IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

"Unlocking the Healing Power of Quercetin: An Ayurvedic Approach to Rhinovirus Infections and Respiratory Health in Children"

Dr. ADARSHA C. PATIL (1), Dr. AJAY KUMAR K.A. (2)

1. Assistant Professor in Department of Kaumarabhritya, Rajeev Institute of Ayurvedic Medical Sciences and Research Centre, Hassan.
2. Professor and HOD in Department of RSBK, Rajeev Institute of Ayurvedic Medical Sciences and Research Centre, Hassan.

Abstract

Rhinovirus, a predominant cause of the common cold, is associated with significant morbidity in children, including exacerbations of asthma and other chronic respiratory conditions. Quercetin, a flavonoid with antiviral, anti-inflammatory, and antioxidant properties, is found abundantly in *Rasna* (Pluchea lanceolata), a renowned herb in Ayurveda. This review explores the therapeutic potential of quercetin in rhinovirus infections and related respiratory diseases, emphasizing its pharmacokinetics, mode of administration, metabolism, excretion, and Ayurvedic context. Insights into the pediatric applications of quercetin are integrated with traditional knowledge and modern scientific evidence.

Keywords: Rhinovirus, Quercetin, Rasna, Ayurveda, Pediatric Respiratory Diseases, Antiviral, Anti-inflammatory, Antioxidant, Pharmacokinetics, Asthma, Allergic Rhinitis, Bronchitis.

1. Introduction

Rhinovirus infections are the most prevalent viral illnesses, especially among children, contributing to significant morbidity and placing a heavy burden on healthcare systems. According to the World Health Organization (WHO), rhinovirus is one of the leading causes of upper respiratory tract infections globally, with over 100 million infections occurring annually [1]. These infections often present as the common cold and can exacerbate chronic respiratory conditions, including asthma, allergic rhinitis, and bronchitis, particularly in pediatric populations. Symptoms such as cough, nasal congestion, and wheezing are common and can severely impact school attendance and overall quality of life for children. Given the high prevalence and impact of these infections, it is crucial to explore alternative and integrative treatment strategies.

Quercetin, a flavonoid with notable antiviral, anti-inflammatory, and antioxidant properties, has demonstrated potential in managing rhinovirus infections and alleviating associated symptoms. As a key component of Rasna (Pluchea lanceolata), an herb used in Ayurveda for treating respiratory disorders like Shvasa (dyspnea) and Kasa (cough), quercetin offers a promising therapeutic approach [2].

Aim of the Study: This study aims to evaluate the therapeutic role of quercetin, particularly from Rasna (Pluchea lanceolata), in managing rhinovirus-induced respiratory diseases in children. By integrating Ayurvedic principles with modern pharmacological insights, the study seeks to provide a comprehensive perspective on how quercetin can contribute to alleviating symptoms, reducing inflammation, and improving clinical outcomes in pediatric respiratory conditions.

2. Methods

A comprehensive systematic review was conducted, integrating modern scientific research with classical Ayurvedic texts. The review involved a thorough search of electronic databases such as PubMed, Scopus, and Google Scholar, using specific keywords including "Quercetin," "Rasna," "Ayurveda," "Rhinovirus," "Pediatric Respiratory Diseases," and "Pharmacokinetics in Children." These keywords were carefully selected to capture studies related to the pharmacological actions of quercetin, the Ayurvedic perspective on Rasna, and its relevance to pediatric respiratory conditions [3,4].

In addition to modern scientific literature, classical Ayurvedic texts, particularly the Charaka Samhita and Sushruta Samhita, were meticulously reviewed. These texts provided a foundational understanding of the traditional applications of Rasna in treating respiratory diseases, including its uses for alleviating symptoms of Shvasa (dyspnea) and Kasa (cough), which are frequently observed in respiratory infections [5].

The review focused on identifying and including studies that provided insights into the pharmacological properties of quercetin, including its antiviral, anti-inflammatory, and antioxidant effects. Furthermore, relevant Ayurvedic formulations containing Rasna, such as Kwatha (decoction), Churna (powder), and Taila (oil), were examined to understand their traditional applications and potential synergistic effects with modern pharmacological agents [6].

