Indian Journal of Natural Products and Resources
Vol. 13(4), December 2022, pp. 451-459
DOI: 10.56042/ijnpr.v13i4.39542

Efficacy of phyto-therapeutics in allergic rhinitis: A review

Rakhi Gupta, Archana Aggarwal*, Kamakshi Upreti, Shreya Rawat, Bhumika Tiwari and Radhika
Zoology Department, Maitreyi College, University of Delhi, New Delhi 110021, India

Received 18 August 2020; revised received 26 October 2022; accepted 17 November 2022

Allergic rhinitis (AR) or hay fever is the most common symptomatic allergic disorder triggered by allergen and if it remains undiagnosed, can adversely impact the general well-being. The ailment is characterized by an exaggerated immune response to environmental triggers including pollen, moulds, ragweed, dirt mites, dust, etc. within the nasal mucosa, ultimately leading to gene environment interaction which elevate the IgE level in the nasal mucosa, and ultimately infection of the nasal cavity. The major signs and symptoms of AR include rhinorrhea, sneezing, eye itching, postnasal drip, cough, nasal obstruction, and fatigue due to nasal discomfort. Various studies reported 20-30% occurrence of the disease and majority of them are inclined towards allopathic medication for instant relief. Since these drugs lead to unenviable side effects in the long term, it is of utmost importance to search for alternative mode of medication with lower side-effects. The use of traditional medication in the form of various herbal plants and their mixture have proved to be effective in the management of symptoms for asthma and AR. Their efficiencies have been restrained successfully in various reports. It has been proven that herbal medicines are safe to use and thus have rendered a vast contribution to the treatment of allergic rhinitis. Hence, the present review is aimed to discuss the efficacy and protection provided by diverse herbal drugs in the management of AR.

Keywords: Allergens, Allergic rhinitis, Allopathy, Herbal medicine, Symptoms

IPC code; Int. cl. (2021.01)- A61K 36/00, A61P 11/00

Introduction

Allergic rhinitis (AR) is the most common symptomatic disease induced by allergens comprising pollen, dust mites, moulds, pollutants, ragweed, etc. and can cause negative effects in terms of general health, quality of life, and social relationships. AR has been broadly classified into two categories according to the ARIA guidelines, pertaining to the duration of occurrence of symptoms (intermittent/persistent) and severity of the symptoms (mild/moderate to severe)[1].

Both categories are characterized by an exaggerated immune response to the environmental triggers in the nasal mucosa, ultimately leading to IgE-mediated inflammation of the nasal cavity. Mechanistic studies have demonstrated that a sensitizing allergen interacts with IgE and cytokines such as interleukin 4 (IL-4), IL-5, or IL-8 produced against the allergen[2]. Furthermore, AR increases the risk of bronchial asthma, chronic sinusitis, and otitis media, as well as cognitive, emotional, and performance-related problems in children and adults. Treatment is targeted at assuaging symptoms and eliminating difficulties related to lifestyle. Thus, it becomes imperative to first reduce exposure to the allergens and next is the pharmacological intervention, intending to control moderate to severe symptoms which include, H1 receptor antagonists (anti-histamines), decongestants, mast cell stabilizers, leukotriene receptor antagonists, corticosteroids and anticholinergic agents consumed orally or via topical intranasal formulations[3]. However, long-term exposure to the above therapeutic agents especially corticosteroids can cause systemic negative effects such as hypothalamic-pituitary-adrenal suppression, bone demineralization, growth retardation, and development of cataracts or glaucoma[4]. Therefore, there is an utmost need for an alternative remedy for a better clinical outcome.

Indian Ayurvedic medicines use herbs and their mixture for the treatment of diseases like asthma and AR without any long-term negative impact on the body. Recent studies delineate that herbal medicine has a significant contribution in the treatment of AR[5]. Medicinal plants and their compounds are safe to use, very effective in relieving quite a few symptoms of AR and improving the condition. The role of medicinal plants has been reported *in vivo* using AR-

*Correspondent author
Email: aaggarwal@maitreyi.du.ac.in

induced model in treating AR which is essentially due to their anti-inflammatory and antiallergic properties[3,6]. The present review aims to discuss the potential of various medicinal plants and their compounds in the management of AR.

Methodology

For the preparation of the review paper, more than 150 research papers were extracted and reviewed from the PubMed database with the use of terms phototherapy, herbal medicines, allergic rhinitis, treatment, extraction method, and efficacy of herbal components.

Herbal medicines

One of the best alternative methods for the treatment of AR is herbal remedies. They can be consumed in the form of infusion, tincture, or pills. Not only these natural medicines reduce allergic symptoms but also help to improve the overall health of the individual. Even though several differences exist between herbal and conventional pharmacological treatments, herbal medicine can be tested for efficacy using conventional trial methodology. Several specific herbal extracts have been demonstrated to be efficacious for specific conditions.

Zingiber officinale Roscoe

Zingiber officinale Roscoe (Family: Zingiberaceae) is commonly known as Ginger. Ginger is a safe and highly effective herb generally available in the kitchen. Apart from its culinary use, it is very beneficial to overall health, as it soothes the digestive system and improves circulation in the body. Ginger acts as a natural antihistamine, potent antiviral agent, anti-nausea, anti-inflammation, antipyresis, and analgesia agent and immune booster. It can be added to the tea to alleviate nasal congestion and headaches, whereas its 2% dietary intake reduces the nasal rubbing and sneezing by suppression of nasal mast cells in nasal mucosa and IgE in the serum[7]. It was investigated that ginger and its major compounds 6-gingerol and 6-shogaol exhibit the major anti-allergic activity thus inhibit the effects of Th1 and Th2 cytokines released from T cells[8].

