54). ARI is a life limiting disease with symptoms of fever, shivering, malaise and cough. Acute respiratory illness is viral disease caused by adenovirus, Rhinovirus, influenza virus and corona virus. Ginseng also possesses immune stimulant and anti-viral activity. It

enhances immune response of body by activating natural killer cells and T lymphocytes. For this concern two studies were conducted on *Eugenia* pig and rats and ginseng found to reduce load of pulmonary pathogens and improve immunity(56-59). Ginsenosides is an active chemical constituent of *panax ginseng*. Ginsenosides ameliorates pulmonary inflammatory response. Ginsenosides inhibits inflammatory response of lungs by disrupting the inflammatory signaling molecules by their potential therapeutic for inflammatory lung diseases. Ginsenosides show anti-viral response by improving response of antibodies, lymphocytes proliferation, inhibiting serum hemeagglutinine and viral clearness in lungs. In addition, Ginsenosides reduce expression of pro-inflammatory chemokines and cytokines such as tumor necrosis factor alpha and interleukins produced in airway macrophages & epithelial cells.

Berries

All over the world berries fruit are considered super food because they contain high content of bioactive natural component which on consumption provide health benefits. As the natural therapeutic agents' berries are used in the treatment of several diseases such as asthma, common cold, bronchitis, inflammation diabetes and ocular disfunctioning. Berries contain high level of phenolic, which greatly contribute in health benefits. The active main chemical constituents of berries are phenolic acid, flavonols and chlorogenic acid. These phytoconstituents show strong anti-oxidant, anti-inflammatory, neuroprotective and cardioprotective properties. Due to the strong anti-oxidant property of these chemical constituents' berries are used in the treatment of bronchitis, asthma, chronic obstruction pulmonary disease and emphysema (60, 61).

Mullein

Verbascum thapsus commonly known as mullein widely used in natural medicine. It is native to Asia and Europe. Mullein belongs to Scrophulariaceae family. In traditional medicine, it has been used as a best remedy for bronchitis. Having expectorant activity, it helps in expelling mucus and clear airway for easy breathing. By expelling mucus and soothing mucus membrane used in the treatment of chronic obstructive pulmonary disease. Due to its anti-inflammatory activity mullein decrease inflammation and help in relaxing muscles of respiratory tract used in the treatment of bronchitis and tonsillitis. It is also used in the treatment of tuberculosis and pneumonia. In the treatment of asthma mullein is a safer choice of treatment with considerable expectorant and demulcent activity. By removing mucus, decreasing inflammation and relax muscles in opening broncho tubules. Due to its anti-spasmodic activity mullein also used in relaxing muscles spasm and clear congestion (62-63).

Hyssop

Hyssopus officinale belongs to lamiaceae family. It is an aromatic and therapeutic herb. It has been used in traditional medicine from many years. This herbaceous plant is native to Europe, middle east and many other regions of the world. From thousands of years it has been used in the treatment of respiratory ailments. Chemical constituents having therapeutic potential are terpenes and flavonoids. Due to its spasmodic activity and relax the spasm of respiratory tract and having anti-septic activity it removes the irritant from tract and soothes & relieve coughing. It removes the mucus from respiratory tract and clear mucus obstruction due to its expectorant activity. Its anti-septic property also helps in the treatment of common cold and flu. Pharmacological investigations and research studies had shown that hyssop alleviate airway inflammation and remodeling & revers pathological changes. It was indicated by

2014 animal study that *Hyssopus officinale* has immune regulating effect on allergy-induced asthma (64).

Valeriana

Valeriana officinalis is an herbaceous plant. It belongs to valerianaceae family. This perennial plant is native to Asia, Europe, north America and in many other regions of world (65). It contains more than 250 species. Since the time of ancient Rome and Greece valeriana has been used for therapeutic functioning. Valerian is an active chemical constituent of *Valeriana officinalis* having therapeutic potential for the treatment of respiratory tract ailments (66).

Liquorice

Liquorice (*Glycyrrhiza glabra* Linn) is one of the most widely therapeutic herb. It has been used from ancient time for medicinal purpose. *Glycyrrhiza glabra* also used as a flavoring agent. Liquorice belong to leguminaceae family. Due to its Ethnopharmacological properties, *Glycyrrhiza glabra* is broadly used in traditional medicine all over the world. Glycyrrhizin, glycyrrhizinic acid, glabrine and isoflavones are the important chemical constituents of *glycyrrhiza glabra*. Liquorice is effectively used as an anti-viral, anti-tussive, anti-inflammatory, immunostimulant, anti-diabetic, anti-fungal, anti-bacterial, anti-oxidant, anti-ulcer, anti-diuretic and skin whitening agent. It is used in the treatment of cough and sore throat due to its expectorant and demulcent properties (67). Liquorice also found effective in the treatment of bronchial catarrh by decreasing irritation and producing expectorant properties. *Glycyrrhiza glabra* used in the treatment of cough, sore throat and bronchial catarrh. Liquorice also has ability to stimulate the secretion of tracheal mucus due to its expectorant and demulcent activities(68). It has proved that glycyrrhizin is responsible for expectorant and demulcent properties. Liquiritin apioside also