3. Results

3.1. Pharmacological Actions of Quercetin

Antiviral Mechanism - Quercetin demonstrates strong antiviral activity against rhinovirus infections, making it a promising candidate for managing respiratory illnesses caused by viral pathogens [7].
• Inhibition of Viral Enzymes: Quercetin targets key viral enzymes, including proteases essential for viral replication. By suppressing these enzymes, quercetin disrupts the viral life cycle, preventing the synthesis of new viral particles and reducing the overall viral load in the respiratory tract [8].
• Prevention of Cellular Entry: Another mechanism of action involves quercetin blocking the interaction between rhinovirus and host cell receptors, such as ICAM-1. By preventing the virus from attaching to and entering host cells, quercetin halts the initial stage of viral infection, significantly reducing the spread of the virus within the host organism [9].

Anti-inflammatory and Antioxidant Effects - Quercetin's therapeutic effects are also attributed to its anti-inflammatory and antioxidant properties, which are crucial in managing viral infections that induce respiratory inflammation [10].

• Modulation of Cytokines: Quercetin has been shown to significantly reduce the production of pro-inflammatory cytokines such as IL-6, IL-8, and TNF-α. These cytokines are typically elevated in viral respiratory infections, contributing to symptoms such as fever, nasal congestion, and cough [11].
• Neutralization of Reactive Oxygen Species (ROS): Viral infections trigger oxidative stress in the respiratory tissues, leading to damage in the lungs and airways. Quercetin, through its potent antioxidant effects, scavenges ROS, reducing cellular damage and inflammation [12].

3.2. Ayurvedic Perspective on Rasna

In Ayurveda, Rasna (Pluchea lanceolata) is known for its medicinal properties that parallel quercetin's actions in modern pharmacology, particularly in managing respiratory conditions [13]. Rasna is categorized as Vedanasthapana (pain-relieving) and Shothahara (anti-inflammatory), making it especially suitable for treating diseases associated with excess Kapha and Vata doshas, which are implicated in respiratory conditions like Shvasa (dyspnea) and Kasa (cough) [14]. These conditions align with the symptoms seen in rhinovirus-induced respiratory infections.

Ayurvedic Preparations of Rasna:

• Kwatha (Decoction): A commonly used preparation in Ayurveda, Kwatha is a concentrated decoction made from Rasna, which is administered for its anti-inflammatory and respiratory benefits [15]. This decoction is typically used to relieve symptoms of cough, breathlessness, and chest tightness.

• Churna (Powder): Rasna powder is often administered with honey or ghee to enhance absorption. When taken in small quantities, Churna can help clear excess mucus from the respiratory system and reduce inflammation [16].

• Taila (Oil): Rasna Taila is applied externally to relieve pain and inflammation. It is also used as nasal drops, which directly target the respiratory passages and help alleviate symptoms like nasal congestion, a common feature of viral infections [17].

3.3. Pharmacokinetics of Quercetin in Children

The pharmacokinetics of quercetin in children is influenced by several factors, including absorption, distribution, metabolism, and elimination, which can affect its therapeutic efficacy [18].

• **Absorption**: Quercetin's absorption in the gastrointestinal tract is limited due to its poor water solubility. In children, absorption primarily occurs in the small intestine via passive diffusion and active transport mechanisms [19].

• **Distribution**: Once absorbed, quercetin binds extensively to plasma proteins, particularly albumin, which helps distribute it to key tissues involved in respiratory function, such as the lungs, liver, and kidneys [20].

• **Metabolism**: Quercetin undergoes extensive first-pass metabolism in the liver, where it is converted into several metabolites, including quercetin glucuronide, quercetin sulfate, and methylated quercetin [21].

• **Elimination**: Quercetin and its metabolites are predominantly excreted through bile, with renal excretion playing a secondary role. Biliary excretion facilitates the recycling of metabolites via enterohepatic circulation, prolonging their systemic effects [22].

3.4. Quercetin in Pediatric Respiratory Diseases

Quercetin's pharmacological profile suggests several beneficial roles in managing pediatric respiratory diseases, particularly those caused by viral infections such as rhinovirus [23].

Rhinovirus Infections: Quercetin's ability to inhibit rhinovirus replication and reduce inflammation can significantly reduce the severity and duration of common cold symptoms, including nasal congestion, sore throat, and coughing [24].

Asthma and Allergic Rhinitis: Asthma exacerbations and allergic rhinitis are common in children with respiratory infections. Quercetin helps stabilize mast cells, which release histamine and other inflammatory mediators, thus reducing symptoms like wheezing, sneezing, and nasal congestion [25].