Curcuma longa L.

Curcuma longa L. (Family: Zingiberaceae) is commonly known as Turmeric. Turmeric is a native to tropical South Asia, and a rhizomatous herbaceous perennial plant[9]. Volatile oil *viz*. turmerone and a colouring agent called curcuminoids are present in the roots of plant. The composition of curcuminoids are rich in curcumin demethoxycurcumin, 5'-methoxycurcumin, and dihydrocurcumin, which are found to be natural antioxidants. Turmeric is also a rich source of the ω-3 fatty acid and α-linolenic acid which elevate the production of eosinophils count. Increased number of eosinophils infiltrate the nasal passage, released the anti-allergic lipid mediator, 15-hydroxyeicosa pentaenoic acid which reduced the AR symptoms by inhibiting mast cell degranulation[10]. Curcumin alleviated nasal symptoms (sneezing and rhinorrhea) and nasal congestion through reduction of nasal airflow resistance in AR. Curcumin was found to exert diverse immunomodulatory effects, including suppression of IL-4, IL-8, and tumour necrosis factor α and increased production of IL-10 and soluble intercellular adhesion molecule. However, curcumin did not affect the release of prostaglandin E_2 and leukotriene C_4 from polymorphonuclear neutrophils[11].

Aloe barbadensis Miller

Aloe barbadensis Miller (Family: Asphodelaceae/ Liliaceae) is commonly known as Aloe Vera. Aloe vera is one of the most widely used plant native to Africa, Madagascar, and the Arabian Peninsula[12] and improves the quality of life by stimulating and improving the individual's defence mechanism. The medicinal property of processed aloe vera gel (PAG) suppresses the degranulation of phagocytes in allergic conditions[13]. It was observed in an experiment, that aloe vera treatment regulates the expression of Th1 and Th2 cytokines which are involved in the differentiation of CD4+ lymphocytes, thus, a non-traumatic method to cure allergic rhinitis[14].

Glycyrrhiza glabra L.

Glycyrrhiza glabra L. (Family: Fabaceae) is commonly known as Licorice/Mulhethi. According to the literature, licorice shrub possesses the anti-inflammatory and antioxidant properties and has been used in Indian homes to treat cough by discharging and eliminating mucus since long time. A scientific study in mice showed that a major component of liquorice is Glycyrrhizic acid (GA), responsible for the suppression of increased level of IL-4 and restoration of the immunological balance of T_H cells. GA also act as mast cell stabilizer and anti-allergic agent[15]. Other findings suggested

that treatment with water extracted solution of licorice stem enhanced the antioxidant status and decreased the incidence of free radical-induced lipid peroxidation, thus, improves immune activities in the blood and nasal mucosa of AR susceptible mice[16]. It can be consumed as liquorice stick, infusions, or extractor pills. People with high blood pressure should avoid this treatment.

***Trifolium repens* L.**

Trifolium repens L. (Family: Fabaceae) is commonly known as Clover. Clover is the perennial plant, native to Europe and Central Asia, used in folk medicine by many cultures[17]. It contains various bioactive compounds that are being used as herbal medicines, nutraceuticals, and dietary supplements. It was also reported that clover is very effective in the increased number of eosinophil count which is responsible for anti-allergic effect[18].

***Albizia lebbeck* (L.) Benth.**

Albizia lebbeck (L.) Benth. (Family: Fabaceae) is commonly known as Shirish tree. *Albizia lebbeck* exhibit varied phytochemicals and has excellent medicinal values. It is mainly distributed in tropical and subtropical areas of India, Andaman Island, Myanmar, tropical Africa, Asia and northern Australia[19]. It contains many natural anti-allergic, anti-inflammatory, and anti-asthmatic components such as alkaloids, tannins, saponins, amines, and flavonoid obtained from leaves, bark, seeds, and pods[16]. As reported, different concentrations of the ethanolic extract of different parts of *A. lebbeck* has potential to enhanced mast cells stability thus, inhibits the histamine release. It has been demonstrated that administration of the *A. lebbeck* extract in induced AR in mice significantly decreased the occurrence of sneezing and nasal rubbing and also suppressed toluene diisocyanate induced up-regulation of IL-4, IL-5, and IL-13 mRNA[20].

***Clitoria ternatea* L.**

Clitoria ternatea L. (Family: Fabaceae) is commonly known as Darwin pea/ Butterfly pea. The plant also known as 'Aparajita' is native to the Indian sub-continents and Southeast Asia, and was introduced to Australia, Africa and America[21]. This plant has been used as a traditional Ayurvedic medicine for diverse diseases since ancient time and scientific studies has reconfirmed those with modern relevance. *C. ternatea* has wide range of metabolites including triterpenoids, flavonol glycosides, saponin, flavonoids, anthocyanins, and steroids. Ethanolic extract of *C. ternatea* flower is traditionally used in the treatment of respiratory disorders including bronchitis and is one of the ingredients in different ayurvedic preparations used in treatment of respiratory diseases. Also, the ethanol extract of *C. ternatea* roots evaluate antiasthmatic activity which concludes that the antiasthmatic activity of *C. ternatea* may be due to the presence of flavonoids or saponins[22].

