Indian Journal of Ecology (2022) 49(3) (SI): 1089-1095
DOI: https://doi.org/10.55362/IJE/2022/3636

Manuscript Number: 3636
NAAS Rating: 5.79

Ethnobotanical Study on Medicinal Plants Used Against Chronic Obstructive Pulmonary Disease by Tribal Healers of Uttarakhand, India

Acharya Balkrishna, Jyoti Sharma[1], Deepika Srivastava[1], Bhaskar Joshi[1], Rama Shankar[1], Neelam Rawat[1], Anurag Dabas[1] and Vedpriya Arya[1*]

University of Patanjali,Patanjali Yogpeeth, Haridwar-249 405, India
[1]Patanjali Herbal Research Department, Patanjali Research Institute, Haridwar-249 405, India
**E-mail: vedpriya.arya@prft.co.in*

***Abstract*:** Chronic obstructive pulmonary disease (COPD) is one of the most fatal respiratory diseases and affects millions of people every year globally. According to WHO, more than 3 million people die each year from COPD, an estimated 6% of all deaths worldwide and more than 90% of COPD deaths occurs in low-income and middle-income countries. Modern pharmaceuticals are inaccessible ubiquitously and exert several side effects, therefore it is imperative to investigate the traditional knowledge of indigenous medicinal plants as an alternative to contemporary medicine. This study is a pioneering attempt to document the traditional use of medicinal plants of Uttarakhand for treating respiratory diseases including COPD. A Traditional Healing Practices (THP) survey was conducted in selected regions of Dehradun and Pithoragarh districts, Uttarakhand. A semi-structured questionnaire was developed for interviewing 116 tribal healers among them 27 herbal practitioners had the experience of 3-40 years with COPD patients. A total of 23 medicinal species were documented belonging to 21 genera and 17 families, prescribed against COPD. Twenty medicinal plants were effective against cough and *Bergenia ciliata* & *Zingiber officinale* were frequently used among them. Among these, only 12 plants were used in myriad pharmacological investigations. The present study concluded that most of the medicinal plants exhibited traditional implications as well as evidence-based scientific validation against COPD, while there is a huge scope for the researchers to explore pre-clinical and clinical properties of traditionally used herbs for futuristic investigations.

***Keywords*:** COPD, Ethnomedicine, Pharmacology, Tribal healer, Uttarakhand

The respiratory disease poses a serious threat and significant burden on the global health system which claims approximately 92.5 million disability-adjusted life years (DALYs) in 2016 (Simkovich et al 2019). Many symptoms of respiratory diseases are often left undiagnosed which leads to chronic obstructive pulmonary diseases (COPD). COPD is a dominant global health problem that affects people without gender bias with a lifetime risk of approximately 25% and its rampant pervasiveness is becoming prevalent, particularly in developing countries (Barnes 2013), leading to approx. 6% of total deaths and expected to rise upto 30% in the next 10 years, demanding a serious challenge to scientists and policymakers to fight COPD (WHO 2021). COPD is manifested in patients in the form of air trappings and shortness of breath, leading to scarcity of the amount of oxygen delivered by the lungs in the bloodstream which is expressed in the form of physical exertion (Barnes et al 2015).

Considering the rapid prevalence and severity of COPD on global health, the hour demands to quickly extend and execute research in all the relevant branches of medical science including the traditional medical systems like Ayurveda, Unani, Siddha, and Homeopathy that use natural products mainly derived from plant sources. Tremendous encouragement and acceptance from WHO as well as across the world advocates further research and incorporation of traditional and herbal drugs in the national health care program (Hussain et al 2009, Gulati et al 2018, Mownika et al 2021). The effectiveness of traditional and modern herbal drugs has been equally and scientifically validated. Although many herbal drugs are currently used for the treatment of Asthma & COPD. B2-agonists, methylxanthines, anticholinergics and chromones are having a herbal origin (Mukheriee and Wahile 2006). Many countries like India, China, Sri Lanka, Thailand and Cuba have substantiated and incorporated the traditional system of medicines in their official therapeutic alternatives. Over 2,500 plants species are officially recognized in India for medicinal purposes while over 6,000 plants are estimated to be explored in traditional, folk, and herbal medicines (Jain et al 2018). Many of these medicinal plants are found in Garhwal region of Uttarakhand state in India (Singh and Navneet 2016, Varshney and Lohia 2018). Recently, State Medicinal

Plants Board (SMPB) listed 5662 medicinal plants however, 1642 medicinal species are listed as the medicinal and aromatic wealth of Uttarakhand (SMPB 2014).