Bronchiolitis: Bronchiolitis, often triggered by viral infections such as rhinovirus, causes inflammation and narrowing of the small airways in the lungs. Quercetin's antioxidant effects offer protection against oxidative damage in the bronchioles, reducing tissue injury and promoting faster recovery [26].

Integrative View: Combining Modern Pharmacology and Ayurveda

When viewed integratively, quercetin offers a comprehensive treatment approach for pediatric respiratory diseases, combining modern pharmacological mechanisms with traditional Ayurvedic wisdom. Ayurvedic preparations like Rasna Kwatha, Churna, and Taila align with quercetin's antiviral, anti-inflammatory, and antioxidant effects, providing a holistic strategy for treating conditions like rhinovirus infections, asthma, allergic rhinitis, and bronchiolitis [27]. The synergy between these approaches underscores the potential of integrating Ayurvedic herbs and modern pharmacological agents to optimize therapeutic outcomes for children with respiratory ailments [28].

4. Discussion

Rhinovirus infections are among the most common viral illnesses affecting children and can lead to significant morbidity, especially in those with underlying respiratory conditions like asthma, allergic rhinitis, or bronchitis. The impact of these infections on public health, coupled with the increasing prevalence of chronic respiratory diseases in pediatric populations, calls for effective, sustainable treatments. Quercetin, a flavonoid present abundantly in *Rasna* (Pluchea lanceolata), offers an intriguing therapeutic approach, blending ancient Ayurvedic wisdom with modern pharmacological principles.

Pharmacological Potential of Quercetin

Quercetin's therapeutic value is primarily derived from its antiviral, anti-inflammatory, and antioxidant properties. Rhinovirus replication relies on viral proteases and host cell receptors, which quercetin targets effectively to reduce viral load. The compound inhibits viral enzymes essential for replication, thereby curbing the spread of the infection. Additionally, quercetin blocks the interaction between rhinovirus and host cell receptors such as ICAM-1, preventing the virus from entering host cells. These mechanisms make quercetin a promising candidate for managing viral infections like the common cold.

Beyond its antiviral effects, quercetin's anti-inflammatory action is particularly relevant in pediatric respiratory diseases. It has been shown to reduce the levels of pro-inflammatory cytokines such as IL-6, IL-8, and TNF-α, which are commonly elevated during viral infections. This action is crucial in managing inflammatory responses that exacerbate symptoms like cough, wheezing, and nasal congestion. By reducing these cytokines, quercetin can help alleviate the systemic inflammation seen in viral infections, potentially reducing the severity and duration of symptoms in children.

The antioxidant properties of quercetin provide an additional layer of protection by neutralizing reactive oxygen species (ROS) produced during viral infections. Oxidative stress in the respiratory tissues is a key factor contributing to the damage seen in conditions like bronchiolitis and asthma. Quercetin's ability to scavenge free radicals could offer protective benefits, reducing tissue damage and supporting faster recovery from viral infections.

Integration of Ayurvedic Principles

Ayurveda emphasizes the use of natural herbs to balance the body's doshas—Vata, Pitta, and Kapha—promoting overall health and preventing disease. *Rasna* (Pluchea lanceolata), a significant herb in Ayurvedic medicine, has been traditionally used for treating respiratory ailments like *Shvasa* (dyspnea) and *Kasa* (cough). These conditions mirror the symptoms of rhinovirus-induced respiratory distress, highlighting the relevance of *Rasna* in managing such infections.

In Ayurveda, *Rasna* is classified under *Vedanasthapana* (pain-relieving) and *Shothahara* (anti-inflammatory) categories, aligning with quercetin's pharmacological actions. The herb has been utilized for centuries to address imbalances in the respiratory system, offering an anti-inflammatory and soothing effect that can relieve congestion, improve airflow, and reduce irritation in the lungs. This traditional use is further validated

by modern pharmacological research, which supports the antiviral, anti-inflammatory, and antioxidant effects of quercetin derived from *Rasna*.

From an Ayurvedic perspective, *Rasna* works synergistically to pacify the doshas involved in respiratory disorders. It is particularly beneficial for alleviating excess *Kapha* and *Vata*, doshas often implicated in conditions like asthma and chronic cough. The balancing of these doshas with *Rasna* not only addresses the immediate symptoms of respiratory distress but also restores long-term equilibrium within the body, fostering resilience against future infections.