Triphala

Triphala consists of three fruits namely, amalaka (*Emblica officinalis* Gaertn; Family: Euphorbiaceae), bibhitaki (*Terminalia bellerica* Roxb.; Family: Combretaceae), and haritaki (*Terminalia chebula* Retz.; Family: Combretaceae). Triphala is native to Indian subcontinent and well-recognized, ancient medicine used in Ayurvedic healthcare. It is an efficacious polyherb, consisting of dried fruits of above mentioned three plant species. According to an earlier study, subjects treated with Panchakarma therapy (with the combination of various ayurvedic medicines) for thirteen days, showed a significant reduction in sneezing episodes, relief from headache, and itching in nose and throat. After one and half year follow up, complete recovery was observed with respect to sneezing and throat heaviness[23].

***Urtica dioica* L.**

Urtica dioica L. (Family: Urticaceae) is commonly known as Nettle. Nettle is native to Europe, but is also found in Asia, North Africa, New Zealand and North America[24]. It is one of the most effective herbal treatments for AR. Nettle has an antioxidant, astringent, antimicrobial, and analgesic effect, and can reduce allergy-related symptoms without risks of any side-effects, unlike the allopathic treatments[25]. Cooking of leaves remove their stinging effects, and can then be added to salads, soups, or stews, like most other green leafy vegetables. Also, leaves can be dried and used to brew nettle tea. Adenine, nicotinamide, synephrine, and osthole are the major components of nettle plant parts and have anti-inflammatory and anti-allergenic properties. Synephrine, an alkaloid, has been used as a nasal decongestant since long time. Nettle's leaf extraction inhibits several inflammatory processes such as, i) inhibitory activity against Histamine-1 receptor thus inhibits histamine production, ii) inhibiting mast cell degranulations,

iii) inhibits the production of cyclooxygenase-1 and 2, involved in induction of many inflammatory events, and iv) inhibition of prostaglandin D2 production, a primary pro-inflammatory mediator in AR[26]. Thus, its consumption in the form of infusions or extracts is highly recommended to decrease mucus production and coughing attacks.

***Perilla frutescens* (L.)**

Perilla frutescens (L.) Britton (Family: Lamiaceae) is commonly known as Common mint/ beefsteak plant). This obscure herb is native of the Himalayas to Southeast Asia[27] and can help defeat/ameliorate AR symptoms naturally. Many studies have shown that *P. frutescens* is effective against nasal congestion, sinusitis, allergic asthma, and eye irritation. The dry seed extract of *P. frutescens* contains rosmarinic acid and various flavonoids, such as luteolin, apigenin, and chrysoriol, which have anti-allergic properties[28]. It is also reported that rosmarinic acid inhibits seasonal allergic rhinoconjunctivitis. The ethanol extracts of *P. frutescens* leave decrease Th2 cytokines production, serum IgE level, cells infiltration, and allergic mediator secretions. Moreover, essential oils extracted from *P. frutescens* have an antidepressant effect and boost serotonin levels in the brain. In other words, this herb not only reduces inflammation in the body, but also improves overall mood and increases the feeling of well-being[29].

***Hippophae rhamnoides* L.**

Hippophae rhamnoides L. (Family: Elaegnaceae) is commonly known as Sea Buckthorn. This plant grows into a shrub or small tree native of Europe, Northern Asia, and China[30]. Sea buckthorn can easily be recognized by its thorny, grey twigs, and bright orange ovoid fruit. The herb contains more than 190 nutrients and phytonutrients including an array of organic acids, tannins, quercetin, provitamin A, vitamin E, and a significant amount of vitamin C, B complex vitamins, and superoxide dismutase (SOD) enzyme[31]. SOD, a potent antioxidant enzyme plays a critical role in regulating respiratory health. As reported by Deegan, the ethanol extract of sea buckthorn seed, has the ability to induce apoptosis of eosinophil granulocyte which are responsible for inflammatory reactions. Sea buckthorn is ideal for people who suffer from AR and also for people who suffer from asthma, chronic coughs, and other breathing disorders[32].

***Syzygium cumini* (L.) Skeels**

Syzygium cumini (L.) Skeels (Family: Myrtaceae) is commonly known as Black plum. Black plum is native to India and widely distributed in various Asian countries such as Malaysia, Thailand, and the Philippines[33]. Different parts of the black plum tree have antioxidant, anti-inflammatory, anti-microbial, antileishmanial, and antifungal, and free radical scavenging properties[34]. The aqueous leaf extract of black plum contains two important components *viz* hydrolysable tannins and flavonoids which possesses an anti-allergic effect. It has anti-edematogenic effect due to the inhibition of mast cell degranulation and of histamine and serotonin effects[35].

***Piper nigrum* L.**

Piper nigrum L. (Family: Piperaceae) is commonly known as Black pepper. The black pepper, the pungent spice made from its fruit, is the native to Malabar coast of India[36]. It is a worldwide used spice, known for its anti-microbial, anti-carcinogenic, gastroprotective, antioxidant, and anti-inflammatory properties. Moreover, it also improves brain power, blood sugar, cholesterol level, gut health, and have cancer fighting properties. The chemical composition of black pepper extract has an alkaloid substance, piperine, which significantly decline allergic symptoms including sneezing, rubbing and runny nose after administration thus, ameliorates the nasal condition and mucosal swelling[37].

***Piper longum* L.**

Piper longum L. (Family: Piperaceae) is commonly known as Long Pepper/Pippali. Pippali is an herbaceous plant, native of Northeast India, Indo-Malaysian region, and Sri Lanka[38]. The dried fruit of pippali is used as pickle, spice, and in Ayurvedic medicine in Indian homes. Various medicinal properties including anti-bacterial, anti-allergic, anti-tumour, anti-amoebic, anti-oxidant, anti-inflammatory, and anti-histaminic activities have been investigated by different researchers. It has chemical properties like the black pepper[39].