Plants and their bioactive molecules are key players in the development of novel drugs (Kumari et al 2018, Balkrishna et al 2021, Sharma et al 2021, Sonam et al 2021, Dhatwalia et al 2021). Herbal remedies have a long history of being used in COPD treatment in Asia, particularly in India, China, and other Asian countries (Guo et al 2006). The Kampo formulation *'hochu-ekki-to*' is given against COPD, in Japan as well as *Ocimum sanctum* for bronchitis and colds in India and *Argemone ochroleuca* is used to treat asthma, cough, pneumonia, and bronchitis in Mexico (Ram et al 2011). India is home to about one third of the total tribal population of the world, comprising 2, 91,903 tribal people in Uttarakhand especially in the Himalayan region (Prakash 2015, Kumar et al 2020, Mir and Sehgal 2021). Five major tribal communities are recognized in this state, namely Tharu, Bhotia, Raji, Jaunsari, Buksa and their health care system relies primarily on traditional knowledge of medical practices and medicinal herbs. Tharu tribe uses the leaves of *Balioselia retusa* (Danti / Vanchura) against asthma, and *Basella rubra* (Poy) and *Cassia tora* (Kasonji) against cold and cough. Bhotia tribes use the juice of *Morus alba* to treat cough and cold. They have also applied a fruit paste made from *Myristica fragrans* on the chest or neck to relieve cough. To treat asthma and chest pain, the tribe Jaunsari uses *Abrus precatorius* (ratti) leaf, seed, and root decoctions. In addition, Jaunsari tribe also uses *Evolvulus alsinoides* (Sankhpushpi) and its flower extracts to treat cough, cold, asthma and bronchitis (Prakash 2015). Raji tribe uses the root juice of binait medicinally for cold, cough and asthma. Raji people also use seed powder with warm water to fight cold (Bhatt et al 2013, Prakash 2015). Vanraji tribes in the Kumaun region of Himalaya use an infusion of the flowers and leaves of *Adhatoda vasica* (vasa) to treat common cold and bronchitis. Similarly, they chew leaves of *Colebrookea oppositifolia* and swallowed juice of the leaves to cure old cough. They roasted *Dioscorea bulbifera* tubers in hot ash and then gave them to sick people with salt (Bhatt et al 2013).

The Himalayas are home to a wide range of medicinal plants and are used in traditional medical practices. Local people with limited financial resources can access traditional medicinal plants found in their regions as an alternative to modern medical facilities. Currently, traditional knowledge about medicinal plants in rural areas is gradually fading and disappearing from the countryside, which is of great concern around the world (Pala et al 2010, Prakash 2015). It is vital to document the ethnomedicinal uses of plants in Uttarakhand by tribal communities to conserve and develop this knowledge (Tewari 2021). In present important medicinal plants used by some tribal communities of Uttarakhand against COPD along with the status of preclinical research are documented.

MATERIAL AND METHODS

Study site and data collection: The survey was conducted from 13 to 18 September, 2020, in the Jaunsari & Buksa region (Vikas Nagar, Tyuni, Chakrata and Kalsi subdivisions) of district Dehradun (30° 18' 59.382" N 78° 1' 55.891" E) and Bhotia region of district Pithoragarh (29° 34' 58.296" N 80° 13' 5.4768" E), Uttarakhand. A semi-structured questionnaire was used for interviewing 116 tribal healers. The questionnaire was designed by the Patanjali Herbal Research Department (PHRD) of Patanjali Research Institute, Haridwar, Uttarakhand, India. The criteria for the selection of tribal healers were a purposive sampling method based on their knowledge and experience regarding traditional medicine. Questionnaires were designed to acquire information about medicinal species used to treat different diseases, morphological parts of the plant used, formulations used, mode of administration, etc. Medicinal plants were identified taxonomically by the taxonomist and botanist of PHRD, were allotted collection numbers and submitted in official herbaria of PHRD.

RESULTS AND DISCUSSION

Taxonomic diversity: The total of 23 medicinal species was identified, belonging to 21 genera and 17 families for treating COPD. The reported information was documented along with their botanical name, local name, family, part used, preparation and application (Table 1). In terms of botanical families, Poaceae (17.39%) was mostly cited, followed by Acanthaceae, Combretaceae and Rosaceae (8.69% each).

Plant parts used and mode of preparation: The foremost often used plant components for the preparation of remedies were root (20%), followed by fruit and rhizome (15% each), leaves (13%), grains (5%), latex and cob axis (5% each), seeds (3%), stem and bark (2% each) (Fig. 1). Preparations from plants were mostly prepared in the form of decoctions followed by powders, extracts, and ashes. Most of the preparation was done with water, but honey was sometimes used as well.