an active constituent of glycyrrhiza glabra, inhibits the capsaicin induced cough. This constituent also been found responsible for inhibition of cough(69, 70). It has been reported that glycyrrhithic acid of Liquorice has anti-inflammatory property. glycyrrhithic acid inhibits all factors which are responsible for mechanism of inflammation. It reduces inflammation by inhibiting prostaglandin formation and cyclooxygenase activity. It also inhibits platelets aggregation(71, 72). Carbenoxolone is another phytoconstituent of Liquorice inhibits enzymes responsible for inflammation. By reducing inflammation, it is used in the treatment of pharyngitis, laryngitis, bronchitis and asthma. Glycyrrhizin having prominent anti-viral activity used in the treatment of flu caused by influenza virus (73). It does not allow the binding of virus cells. From the recent studies which was conducted on two isolates of severe acute respiratory virus gave valuable remarks on the strong anti-viral activity of glycyrrhizin. Glycyrrhizin inhibit the replication of virus cells. Due to the immunostimulant activity of Liquorice it is also used in the treatment of common cold.

Chemical constituents of glycyrrhiza glabra increase production of macrophages and T lymphocyte from granulocytes(71,67).

CONCLUSION

Sicknesses and other related infections are obvious for the duration of regular day to day existence and have driven man to find courses by which they could be dealt with. Plants have reliably been a compelling resource of treatment from nature. People usually rely on the indigenous plant resources for the treatment of many respiratory disorders. Herbal or natural medicine in the treatment of various respiratory conditions are common practice in many regions of the world. In all over the world plants are used for the treatment of diseases. From the research and experimental studies conducted on plants for the treatment of respiratory tract ailment it was concluded that plants have best therapeutic potential in treating all kind of respiratory problems with high effectiveness and least or no side effects.

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Table1. Plant Activity Best for the Treatment of Respiratory Disorders

Plant	Scientific name	Active chemical constituent	Activity	Best for
Turmeric	<i>Curcuma longa</i>	Curcumin	Anti-inflammatory, anti-viral, anti-bacterial	Cold Flu cough, bronchitis, asthma
Ginger	<i>Zingiber officinale</i>	Gingerole Shagoal Arachidonic acid	Anti-inflammatory, immunostimulant, anti-bacterial, muscle relaxant	Dry cough Bronchitis Asthma
Garlic	<i>Allium sativum</i>	Allicin Ethyl linoleate	Decongestant, anti-viral, anti-infective, anti-inflammatory	Flu Cold Bronchitis Asthma

**PLANT-BASED THERAPIES: A COMPREHENSIVE REVIEW OF NATURAL APPROACHES TO
RESPIRATORY HEALTH**

Peppermint	<i>Mentha piperita</i>	Menthol	Anti-viral, open airway for breathing, numb nerve ending	Relief and reduce the urge of cough Flu bronchitis
Liquorice	<i>Glycyrrhiza glabra</i>	Glycyrrhizin Glycyrrhithinic acid Liquiritin	Anti-tussive Calm breathing passageway	Cough Restore breathing Asthma Bronchitis Pharyngitis flu
Echinaceae	<i>Echinacea purpurea</i>	Polysaccharides Glycoproteins Flavonoids Alkamides	Anti-viral Anti-inflammatory, immunostimulant	Flu Cold Cough Asthma bronchitis
Thyme	<i>Thymus vulgaris</i>	Thymol and Carvacol	Expectorant Decongestant Anti-viral Anti-septic	Flu Cold Cough Asthma bronchitis
Marshmallow	<i>Althaea officinalis</i>	Mucilage	Anti-tussive	Cough
Eucalyptus	<i>Eucalyptus globulus</i>	Cineole	Decongestant Expectorant Anti-tussive Anti-microbial Anti-inflammatory	Cough Bronchitis Flu Common cold Pneumonia COPD Sinusitis tonsillitis
Chillipepper	<i>Capsicum annum</i>	Capsaicin	Decongestant immunostimulant	Reduce congestion, best for dry cough, bronchitis
Ephedra	<i>Ephedra sinica</i>	Ephedrine	Decongestant	Clear congestion Bronchitis Asthma

**PLANT-BASED THERAPIES: A COMPREHENSIVE REVIEW OF NATURAL APPROACHES TO
RESPIRATORY HEALTH**

Adhatoda	<i>Adhatoda vasica</i>	Quinozoline alkaloid and vasicine alkaloid	Broncho-dilator Expectorant	Reproductive cough, Bronchitis Asthma Cold Whooping cough Tuberculosis Lung cancer
Elderberry	<i>Sambucus nigra</i>	Bioflavonoid Vitamins Micronutrients	Immunostimulant Anti-viral	Flu Cold Enhance immunity
Oregano	<i>Origanum vulgare</i>	Carvacrol Rosmarinic acid Flavonoids Terpene	Anti-septic Anti-oxidant Expectorant Decongestant	Cold Cough Bronchitis Asthma Clear congestion from airway