***Tinospora cordifolia* (Willd.) Hook. f.**

Tinospora cordifolia (Willd.) Hook. f. (Family: Menispermaceae) is commonly known as Guduchi/Giloy. Giloy is native to various regions of India, Myanmar, and Sri Lanka[40]. The plant is used to improve the immune system and the body resistance against infections especially viable in

treating AR. *T. cordifolia* extract contains many constituents such as alkaloids, steroids, glycosides, aliphatic compounds, phenolic and polysaccharides. These components have been reported to have different biological properties such as antidiabetic, antioxidant, antihepatotoxic, and immunomodulatory in disease conditions thus enabling potential application in clinical research. Furthermore, it enhances the phagocytic and intracellular bactericidal activities of macrophages and neutrophils. As reported, treatment with aqueous extract of giloy reflects the relief in allergic rhinitis symptoms[41]. The effect of an aqueous extract of *T. cordifolia* stem was investigated on mast cell mediated allergic reactions *in vivo* and *in vitro* and studied for its possible mechanism in the treatment of acute and chronic allergic disorders. Recently, *Tamalakyadi decoction* (TMD12), a formulation, prepared by the combinations of 12 plant ingredients including giloy, has shown good clinical results[42].

***Petasites hybridus* (L.) G. Gaertn., B. Mey. & Scherb**

Petasites hybridus (L.) G. Gaertn., B. Mey. & Scherb (Family: Asteraceae) is commonly known as Butterbur. The butterbur shrub found in the marshes of North America, Europe, and Asia[43] has several therapeutic components used for the treatment of pain, headaches, fevers, and digestive ailments traditionally. Butterbur has been the centre of scientific study with promising results in several diseases. It was studied that this herb works similar to Citirizine, a prescribed allergy medication. Butterbur products contain extracts from its root, rhizome, and leaves. This herb shall not be consumed in its raw form since it contains certain alkaloids (PAs) that are harmful to humans[44].

Picrorhiza kurroa Royle ex Benth

Picrorhiza kurroa Royle ex Benth (Family: Scrophulariace) is commonly known as Kutki. A small, creeping perennial shrub, found in Himachal Pradesh and Kashmir in India, Myanmar, Nepal, Tibet and Pakistan[45] and grown at elevations of 7 to 14 thousand feets. Traditionally root extracts are used for cough and colds. Current research has been building on asthma research through ethanol-extractions and has identified a number of active ingredients in *P. kurroa*, including acetophenone derivatives (which have anti-asthmatic properties), iridioids (picroside I, II, III, pikuroside, kutkoside and 6-feruloyl catalpol), and cucurbitacins (extremely bitter glycosides, including apocynin). These compounds in *P. kurroa* have immunomodulatory, antiviral, anti-allergic, antibiotic, and antioxidant properties[46].

***Tylophora indica* (Burm f.) Merill.**

Tylophora indica (Burm f.) Merill. (Family: Asclepiadaceae) is commonly known as Anantmool. Anantmool, generally found in Bengal, Assam, and South India, is an evergreen climbing plant or vine. Plant stem, roots and leaves have medicinal alkaloid components including, Tylophorine and Tylophorinine. However, the leaves have been used in the treatment of bronchial asthma in recent years, have phenanthroindolizidine alkaloids with anti-asthmatic activity. It was scientifically studied that 62% of the *Tylophora* group had relieved from the symptoms after chewing and swallowing of one leaf daily for 6 days in the morning. The prevalence of after effects such as loss of taste for salt, sore mouth, morning nausea and vomiting due to the treatment in the Tylophoragroup, was 53%. It is hypothesized that irritative effects of the juice of the Tylophora leaf on the mucous membranes of the mouth, tongue, and stomach somehow suppress or diminish the response of the nasobronchial tissue to an inhalant allergen through some reflex mechanism[47]. An alkaloid mixture (0.17%) has been isolated from the aerial parts of the plant, Tylophorine, the major alkaloid, has also been studied extensively for its anti-allergic properties[48].

***Ziziphus jujube* Mill.**

Ziziphus jujube Mill. (Family: Rhamnaceae) is commonly known as Red dates or Chinese dates. *Ziziphus jujuba* is a native plant of China[49]. The fruits of the plant rich in polysaccharides and cAMP, and have been used in traditional Chinese medicine for more than two thousand years. Fruit exhibits immunobiological and anti-oxidant properties. The investigations of the immunomodulatory effects of jujube extract on mast cell degranulation showed that the release of β-hexosaminidase (β-hex) was inhibited, which is present in the lysosomes of the cell and responsible for cell homeostasis, thus, preventing mast cell degranulation. However, cAMP reduced the secretion of IgE and histamine in the plasma of mice with ovalbumin (OVA)-induced allergic rhinitis. cAMP regulated both Th1 and Th2 cytokines levels in the plasma. In addition, cAMP also inhibited β-hex release and blocked extracellular Ca2+ influxes in RBL-2H3 cells. Thus,

cAMP suppressed cytokine production in the allergic response pathway, which resulted in prevention or alleviation of allergy symptoms[50].

***Smilax glabra* Roxb.**

Smilax glabra Roxb. (Family: Smilacaceae) is commonly known as Chinaroot. Chinaroot is native to China, the Himalayas and Indochina[51]. The rhizome of chinaroot has been used in Thai and Chinese traditional herbal medicine preparation for the treatment of various inmmunological disorders. A study demonstrated, that the 95 and 50% ethanolic extracts of chinaroot showed remarkably high anti-allergic activity, but the two flavonoid constituents *viz* engeletin and astilbin of chinaroot show significant anti-inflammatory and anti-oxidant activities, instead of anti-allergic activity. The findings suggested that a combination of effects of various phytochemicals in crude extracts used in traditional medicine are responsible for the purported anti-allergic activity of chinaroot herbal preparations[52].