Medicinal plants used against COPD and related diseases: The cough (61%) is most common to be treated among COPD-related diseases, followed by throat diseases (12%), nasal sinus, tonsil (9% each), cold (6%), and asthma (3%) (Fig. 2).

Mechanistic approach of traditionally used plant: The 23 plants used in the treatment of respiratory conditions were analyzed along with mechanisms of action however, only 12 plants were scientifically validated as mentioned in various pharmacological investigations (Table 2).

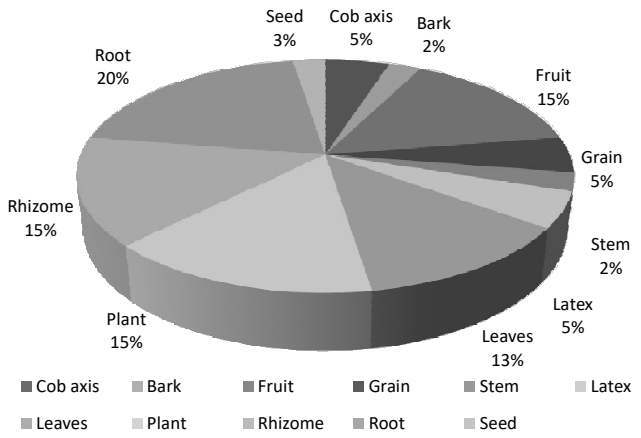

Fig. 1. Plant parts used to treat COPD and related diseases

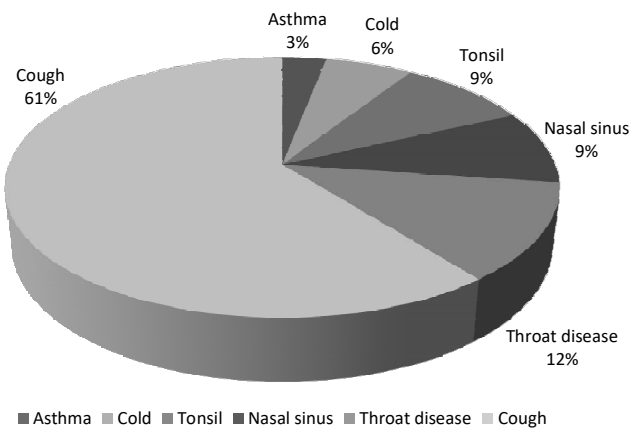

Fig. 2. COPD and related diseases treated by tribal healers of Uttarakhand

Table 1. Medicinal plants used by tribal healers of Uttarakhand against COPD

Disease	Botanical name (Family)	Plant local name	Plant part used	Preparation
Cough	*Ocimum tenuiflorum* L. (Lamiaceae)	Tulsi	Plant, Leaf	Decoction, Powder
	Zingiber officinale Roscoe (Zingiberaceae)	Adrak	Plant, Rhizome	Decoction, Powder
	Zea mays L. (Poaceae)	Makka	Cob axis	Ash with honey
	Zanthoxylum armatum DC. (Rutaceae)	Timbru	Leaf	Decoction
	Terminalia chebula Retz. (Combretaceae)	Harad	Fruit	Powder, Dried to chew
	Justicia gendarussa Burm.f. (Acanthaceae)	KalaVasa	Leaf	Powder
	Piper longum L. (Piperaceae)	Chhoti Pippali	Fruit	Powder
	Justicia adhatoda L. (Acanthaceae)	Basoi	Root, Leaf	Decoction
	Violaodorata L. (Violaceae)	Vanafsa	Leaf	Decoction
	Saccharum officinarum L. (Poaceae)	Gur	Stem juice	Burning
	Terminalia bellirica (Gaertn.) Roxb. (Combretaceae)	Bedara	Bark	Fresh or dry
	Rubus paniculatus Sm. (Rosaceae)	Kavi Achoi	Root	Decoction, fresh or dry
	Potentilla indica (Andrews) Th.Wolf (Rosaceae)	Goli Ousu	Root	Decoction
	Hippophae salicifolia D.Don (Elaeagnaceae)	Seabuck Thorn	Fruit	Decoction
	Swertia chirayita (Roxb.) H.Karst. (Gentianaceae)	Chirayita	Plant	Decoction, Juice
	Bergenia ciliata (Haw.) Sternb. (Saxifragaceae)	Pashanbhea	Root	Decoction, chewed after soaking
Cold	*Polygonatum Verticillatum* (L.) All. (Asparagaceae)	Salam Misri	Seed	_
	Zanthoxylum armatum DC. (Rutaceae)	Timbru	Fruit	Powder
	Eleusine coracana (L.) Gaertn. (Poaceae)	Maduwa	Grain	Powder (cooked)
Throat disease	*Centratherum Anthelminticum* (L.) Gamble (Asteraceae)	Kaljadi	Plant	Powder
	Zingiber officinale Roscoe (Zingiberaceae)	Adrak	Rhizome	Juice after soaking
Nasal sinus	*Calotropis procera (*Aiton) W.T.Aiton (Apocynaceae)	Ak	Latex	Dried
	Oryza sativa L. (Poaceae)	Chawal	Grain	Powder
	Calotropis procera (Aiton) W.T.Aiton (Apocynaceae)	Aak	Latex	Fresh
Tonsil	*Oryza sativa* L. (Poaceae)	Chawal	Grain	Powder
	Musa paradisiaca L. (Musaceae)	Kela	Root	Boiling
	Potentilla indica (Andrews) Th.Wolf (Rosaceae)	Goli Ousu	Root	Decoction
Asthma	*Taxus wallichiana* Zucc. (Taxaceae)	Thunir	Plant	Decoction