Pediatric Implications and Challenges

The pediatric application of quercetin, particularly in the form of *Rasna*, is a promising avenue for improving respiratory health. However, there are several challenges in translating this natural remedy into a widely used treatment for children. The pharmacokinetics of quercetin in children are not well understood, particularly in regard to its absorption, distribution, metabolism, and elimination. As mentioned, quercetin's bioavailability is inherently low due to its poor water solubility, which presents a challenge when administering it in its traditional forms such as decoctions, powders, or oils. Pediatric dosing protocols need to be carefully adjusted, as children's gastrointestinal and hepatic systems are still developing, which could affect the absorption and metabolism of quercetin.

Additionally, while *Rasna* is used traditionally in Ayurveda for respiratory ailments, the lack of standardized formulations raises concerns about consistency and efficacy. Variations in the concentration of active ingredients, the quality of the raw herb, and the preparation methods can lead to unpredictable outcomes. Thus, the development of standardized formulations for pediatric use is crucial to ensure safe and consistent therapeutic effects.

Another challenge lies in the variability of quercetin's effects based on individual pediatric constitutions or doshic imbalances. Ayurveda emphasizes personalized treatment, considering a child's unique *Prakriti* (constitution) and the specific imbalance of doshas. While modern science offers a generalized approach, an integrative model combining Ayurvedic insights and pharmacology could offer a more tailored therapeutic strategy, optimizing quercetin's benefits for each child.

5. Conclusion

Quercetin, a potent flavonoid with remarkable antiviral, anti-inflammatory, and antioxidant properties, holds substantial promise in managing rhinovirus infections and related respiratory diseases in children. As a natural compound abundant in *Rasna* (Pluchea lanceolata), a revered herb in Ayurveda, quercetin not only aligns with modern pharmacological principles but also offers a holistic approach rooted in ancient wisdom. The pharmacological actions of quercetin, including inhibition of viral replication, reduction of inflammatory cytokines, and neutralization of oxidative stress, make it a valuable therapeutic tool in the management of pediatric respiratory diseases.

From an Ayurvedic perspective, *Rasna* has been traditionally used for addressing conditions such as *Shvasa* (dyspnea) and *Kasa* (cough), which align closely with the symptoms of rhinovirus-induced respiratory distress. The integration of Ayurvedic knowledge with modern pharmacological research opens up new possibilities for pediatric care, particularly in the management of recurrent respiratory infections, asthma, and allergic rhinitis.

However, several challenges remain. The limited number of pediatric-specific clinical trials, issues surrounding the bioavailability of quercetin, the variability in Ayurvedic formulations, and the need for standardized dosing regimens all point to the necessity for further research. The pharmacokinetics of quercetin in children—especially regarding its absorption, distribution, metabolism, and elimination—requires more in-depth investigation to optimize its therapeutic use. Additionally, long-term safety data and studies focusing on individualized treatment approaches, integrating both Ayurvedic and modern pharmacological interventions, are crucial to fully harness quercetin's therapeutic potential.

Future research must focus on developing bioavailable formulations, conducting robust clinical trials, and standardizing Ayurvedic remedies for consistent therapeutic outcomes. Investigating the synergistic effects of quercetin with other Ayurvedic herbs or conventional treatments could offer comprehensive respiratory care, especially for children suffering from chronic and recurrent respiratory illnesses.

In conclusion, quercetin, as sourced from *Rasna*, represents a promising therapeutic option for pediatric respiratory diseases, offering a bridge between traditional Ayurvedic healing and modern pharmacology. With the integration of these two perspectives, there is significant potential to enhance pediatric respiratory care, improve patient outcomes, and reduce the burden of rhinovirus infections and related conditions on public health.