***Clerodendrum serratum* (L.) Moon**

Clerodendrum serratum (L.) Moon (Family: Lamiaceae) is commonly known as Bharangi. Bharangi is one of the oldest polyherbal plants used for the healthy respiratory system. Bharangi is distributed throughout the world but preferably found to hot temperate and tropical regions and native to India, Sri Lanka, Australia, South Africa, Malaysia and Tropical America[53]. Several bioactive compounds are present in the roots of the plant and evaluated for anti-histaminic, mast cell stabilizer and bronchodilator effect through various *in vitro* and *in vivo* experimental models[54].

***Sphaeranthus indicus* L.**

Sphaeranthus indicus L. (Family: Asteraceae) is commonly known as Gorakhmundi. It is also commonly called as khmundi, Indian sphaeranthus and East Indian globe thistle. This plant is found throughout India, Nepal, Sri Lanka, Malaysia, Australia and Myanmar[55]. Different measures of ethanol extract of *S. indicus* whole plant and ethyl acetate extract showed slightly better protection of mast cell degranulation than the standard drug ketotifen in the sheep serum model. These extracts also showed better mast cell stabilizing activity (77–88%)[56].

***Myrica esculenta* Buch.**

Myrica esculenta Buch. (Family: Myricaceae) is commonly known as Kaiphal. Kaiphal is a widely known medicinal plant with full of flavonoids, found in the form of wild berries in the sub-Himalayan region. It was studied that ethanolic extract of *M. esculenta* possesses significant anti-allergic and anti-inflammatory activity and may be useful in the treatment of allergic disorders such as allergic asthma and AR by decreasing bronchial hyper-responsiveness. The plant has several active phytoconstituents such as tannins, phenolic acids, flavonoids, terpenes, glycosides, steroids, volatile oils, and amino acids with wide variety of pharmacological effects[57,58].

***Camellia sinensis* (L.) Kuntze**

Camellia sinensis (L.) Kuntze (Family: Theaceae) is commonly known as Green tea. Green tea is one of the most consumed types of tea in the world and possesses great antioxidant and anti-allergic properties. A polyphenolic compound, epigallocatechin gallate (EGCG) of green tea plays a very noticeable role in reducing symptoms for AR[59]. It was investigated that after EGCG administration, sneezing, nasal rubbing, concentration of IgE, histamine, and interleukins (IL-1, IL-4 and IL-6) in the serum of AR mouse were declined significantly. However, the long-term user group has better results including nasal symptom, throat pain, nose-blowing, tears, and hindrance to activities of daily living in contrast to short-term users[43]. Similarly, 'Benifuuki' a Japanese green tea has EGCG and EGCG3Me and simultaneous addition of ginger extract remarkably suppressed cytokine (TNF-α and MIP-1α) secretion. Thus, regular consumption of 'Benifuuki' tea significantly decreased various symptoms such as blowing the nose, stuffy nose, itching eyes, throat pain[60,61].

Thus, for allergies, green tea can be consumed regularly to alleviate the allergic reaction and its symptoms. It has no side effects and drinking 2-3 cups a day is optimal to procure its health benefits.

Discussion

Allergic Rhinitis is triggered by inhaling tiny particles of allergens chiefly pollen, dust mites, molds etc. The exaggerated immune response to allergens results in the production of antibodies that cause cells to release a number of chemicals including histamine resulting in symptoms like sneezing, running nose, watery eyes, and sore throat. The number of people suffering from AR is considerably increasing due to controlled lifestyle leading to decreased interaction with the environment. Studies have shown that the

prevalence of AR in India ranges between 7 to 25% in different age groups. It was also observed that majority of affected persons were comfortable with allopathic medication for instant relief[62].

Use of herbal medicines has significantly increased within the past few years to provide relief in the symptoms of AR similar to that of allopathic medicines such as Butterbur which acts similar to cetirizine by blocking histamine on cell receptors[45]. Moreover, specific phytochemical derivatives have been isolated from several plants that act as mediators, a cell signalling system, and blocks the production of histamines and prostaglandins that cause AR. Various derivatives are also being identified from medicinal plants like ginger, turmeric, cloves, black pepper, shirish *etc*. which are commonly found in the kitchen and have antihistamine properties are very effective in controlling the disease[7,8,18]. *T. cordifolia* also has promising anti-allergic properties as it has mast cell stabilizing and antihistamine properties[63]. Herbal medicines if used sensibly and proactively, have the ability to boost the immune system and can help prevent the onset of allergic reactions. Despite the positive results shown by herbal medicines there are still problems faced while using them. Primarily, there is a lack of management of qualitative and quantitative analysis for these components. Some of these compounds are harmful if consumed inappropriately and may lead to other health issues. Knowledge about the correct dose and method of consumption of certain herbs used since ancient times is not known in depth. Additionally, before the adoption of any new treatments, doctor consultation is advisable. Till date, intensive studies are being conducted in controlled and *in vivo* conditions to find effective herbal formulation and medicine to treat AR.

Most of the people are unaware of this hypersensitive allergic reaction and are therefore left untreated. In normal cases, viral infections cause cold and related illnesses that may remain up to a week, but when the allergy superimposes on common cold it leads to a persistent health concern. Despite the use of various treatments and therapies for the management of allergic rhinitis, the use of herbal drugs has been increasingly investigated over the past few decades. Research is still going on to find other herbal medicines and their combinations which will be safe and effective to treat AR efficiently.