Table 2. Mechanism of medicinal plants used by tribal healers of Uttarakhand against COPD

Family	Botanical name	Pharmacological activity	Chemicals	Mechanism of action	References
Asteraceae	*Centratherum anthelminticum* (L.) Gamble	Anti-asthmatic activity	Flavonoids, proteins, saponins, tannins, steroids, glycosides and phenols	*↓ degranulation of mast cells and expressed broncho spasmolytic action	Shah et al (2017)
Acanthaceae	*Justicia adhatoda* L.	Anti-tussive effect	Vasicine and vasicinone	Bronchodilation and mucolytic effects (vasicine)	Barth et al (2015)
		SARS CoV-2 inhibition effect	Alkaloids (vasicoline, vasicolinone, vasicinone, vasicine, adhatodine and anisotine)	#-┤ of proteolytic activity of Mpro to block the viral replication	Ghosh et al (2020)
		Anti-tussive effect	Vasicinone and vasicine	Prescence of site of action of Vasicinone and Vasicine (major alkaloids) which suppress coughing by its action on its neuronal system in the medulla.	Kaur et al (2013)
Musaceae	*Musa paradisiaca* L.	Anti-asthmatic activity	Flavonoids, steroids, saponin, terpenoids, lignins, and phenolic compounds	Suppression of antibody production, stabilization of membrane and also #-┤ of antigen-induced acetylcholine and histamine	Patro et al (2016)
Lamiaceae	*Ocimum tenuiflorum* L.	Anti-tussive effect	Plant extract	By central action, supposed to be mediated by GABA-ergic system as well as opioid system.	Nadig and Laxmi (2005)
Poaceae	*Oryza sativa* L.	Anti-asthmatic activity	Plant extract [DA-9201]	*↓ total serum and BALF IgE level *↓ eosinophilia in BALF	Lee et al (2006)
		Anti-asthmatic activity	Plant extract	NF-kappaB suppression *↓ airway hyper responsiveness (AHR), *↓ level of IgE in BALF and plasma *↓ IL-2, 4, 13 in BALF along with eosinophils percentage in BALF.	Lee et al (2005)
Piperaceae	*Piper longum* L.	Anti-asthmatic activity	Alkaloid, flavonoids, steroids, glycoside, carbohydrates	H1- receptor antagonistic activity.	Kaushik et al (2012)
Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb	Bronchodilatory effect	Plant extract	Combined blockade of muscarinic receptors and Ca++ influx	Gilaniet al (2008)
Rutaceae	*Zanthoxylum armatum* DC.	Anti-asthmatic activity	Linalool	Blocks the IgE effect by *↓ its serum level *↓ level of total inflammatory cells including neutrophils and eosinophils in the BALF .	Sharma et al (2018)
		Bronchodilatory effects	Plant extract	Blockage of calcium channels and muscarinic receptors antagonists.	Alam and Shah (2019)
Zingiberaceae	*Zingiber officinale* Roscoe	Anti-asthmatic activity	Plant extract	*↓ T2 type cytokines mRNA expression and its protein *↓ the level of serum IgE	Khanet al (2015)
		Anti-asthmatic activity	6-Shogaol	Put down the induction of NF-κB signaling and pro332 inflammatory cytokine as IL-2, TNF α & γ Elevates CD4 cell cAMP concentrations and increase Treg polarization in vitro.	Yocum et al (2020)

Cont...