Limitations

Despite the promising therapeutic potential of quercetin in treating rhinovirus infections and respiratory diseases, several limitations must be acknowledged:

1. **Limited Pediatric-Specific Studies:** While quercetin has shown efficacy in preclinical and adult studies, its pharmacokinetics and safety profile in children, especially at varying doses and forms (e.g., decoctions or powders), are not well-established. Limited pediatric-specific clinical trials restrict our ability to fully assess its long-term effects and the appropriate dosing strategies for young children.
2. **Low Bioavailability:** Quercetin's low bioavailability due to its poor water solubility remains a major challenge in maximizing its therapeutic potential. In children, the potential impact of co-administration with other substances (like fats or vitamin C) to enhance absorption remains unclear and warrants further investigation.
3. **Lack of Standardized Ayurvedic Formulations:** While *Rasna* is traditionally used in Ayurvedic practice, there is a lack of standardized formulations that can be universally recommended. Variations in the preparation, dosage, and administration methods of *Rasna*-based formulations may lead to inconsistent results in clinical practice.
4. **Incomplete Understanding of Dosha Interactions:** Ayurveda emphasizes personalized medicine based on doshic imbalances, but the scientific evidence regarding the precise interactions of quercetin with individual dosha imbalances, especially in pediatric populations, remains underexplored. The complex interplay between doshas, prakriti (individual constitution), and disease presentation needs further clarification.
5. **Limited Long-Term Data:** The long-term safety of quercetin in pediatric respiratory diseases, especially when used chronically for conditions like asthma or recurrent cold, remains largely unknown. More studies are needed to understand the risks and benefits of long-term quercetin usage.

Further Research Studies

Further studies are needed to validate and optimize the use of quercetin in the context of pediatric rhinovirus infections and related respiratory diseases. Areas for future research include:

1. **Pediatric-Specific Clinical Trials:** More controlled clinical trials targeting pediatric populations are essential to determine the safety, efficacy, and optimal dosing of quercetin. Studies should focus on various age groups, especially those below 5 years, who are particularly vulnerable to viral infections.
2. **Bioavailability Enhancements:** Research into the formulation of quercetin to improve its bioavailability in children, such as the development of novel delivery systems (e.g., nanoparticles, liposomal formulations), could increase its therapeutic potential. Investigating synergistic combinations with other compounds like vitamin C or phospholipids could be beneficial in improving absorption and efficacy.

3. **Standardization of Ayurvedic Formulations:** Research into the standardization of *Rasna*-based Ayurvedic formulations is critical to ensure consistent quality and dosage. Rigorous testing of these formulations in clinical trials will allow for evidence-based recommendations for pediatric use.
4. **Mechanisms of Action in Pediatrics:** Further studies are needed to explore the precise mechanisms through which quercetin acts on pediatric respiratory diseases, including its impact on immune modulation, cytokine regulation, and viral replication. Investigating quercetin's effects on the pediatric immune system would provide a deeper understanding of its role in managing respiratory infections.
5. **Long-Term Safety and Efficacy:** Longitudinal studies to assess the long-term safety of quercetin in pediatric patients, particularly in those with chronic respiratory conditions, would provide critical data on the risks and benefits of prolonged use. These studies could help establish recommended guidelines for long-term management of conditions like asthma, allergic rhinitis, and recurrent upper respiratory infections.
6. **Integrative Approaches in Pediatric Care:** Future research should focus on the integration of Ayurveda with modern pharmacology, exploring the synergistic effects of quercetin when combined with other Ayurvedic herbs or conventional treatments. Clinical trials that incorporate both Ayurvedic and pharmacological interventions could open new avenues for personalized and holistic care in pediatric respiratory diseases.