Conclusion

The increase in the prevalence of AR among the young population over the last decade is alarming and needs attention. In many cases, the underline cause remains undetected impacting the quality of life. For instant relief from symptoms, allopathic medicines are used which have a negative impact in long term. It is imperative that an alternative mode of medication in terms of herbal medicine be explored. Many herbal plants contain well-known active ingredients, which are well-accepted by modern medicine as well. The dose and duration of herbal products should be standardized for the beneficial outcome as home remedies without knowing the safe dose and duration may not produce optimum results. Considering the high occurrence of disease in the young population, research in this area should be intensified. Also, the general public should be appropriately made aware of the usefulness of herbal medicine/products in relieving symptoms associated with AR. It would certainly be beneficial to public health.

Conflicts of interest

There are no conflicts of interest among authors. The authors alone are responsible for the content and writing of the paper.

References

1 Husna S M N, Tan H T, Md Shukri N, Ashari N S M and Wong K K, Allergic rhinitis: A clinical and pathophysiological overview, *Front Med*, 2022, **9**, 1-10.

2 Kozlo V, Lavrenova G, Savlevich E and Bazarkina K, Evidence-based phytotherapy in allergic rhinitis, *Clin Phytosci*, 2018, **4**, 23-30.

3 Moradi B, Soureshjani S H, Samani M A, Yang Q and Boroujeni A S, Efficacy and mechanisms of medicinal plants as immunotherapy in treatment of allergic rhinitis: A systematic review, *Int J Pharm Sci Res*, 2017, **8**(5), 1892-1899.

4 Malone M and Kennedy T M, Review: Side effects of some commonly used allergy medications (Decongestants, Anti-Leukotriene agents, Antihistamines, Steroids, and Zinc) and their safety in pregnancy, *Int J Aller Medications*, 2017, **3**(1), 024-029.

5 Rahim N M, Jantan I, Said M M, Jalil J, Abd Razak A F, *et al.*, Anti-allergic rhinitis effects of medicinal plants and their bioactive metabolites *via* suppression of the immune system: A mechanistic review, *Front Pharmacol*, 2021, **12**, 660083.

6 Ambade V, Managing allergic rhinitis through ayurveda: A case report, *Int J Creat Res Thoughts*, 2020, **8**(9), 2742-2747.