In some scientific studies, different extracts were used as a whole, while in others, specific phytochemical groups were used. The plants used by tribal healers have shown bronchodilator effects, anti-asthmatic effects, relaxant effects, anti-tussive effects, respiratory ailment preventing effects, SARS-CoV-2 inhibition effects, anti-rhinitis effects and anti-inflammatory action. There are several cellular and molecular mechanisms involved in the expression of these effects including anti-histamine activity & histamine H1-blocking properties, β-adrenergic stimulation activity, opening of potassium channel and inhibition of calcium channel, inhibition of stimulatory nonadrenergic-noncholinergic nervous system (NANC), inhibiting the proteolytic activity of Mpro, decreasing eosinophilia and neutrophils in BALF, bronchodilation & mucolytic effect, anti-tussive effect by central action mediated by opioid and GABA-ergic system, suppression of Th-2 mediated immune response, reduction of degranulation of mast cells and suppression of NF-kappa B (Nuclear factor-kappa β) pathway (Fig. 3).

Table 2. Mechanism of medicinal plants used by tribal healers of Uttarakhand against COPD

Family	Botanical name	Pharmacological activity	Chemicals	Mechanism of action	References
		Anti-asthmatic activity	Hydroalcoholic extract and 6-gingerole	Expression of GATA-3 and ROR-t *↓. T-bet as Th1 transcription factor decrease considerably in the PBMCs	Kardan et al (2019)
		Anti-asthmatic activity	Plant extract	Blockage of plasma memebrane Ca++ channels.	Ghayuret al (2008)
		Anti-asthmatic activity	Gingerol and shogaol	Lowered the Ca21 influx through L-type Ca^{++} channels subside Ca^{++} responses to the Gq-coupled receptor agonists i.e. acetylcholine and bradykinin.	Townsendet al (2013)
Violaceae	*Viola odorata* L.	Antiasthmatic activity	Plant extract	Activated T lymphocytes possibly might be suppressed	Haratiet al (2018)
Gentianaceae	*Swertia chirayita* (Roxb.) H.Karst.	Bronchodilating effect	Crude extract	Ca++ antagonist mechanism	Khanet al (2012)
Saxifragaceae	*Bergenia ciliata* (Haw.) Sternb.	Anti-tussive activity and bronchodilator action	Methanol extract	#┤ histamine and acetylcholine induced contractions on isolated tracheal strips. Delayed the onset time of the histamine and acetylcholine induced bronchospasm	Sinha et al (2001), Kour et al (2019)