References

1. World Health Organization. Global Surveillance and Monitoring System for Influenza. 2020.
2. Nguyen QH, Wang J, Huang Y, et al. Quercetin: A therapeutic potential in viral infections and respiratory diseases. J Med Virol. 2021;93(9):5428-5437.
3. Lee H, Lim H, Yoo S, et al. The role of quercetin in reducing oxidative stress and inflammation in asthma and allergic rhinitis. Clin Exp Immunol. 2020;199(3):291-303.
4. Jayaprakasha GK, Singh RP, Sakariah KK. Antioxidant and antimicrobial properties of quercetin in vitro. Free Radic Biol Med. 2018;45(3):459-468.
5. Sahoo S, Mishra T, Bhatia S, et al. Quercetin-based formulations in pediatric respiratory diseases: A comprehensive review. Int J Pharm Sci Res. 2022;13(10):3920-3928.
6. Vaidya AD, Joshi V, Shah K, et al. Pharmacological review of Ayurvedic medicinal plants used for respiratory conditions in pediatric practice. Ayu. 2019;40(3):164-170.
7. Mantha S, Pal P, Gupta S, et al. A comparative study of Rasna (Pluchea lanceolata) with other anti-inflammatory agents in the treatment of respiratory diseases. J Indian Med Assoc. 2020;118(6):67-71.
8. Geng Y, Jiang X, Xu H, et al. Impact of quercetin on the immune system and respiratory inflammation: A systematic review. Inflammopharmacology. 2020;28(6):1155-1168.
9. Sharma A, Raj S, Kalra S, et al. Role of quercetin in viral respiratory infections: Potential for application in COVID-19 and other viral diseases. J Virus Erad. 2021;7(1):22-28.
10. Bajpai M, Aggarwal R, Shukla A, et al. Antiviral and anti-inflammatory properties of quercetin and its role in pediatric respiratory diseases. Expert Rev Anti Infect Ther. 2020;18(5):445-456.
11. Kaur S, Bains K, Saini M, et al. Anti-inflammatory properties of quercetin: Clinical implications in the management of pediatric asthma and bronchitis. J Asthma. 2021;58(3):339-347.
12. Kim H, Choi J, Lee D, et al. Pluchea lanceolata (Rasna) as a traditional medicine in the treatment of respiratory diseases. J Ethnopharmacol. 2019; 246:112223.
13. Gupta R, Goyal A, Pandey R, et al. Pharmacokinetics and clinical efficacy of quercetin in the pediatric population: An in-depth review. Pediatr Clin North Am. 2020;67(4):741-757.

14. Sharma D, Mendiratta P, Varma R, et al. The integrative role of Ayurveda and modern pharmacology in managing respiratory infections in children: Focus on Rasna (Pluchea lanceolata). J Tradit Complement Med. 2021;11(3):273-280.

15. Bose R, Ghosh R, Roy B, et al. Integrating Ayurvedic therapeutics in pediatric practice: A study of Rasna's therapeutic action. J Ayurveda Integr Med. 2021;12(2):199-206.

16. Singh V, Sharma M, Gupta S, et al. Rasna as a therapeutic model for respiratory diseases in children. J Ayurveda. 2020;14(1):12-16.

17. Khanna S, Verma K, Rana P, et al. Efficacy of Rasna Kwatha and its relevance in modern pharmacology for pediatric respiratory disorders. Phytother Res. 2021;35(8):502-511.

18. Furlong O, Patel S, Aggarwal A, et al. Pharmacokinetics and therapeutic use of quercetin in pediatric respiratory disorders. Pediatrics. 2022;150(3):431-438.

19. Tiwari A, Mukherjee S, Shah G, et al. Quercetin in pediatric clinical pharmacology: A comprehensive review. J Clin Pharmacol. 2020;60(9):1245-1252.

20. Nithin SA, Patil A. Ayurvedic pharmacology in the treatment of respiratory diseases in children: Integrating modern and traditional approaches. J Ayurveda. 2021;22(1):80-88.

21. Sharma G, Patel M, Verma R, et al. Pediatric respiratory disease management through integrative Ayurvedic and modern pharmacology: The case of quercetin. Med Hypotheses. 2021; 146:110371.

22. Xu H, Zhang S, Wang Y, et al. Role of quercetin in pediatric respiratory diseases: Implications for treatment. Front Pediatr. 2021; 9:729.

23. Sharma R, Gupta N, Kumar P, et al. Impact of Ayurveda in pediatric respiratory disease management: A study on Rasna-based formulations. J Ayurveda Integr Med. 2021;12(5):467-473.

24. Verma S, Rana R, Mehta S, et al. Quercetin in pediatric care: An evaluation of therapeutic use in respiratory disorders. J Med Sci Clin Res. 2020;8(6):1132-1137.

25. Khan A, Ahmed R, Malik M, et al. Management of pediatric asthma and allergic rhinitis with Quercetin: A review of clinical trials. Pediatr Pulmonol. 2020;55(5):1206-1212.

26. Gupta M, Chhabra P, Pandey G, et al. Role of Rasna (Pluchea lanceolata) in the management of pediatric respiratory diseases: A review. Int J Res Ayurveda Pharm. 2020;11(3):110-115.

27. Rai A, Yadav S, Mishra K, et al. Rasna and Quercetin: Synergistic effects in pediatric respiratory disorders. J Integr Complement Med. 2020;22(4):58-67.

28. Kumar P, Choudhury A, Reddy N, et al. Integrative therapeutic approaches in pediatric care: Focus on Quercetin and Ayurvedic formulations. J Complement Integr Med. 2020;17(1):109-118.