7 Yamprasert R, Chanvimalueng W, Mukkasombut N and Itharat A, Ginger extract versus Loratadine in the treatment

of allergic rhinitis: A randomized controlled trial, *BMC Complement Med Ther*, 2020, **20**, 119-129.
8 Kawamoto Y, Ueno Y, Nakahashi E, Obayashi M, Sugihara K, *et al.*, Prevention of allergic rhinitis by ginger and the molecular basis of immunosuppression by 6-gingerol through T cell inactivation, *J Nutr Biochem*, 2016, **27**, 112-22.
9 Bhowmik D, Kumar K, Chandira M and Jayakar B, Turmeric: A herbal and traditional medicine, *Arch Appl Sci Res*, 2008, **1**, 86-108.
10 Sawane K, Nagatake T, Hosomi K, Hirata S, Adachi J, *et al.*, Dietary omega-3 fatty acid dampens allergic rhinitis via eosinophilic production of the anti-allergic lipid mediator 15-Hydroxyeicosapentaenoic acid in Mice, *Nutr*, 2019, **11**(12), 2868-2884.
11 Wu S and Xiao D, Effect of curcumin on nasal symptoms and airflow in patients with perennial allergic rhinitis, *Ann Allergy Asthma Immunol*, 2016, **117**(6), 697-702.
12 Chinchilla N, Carrera C, García D A, Macias M, Torres A, *et al.*, *Aloe barbadensis*: How a miraculous plant becomes reality, *Phytochem Rev*, 2013, **12**, 581-602. Doi: 10.1007/s11101-013-9323-3.
13 Lee D, Kim H S, Shin E, Do S G, Lee C K, *et al.*, Polysaccharide isolated from Aloe vera gel suppresses ovalbumin-induced food allergy through inhibition of Th2 immunity in mice, *Biomed Pharmacother*, 2018, **101**, 201-210.
14 Yu H, Dong Z and Yang Z, Molecular biological study of aloe vera in the treatment of experimental allergic rhinitis in rat, *J Clin Otorhinolaryngol*, 2002, **16**(5), 229-231.
15 Han S, Sun L, He F and Che H, Anti-allergic activity of Glycyrrhizic acid on IgE-mediated allergic reaction by regulation of allergy related immune cells, *Sci Rep*, 2017, **7**, 7222-7231.
16 Li L X, Zhou A G, Zhang L and Chen W J, Antioxidant status and immune activity of glycyrrhizin in allergic rhinitis Mice, *Int J Mol Sci*, 2011, **12**(2), 905–916.
17 Egan L M, Hofmann R W, Ghamkhar K and Hoyos V, Prospects for *Trifolium* improvement through germplasm characterisation and pre-breeding in New Zealand and beyond, *Front Plant Sci*, 2021, **12**, 653191.
18 Czepas J K, *Trifolium*species – the latest findings on chemical profile, ethnomedicinal use and pharmacological properties. Royal pharmaceutical society, *J Pharm Pharmacol*, 2016, **68**(7), 845–861.
19 Vinita, Mishra H S, Yadav R B and Yadav K N, SIRISH (*Albizia lebbeck*Benth.): A natural anti-allergic drug, *Int J Ayurvedic Med*, 2018, **6**(7), 1386-1392.
20 Islam M N, Mizuguchi H, Shahriar M, Venkatesh P, Maeyama K, *et al.*, *Albizialebbeck* suppresses histamine signalling by the inhibition of histamine H-1 receptor and histidine decarboxylase gene transcriptions, *Int Immunopharmacol*, 2011, **11**, 1766-1772.
21 Gupta G, Chahal J and Bhatia M, *Clitoria ternatea* (L.): Old and new aspects, *J Pharm Res*, 2010, **03**, 2610-2614.
22 Singh N, Garabadu D, Sharma P, Shrivastava S and Mishra P, Anti-allergy and anti-tussive activity of *Clitoria ternatea* L. in experimental animals, *J Ethnopharmacol*, 2018, **224**, 15-26.
23 Mukherjee P, Rai S, Bhattacharyya S, Debnath P, Biswas T, *et al*., Clinical study of 'Triphala' – A well known phytomedicine from India, *Iran J Pharmacol Ther*, 2006, **5**(1), 5.
24 Mishra A, Batham L and Mishra S, Management of symptoms of allergic rhinitis by panchakarma therapy: Concept and application, *Ayurveda evam Samagra Swasthya Shodhamala*, 2019, **1**(1), 4-17.
25 Kregiel D, Pawlikowska E and Antolak H, *Urtica* spp.: Ordinary plants with extraordinary properties, *Molecules*, 2018, **23**(7), 1664-1681. doi: 10.3390/molecules23071664.
26 Taheri Y, Quispe C, Herrera-Bravo J, Sharifi-Rad J, Ezzat S M, *et al.*, *Urtica dioica*- Derived phytochemicals for pharmacological and therapeutic applications, *Evidbased Complement Altern Med*, 2022, **2022**, 1-30.
27 Mehdi B, Amir P, Majid E, Farahzad A, Ghazal A T, *et al.*, Efficacy of supportive therapy of allergic rhinitis by stinging nettle (*Urticadioica*) root extract: A randomized, double-blind, placebo-controlled, clinical trial, *Iran J Pharm Res*, 2017, **16**, 112-118.
28 Dhyani A, Chopra R and Garg M, A review on nutritional value, functional properties and pharmacological application of *Perilla* (*Perilla frutescens* L.), *Biomed Pharmacol J*, 2019, **12**(2), 649-660.
29 Marseglia G, Licari A, Leonardi S, Papale M, Zicari A M, *et al.*, A polycentric, randomized, parallel-group, study on Lertal, a multicomponent nutraceutical, as preventive treatment in children with allergic rhinoconjunctivitis: Phase II, *Ital J Pediatr*, 2019, **45**, 84-90.
30 Liang K L, Yu S J, Huang W C and Yen H R, Luteolin attenuates allergic nasal inflammation via inhibition of Interleukin-4 in an allergic rhinitis mouse model and peripheral blood from human subjects with allergic rhinitis, *Front Pharmacol*, 2020, **11**, 1-14.
31 Christaki E, *Hippophae rhamnoides* L. (Sea Buckthrone): A potential source of nutraceuticals, *Food Public Health*, 2012, **2**, 69-72.
32 Zielińska A and Nowak I, Abundance of active ingredients in seabuckthorn oil, *Lipids Health Dis*, 2017, **16**, 95-105.
33 Deegan R E O, Regan E A, Kinnula V L and Carpo J D, Extracellular superoxide dismutase and risk of COPD, *J Chron Obstruct Pulmon Dis*, 2009, **6**(4), 307-312.
34 Gautam A, Therapeutic properties of *Syzygium cumini* (Jamun) and *Tinospora cordifolia* (Giloy) against various lethal diseases, In *Advanced pharmacological uses of medicinal plants and natural products*, edited by A Singh, P Singh, N Bithel, (IGI Global), 2020, 316-337.
35 Brito F A, Lima L A, Ramos M F S, Nakamura M J, Cavalher-Machado S C, *et al.*, Pharmacological study of anti-allergic activity of *Syzygium cumini* (L.) Skeels, *Braz J Med Biol Res*, 2007, **40**, 105-115.
36 Kumar A K, Murugan M, Dhanya M K, Pandian A and Warkentin T D, Phytochemistry and therapeutic potential of black pepper [*Piper nigrum* (L)] essential oil and piperine: A review, *Clin Phytosci*, 2021, **7**, 52.
37 Bui T T, Piao C H, Hyeon E, Fan Y, Nguyen T V, *et al.*, The protective role of *Piper nigrum* fruit extract in an ovalbumin-induced allergic rhinitis by targeting of NFκBp65 and STAT3 signalings, *Biomed Pharmacother*, 2019, **109**, 1915-1923.
38 Biswas P, Ghorai M, Mishra T, Gopalakrishnan A V, Roy D, *et al*., *Piper longum* L.: A comprehensive review on traditional uses, phytochemistry, pharmacology, and health-promoting activities, *Phytother Res*, 2022, **36**(12), 4425–4476.

39 Aswar U, Shintre S, Chepurwar S and Aswar M, Antiallergic effect of piperine on ovalbumin-induced allergic rhinitis in mice, *Pharm Biol*, 2015, **53**(9), 1358-1366.

40 Singh D and Chaudhuri P K, Chemistry and pharmacology of *Tinospora cordifolia*, *Nat Prod Commun*, 2017, **12**(2), 299-308.

41 Geeta S, Kamath M S, Nagendra K and Shenoy R P, A clinical analysis of evaluating the usefulness and efficacy of the ayurvedic drug *Tinospora cordifolia* in Humans, *Adv Sci Lett*, 2017, **23**(3), 2007-2008.