*↓- reduced, decreased; #┤-inhibited, blocked

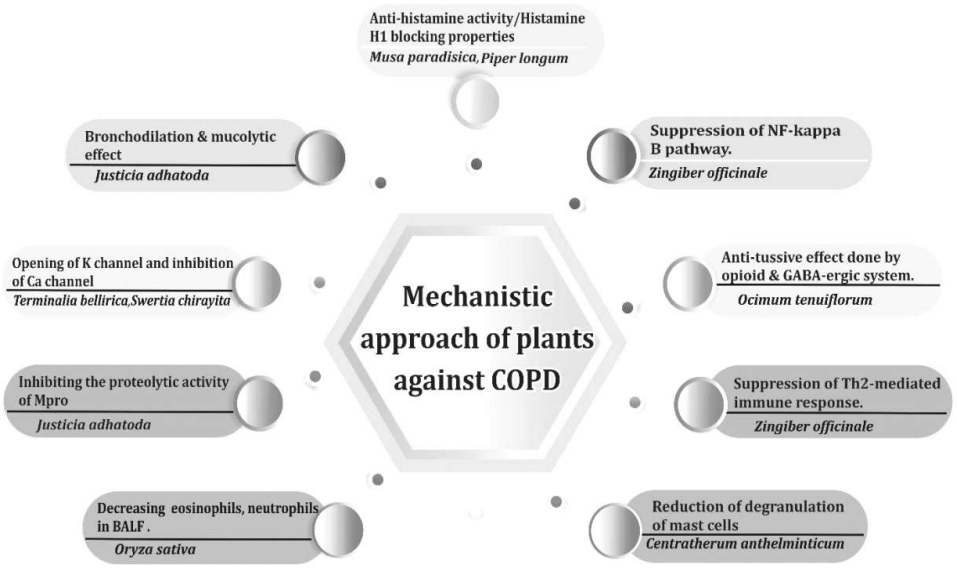

Fig. 3. Mechanistic insight of plants used against COPD-related diseases

CONCLUSION

Uttarakhand is cradle of diverse medicinal plants, which are utilized by the tribal healers for treating variety of ailments. Despite of this, well-documented records of indigenous knowledge via ethnobotanical and ethnomedicine studies are crucial, which is imperative for the conservation of this rich heritage. Tribal healers around the world use several medicinal plants for the treatment of COPD-related diseases, nevertheless the lack of scientific validity of their use is not well explored. Although, there are several surveys conducted in Uttarakhand, India to collect information about the medicinal plants used by the tribal healers without any scientific validation, which is crucial. To support this, the present study documented some important medicinal plants used in some tribal communities of Uttarakhand against COPD, as well as their mode of action, to make them available to mankind. It is necessary to develop specific formulations and dosages of medicinal plants and to conduct preclinical and clinical trials to ensure their safety and efficacy. To elucidate the mechanism of action of the herbs against diseases, further pharmacological or scientific research is needed. This approach would create new avenues to make herbal drugs to treat different respiratory diseases. The finding of this study will not only serve as a benchmark for screening promising COPD plants in Uttarakhand but will also prove useful in conducting phytochemical studies using ethnobotanical indices. Exploration of this indigenous knowledge should be done through the survey in tribes to know the hidden potential of these medicinal plants. Along with this overexploitation of natural resources should be reduced as the non-managed way of using medicinal plants has resulted in the loss of some species in nature. To meet the increasing demand for these plants, it is necessary to conserve them through domestication and cultivation, as well as other ex-situ and in-situ conservation methods, to ensure their long-term viability. Instead of gathering from the wild, a focus on the cultivation of wild forms would assure botanical uniqueness, genetic improvement, quality, and consistency in the wild forms. Such cultivation may need to begin under well-defined settings, such as microclimates that are similar to the niche requirements of different species.

ACKNOWLEDGEMENTS

The authors are thankful to revered Swami Ramdev for his continuous support. The authors are also grateful to Dr. Naval Kapoor, Joint Secretary, MoTA for his continuous support & motivation for tribal development work. Authors are thankful to Dr. Anupam Srivastava for his identification work and to the tribal healers of Pithoragarh and Dehradun of Uttarakhand district for sharing their traditional knowledge and their cooperation during the study.

FUNDING DETAILS

This work is funded by the grant received from the Ministry of Tribal Affairs (MoTA) with project entitled “Tribal Medicine, Healing Practices & Livelihood initiatives in Uttarakhand”.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest regarding this study.

AUTHOR CONTRIBUTIONS

AB designed and supervised the study; BJ and RS conducted the field survey; VA, JS and DS analyzed the data and interpreted the result; JS and DS wrote the manuscript; NR, and AD reviewed and edited the manuscript; all authors approved final version of the manuscript.

REFERENCES

Alam F and Shah AJ 2019. Butyrlycholine esterase inhibitory activity and effects of extracts (fruit, bark and leaf) from *Zanthoxylum armatum* DC in gut, airways and vascular smooth muscles. *BMC Complementary and Alternative Medicine* **19**(1): 1-9.

Balkrishna A, Rohela A, Kumar A, Kumar A, Arya V, Thakur P, Oleksak P, Krejcar O, Verma R, Kumar D and Kuca K 2021. Mechanistic insight into antimicrobial and antioxidant potential of *Jasminum* species: A herbal approach for disease management. *Plants* **10**(6): 1-25.

Barnes PJ 2013. New anti-inflammatory targets for chronic obstructive pulmonary disease. *Nature Reviews Drug Discovery* **12**(7): 543-559.

Barnes PJ, Burney PG, Silverman EK, Celli BR, Vestbo J, Wedzicha JA and Wouters EF 2015. Chronic obstructive pulmonary disease. *Nature Reviews Disease Primers* **1**: 1-21.

Barth A, Hovhannisyan A, Jamalyan K and Narimanyan M 2015. Antitussive effect of a fixed combination of *Justicia adhatoda, Echinacea purpurea* and *Eleutherococcus senticosus* extracts in patients with acute upper respiratory tract infection: A comparative, randomized, double-blind, placebo-controlled study. *Phytomedicine* **22**(13): 1195-1200.

Bhatt D, Kumar R, Joshi GC and Tewari LM 2013. Indigenous uses of medicinal plants by the Vanraji tribes of Kumaun Himalaya, India. *Journal of Medicinal Plants Research* **7**(37): 2747-2754.

Dhatwalia J, Kumari A, Verma R, Upadhyay N, Guleria I, Lal S, Thakur S, Gudeta K, Kumar V, Chao CJ, Sharma S, Kumar A, Manicum AE, Lorenzo JM and Amarowicz R 2021. Phytochemistry, pharmacology, and nutraceutical profile of *Carissa* species: An updated review. *Molecules* **26**(22): 1-34.

Ghayur MN, Gilani AH and Janssen LJ 2008. Ginger attenuates acetylcholine-induced contraction and Ca^{2+} signalling in murine airway smooth muscle cells. *Canadian Journal of Physiology and Pharmacology* **86**(5): 264-271.

Ghosh R, Chakraborty A, Biswas A and Chowdhuri S 2020. Identification of alkaloids from *Justicia adhatoda* as potent SARS CoV-2 main protease inhibitors: An in silico perspective. *Journal of Molecular Structure* **1229**(7). Retrieved from https://doi.org/10.1016/j.molstruc.2020.129489.

Gilani AH, Khan AU, Ali T and Ajmal S 2008. Mechanisms underlying the antispasmodic and bronchodilatory properties of *Terminalia bellerica* fruit. *Journal of Ethnopharmacology* **116**(3): 528-538.

Gulati K, Rai N and Ray A 2018. Status of Research in Respiratory Pharmacology in India During the Last Five Years (2012-2017). *Proceedings of the Indian National Science Academy* **84**(1): 55-72.

Guo R, Pittler MH and Ernst E 2006. Herbal medicines for the treatment of COPD: a systematic review. *European Respiratory Journal* **28**(2): 330-338.

Harati E, Bahrami M, Razavi A, Kamalinejad M, Mohammadian M and Rastegar T 2018. Effects of *viola tricolor* flower hydroethanolic extract on lung inflammation in a mouse model of chronic asthma. *Iranian Journal of Allergy, Asthma and Immunology* **17**(5): 409-417.

Hussain K, Majeed MT, Ismail Z, Sadikun A and Ibrahim P 2009. Traditional and complementary medicines: Quality assessment strategies and safe usage. *Southern Med Review* **2**(1): 19-23.

Jain M, Shrivastava PN and Samar R 2018. Survey of ethnobotanical medicinal plants used by the people of District Guna, Madhya Pradesh, India. *International Journal of Life-Sciences Scientific Research* **4**(4): 1880-1888.

Kardan M, Rafiei A, Ghaffari J, Valadan R and Morsaljahan Z 2019. Effect of ginger extract on expression of GATA3, T-bet and RORγt in peripheral blood mononuclear cells of patients with allergic asthma. *Allergologia et Immunopathologia* **47**(4): 378-385.

Kaur R, Ruhil S, Balhara M, Dhankhar S and Chhillar AK 2013. A review on *Justicia adhatoda*: A potential source of natural medicine. *African Journal of Plant Science* **5**(11): 620-627.

Kaushik D, Rani R, Kaushik P, Sacher D and Yadav J 2012. *In vivo* and *in vitro* antiasthmatic studies of plant *Piper longum* Linn. *International Journal of Pharmacology* **8**(3): 192-197.

Khan AM, Shahzad M, Raza Asim MB, Imran M and Shabbir A 2015. *Zingiber officinale* ameliorates allergic asthma via suppression of Th2-mediated immune response. *Pharmaceutical Biology* **53**(3): 359-367.

Khan AU, Rahim A, Iqbal Z and Gilani AH 2012. Insights into mechanisms underlying the gut and airways modulatory effects of *Swertia chirata*. *Journal of Natural Medicines* **66**(1): 140-148.

Kour H, Raina R, Verma PK, Pankaj NK and Singh SP 2019. Phytochemical ingredients and pharmacological properties of *Bergenia ciliata*. *Journal of Veterinary Pharmacology and Toxicology* **18**(1): 1-10.

Kumar MM, Pathak VK and Ruikar M 2020. Tribal population in India: A public health challenge and road to future. *Journal of Family Medicine and Primary Care* **9**(2): 508-512.

Kumari A, Verma R, Sharma M, Chauhan P and Kumar A 2018. Evaluation of phytochemical, antioxidant, antibacterial and anti-cancerous activity of *Ficus auriculata* Lour. and *Osyris wightiana* Wall. ex Wight. *Bulletin of Environment, Pharmacology and Life Sciences* **7**(8): 64-70.

Lee SH, Choi SM, Sohn YS, Kang KK and Yoo M 2006. Effect of *Oryza sativa* extract on the progression of airway inflammation and remodeling in an experimental animal model of asthma. *Planta Medica* **72**(05): 405-410.

Lee SH, Seo MJ, Choi SM, Sohn YS and Kang KK 2005. DA-9201 shows anti-asthmatic effects by suppressing NF-κB expression in an ovalbumin-Induced mouse model of asthma. *Archives of Pharmacal Research* **28**(12): 1350-1357.

Mir GA and Sehgal S 2021. Medicinal uses of edible wild fruits of Chenab Valley of Jammu, India. *Indian Journal of Ecology* **48**(2): 563-568.

Mownika S, Sharmila S and Ramya EK 2021. Documentation of ethnomedicinal plants used for treating rheumatoid arthritis disorder by aboriginal communities of manar beat, karamadai range, western ghats, India. *Indian Journal of Ecology* **48**(1): 75-84.