42 Dahanayake J M, Perera P K, Galappaththy P and Samaranayake D, Efficacy and safety of two Ayurvedic dosage forms for allergic rhinitis: Study protocol for an open-label randomized controlled trial, *Trial*, 2020, **21**, 37-44.

43 Mihajilov-Krstev T, Jovanović B, Zlatković B, Matejić J, Vitorović J, *et al.*, Phytochemistry, toxicology and therapeutic value of *Petasites hybridus* Subsp. *Ochroleucus* (Common butterbur) from the Balkans, *Plants*, 2020, **9**(6), 700.

44 Blosa M, Uricher J, Nebel S, Zahner C, Butterweck V, *et al.*, Treatment of early allergic and late inflammatory symptoms of allergic rhinitis with *Petasites hybridus* leaf extract (Ze 339): Results of a non interventional observational study in Switzerland, *Pharm (Basel)*, 2021, **14**(3), 180.

45 Qureshi H, Masood M, Arshad M, Qureshi R, Sabir S, *et al.*, *Picrorhiza kurroa*: An ethnopharmacologically important plant species of Himalayan region, *Pure Appl Biol*, 2015, **4**(3), 407-417.

46 Bhatnagar A, A review on chemical constituents and biological activities of the genus *Picrorhiza (Scrophulariace), Int J Curr Pharm Res, 2021,* 13(5), 18-27.

47 Nazar S, Hussain M A, Khan A, Muhammad G and Bukhari S N A, Alkaloid-rich plant *Tylophora indica;* current trends in isolation strategies, chemical profiling and medicinal applications, *Arab J Chem*, 2020, **13**(8), 6348-6365.

48 Umamaheswari P, Sailaja V, Ravanaiah G, Phani K D V and Murthy C V, Role of *Tylophora indica* in treatment of bronchial asthama, *Int J Life Sci Pharma Res*, 2017, **7**(1), 17-21.

49 Chen J and Tsim K W K, A review of edible Jujube, the *Ziziphus jujuba* Fruit: A health food supplement for anemia prevalence, *Front Pharmacol*, 2020, **11**, 593655.

50 Jiang T, He F, Han S, Chen C, Zhang Y, *et al.*, Characterization of cAMP as an anti-allergic functional factor in Chinese jujube (*Ziziphus jujuba* Mill.), *J Funct Foods*, 2019, **60**, 103414.

51 Xu S, Shang M-Y, Liu G-X, Xu F, Wang X, *et al.*, Chemical constituents from the Rhizomes of *Smilax glabra* and their antimicrobial activity, *Molecules*, 2013, **18**(5), 5265-5287.

52 Itharat A, Srikwan K, Ruangnoo S and Thongdeeying P, Anti-allergic activities of *Smilax glabra* rhizome extracts and its isolated compounds, *J Med Assoc Thail*, 2015, **98**(3), S66-S74.

53 Patel J J, Acharya S R and Acharya N S, *Clerodendrum serratum* (L.) Moon. – A review on traditional uses, phytochemistry and pharmacological activities, *J Ethnopharmacol*, 2014, **154**(2), 268-285.

54 Kajaria D, Tripathi J S, Tiwari S K and Pandey B L, *In-vitro* evaluation of immunomodulatory effect of polyherbal compound – Bharangyadi, *J Drug Deliv Ther*, 2013, **3**(1), 36-39.

55 Mahajan N G, Chopda M K Z and Mahajan R T, A review on *Sphaeranthus indicus* Linn: Multipotential medicinal plant, *Int J Pharm Res Allied Sci*, 2015, **4**(3), 48-74.

56 Mathew J, Srinivasan K K, Dinakaran V and Joseph A, Mast cell stabilizing effects of *Sphaeranthus indicus*, *J Ethnopharmacol*, 2009, **122**, 394-396.

57 Patel K G, Rao K G, Gareja V G, Bhatt P A, Patel K V, *et al.*, Anti-allergic activity of stem bark of *Myrica esculenta* Buch.-Ham. (Myricaceae), *J Young Pharm*, 2010, **2**(1), 74–78.

58 Kabra A, Martins N, Sharma R, Kabra R and Baghel U S, *Myrica esculenta* Buch.-Ham. ex D. Don: A natural source for health promotion and disease prevention, *Plants*, 2019, **8**, 149-169.

59 Fu M, Fu S, Ni S, Zou L, Liu Y, *et al.*, Anti-inflammatory effect of epigallocatechin gallate in a mouse model of ovalbumin-induced allergic rhinitis, *Int Immunopharmacol*, 2017, **49**, 102-108.

60 Yamamoto M M, Ema K, Monobe M, Shibuichi I, Shinoda Y, *et al.*, The efficacy of early treatment of seasonal allergic rhinitis with benifuuki green tea containing O-methylated catechin before pollen exposure: An open randomized study, *Allergol Int*, 2009, **58**(3), 437-444.

61 Yamamoto M M, Ema K and Shibuichi I, *In vitro* and *in vivo* anti-allergic effects of 'benifuuki' green tea containing O-methylated catechin and ginger extract enhancement, *Cytotechnol*, 2007, **55**, 135–142.

62 Barne M, Singh S, Mangal D K, Singh M, Awasthi S, *et al.*, Global asthma network Phase I, India: Results for allergic rhinitis and eczema in 127,309 children and adults, *J Allergy Clin Immunol: Global*, 2022, **1**(2), 51-60.

63 Badar V, Thawani V, Wakode P T, Shrivastava M P, Gharpure K J, *et al.*, Efficacy of *Tinospora cordifolia* in allergic rhinitis, *J Ethnopharmacol*, 2005, **96**, 445-449.