Mukheriee PK and Wahile A 2006. Integrated approaches towards drug development from Ayurveda and other Indian system of medicines. *Journal of Ethnopharmacology* **103**(1): 25-35.

Nadig P and Laxmi S 2005. Study of anti-tussive activity of *Ocimum sanctum* Linn in guinea pigs. *Indian Journal of Physiology and Pharmacology* **49**(2): 243-245.

Pala NA, Negi AK and Todaria NP 2010. Traditional uses of medicinal plants of Pauri Garhwal, Uttrakhand. *Nature and Science* **8**(6): 57-61.

Patro G, Panda M, Das P, Bhaiji A and Panda A 2016. Pharmacological evaluation of *Musa paradisiaca* (Linn.) on bronchial asthma. *Egyptian Pharmaceutical Journal* **15**(1): 25-30.

Prakash R 2015. Medicinal plants used by tribal communities: A study of Uttarakhand Himalayan region. *International Journal of Humanities and Social Science Invention* **4**(2): 55-61.

Ram A, Balachandar S, Vijayananth P and Singh VP 2011. Medicinal plants useful for treating chronic obstructive pulmonary disease (COPD): current status and future perspectives. *Fitoterapia* **82**(2): 141-151.

Shah S, Patel K and Suraj K 2017. Evaluation of anti-asthmatic activity of *Centratherum anthelminticum* Linn. in experimental animals. *Journal of Pharmaceutical Research* **16**(1): 19-24.

Sharma S, Rasal VP, Joshi RK and Patil PA 2018. *In vivo* evaluation of antiasthmatic activity of the essential oil of *Zanthoxylum armatum*. *Indian Journal of Pharmaceutical Sciences* **80**(2): 383-390.

Sharma S, Kumari A, Dhatwalia J, Guleria I, Lal S, Upadhyay N, Kumar V and Kumar A 2021. Effect of solvents extraction on phytochemical profile and biological activities of two *Ocimum* species: A comparative study. *Journal of Applied Research on Medicinal and Aromatic Plants* **25**: 100348.

Simkovich MS, Goodman D, Roa C, Crocker ME and Gianella G E 2019. The health and social implications of household air pollution and respiratory diseases. *npj Primary Care Respiratory Medicine* **29**(1): 1-12.

Singh A and Navneet 2016. A review on medicinal plants and herbs of Uttrakhand (India): its traditional, ethanomedicinal and antimicrobial potential. *Nature and Science* **14**(12): 90-107.

Sinha S, Murugesan T, Pal M and Saha B P 2001. Evaluation of anti-tussive activity of *Bergenia ciliata* Sternb. rhizome extract in mice. *Phytomedicine* **8**(4): 298-301.

SMPB Uttrakhand 2014. *Plant prospect*. Available online: http://www.smpbuk.org/ (accessed on 25 November 2021).

Sonam, Kumari A, Kumar V, Guleria S, Sharma M, Kumar A, Alruways MW, Khan N and Raina R 2021. Antimicrobial potential and chemical profiling of leaves essential oil of *Mentha* species growing under North-West Himalaya conditions. Journal of Pure and Applied Microbiology **15**(4): 2229-2243.

Tewari LM 2021. Alpine medicinal and aromatic plants in the Western Himalaya, India: An ecological review. *Indian Journal of Ecology* **48**(2):319-331.

Townsend EA, Siviski ME, Zhang Y, Xu C and Hoonjan B 2013. Effects of ginger and its constituents on airway smooth muscle relaxation and calcium regulation. *American Journal of Respiratory Cell and Molecular Biology* **48**(2): 157-163.

Varshney S and Lohia PK 2018. An ethnobotanical study of undocumented medicinal plants of Uttarakhand region. *International Journal of Recent Scientific Research* **9**(4): 25652-25655.

WHO 2021. *Burden of COPD*. Available online: https://www.who.int/respiratory/copd/burden/en/ (accessed on 25 November 2021).

Yocum GT, Hwang JJ, Mikami M, Danielsson J and Kuforiji AS 2020. Ginger and its bioactive component 6-shogaol mitigate lung inflammation in a murine asthma model. *American Journal of Physiology-Lung Cellular and Molecular Physiology* **318**(2): L296-L303.

Younis W, Asif H, Sharif A, Riaz H and Bukhari IA 2018. Traditional medicinal plants used for respiratory disorders in Pakistan: A review of the ethno-medicinal and pharmacological evidence. *Chinese Medicine* **13**(1): 1-29.

Received 16 January, 2022; Accepted 23 May, 2022