International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Ethnobotanical Knowledge and Traditional Medicinal Uses of Azadirachta Indica Among Rural Communities of Hanumangarh District, Rajasthan

Randeep Singh Choudhary[1], Dr. Anita Dhaka[2]

[1]Research Scholar, Department of Botany, Shri Khushal Das University
[2]Assistant Professor, Department of Botany, Shri Khushal Das University

Abstract:
Ethnobotanical knowledge constitutes an important component of indigenous healthcare systems and reflects the long-standing interaction between local communities and plant resources. Throughout India, medicinal plants have been utilized for centuries in the prevention and treatment of diseases, particularly in rural regions where traditional remedies continue to play a significant role in primary healthcare. Among these medicinal plants, *Azadirachta indica* A. Juss., commonly known as Neem, occupies a prominent position due to its extensive therapeutic applications and cultural significance. Neem has been recognized as one of the most versatile medicinal trees owing to its antimicrobial, anti-inflammatory, antioxidant, and insecticidal properties The present study explores the ethnobotanical significance of *Azadirachta indica* among rural communities of Hanumangarh district. It examines traditional medicinal applications, methods of preparation, cultural beliefs, and socio-economic relevance associated with the species. The study also highlights the role of Neem in sustainable healthcare practices and environmental conservation. By documenting local knowledge systems, the research contributes to the preservation of valuable ethnomedicinal traditions that are increasingly threatened by modernization and changing socio-cultural conditions. The study further emphasizes the ecological and economic importance of Neem in rural livelihoods. Apart from medicinal applications, Neem contributes to sustainable agriculture through its natural pesticidal properties and supports environmental management through soil conservation and biodiversity enhancement. Such multifunctional benefits make Neem a valuable resource for promoting sustainable rural development. The research concludes that *Azadirachta indica* remains an indispensable component of traditional healthcare and rural culture in Hanumangarh district. Strengthening community awareness, encouraging conservation initiatives, and integrating indigenous knowledge with contemporary scientific research can contribute significantly to sustainable utilization of medicinal plant resources and the preservation of cultural heritage (Pandey et al., 2014).

Keywords: Ethnobotany, Azadirachta indica, Neem, Traditional Medicine, Hanumangarh, Rajasthan.

1. INTRODUCTION

Ethnobotany is a multidisciplinary field that examines the interactions between human societies and plant resources. It encompasses the study of how communities perceive, utilize, manage, and conserve plant

species for medicinal, nutritional, agricultural, and cultural purposes. Across developing countries, traditional plant-based knowledge continues to serve as an important source of healthcare, particularly among rural populations where access to modern medical facilities may be limited. Ethnobotanical investigations not only document indigenous wisdom but also contribute to biodiversity conservation and pharmaceutical research by identifying plants with potential therapeutic value (Cotton, 1996).

India possesses one of the richest traditions of medicinal plant utilization in the world. Ancient systems such as Ayurveda, Siddha, and Unani have extensively documented the medicinal properties of numerous plant species. Rural and tribal communities continue to rely on traditional remedies derived from local flora for treating common illnesses and maintaining health. Such knowledge has been transmitted orally across generations and represents a valuable cultural asset. However, increasing urbanization, migration, and changing lifestyles have accelerated the erosion of indigenous medicinal knowledge, creating an urgent need for systematic documentation and preservation (Jain, 1991).

The state of Rajasthan is characterized by diverse ecological conditions ranging from arid deserts to semi-arid agricultural landscapes. Despite environmental challenges, the region supports a considerable variety of medicinal plant species that are utilized by local communities. Traditional healers, farmers, pastoralists, and elderly villagers possess extensive knowledge regarding plant-based therapies and household remedies. Ethnobotanical studies conducted in Rajasthan have documented the medicinal applications of numerous species used in the treatment of dermatological, gastrointestinal, respiratory, and infectious diseases (Katewa et al., 2004).

Among the medicinal plants found in Rajasthan, *Azadirachta indica* A. Juss. occupies a unique and highly respected position. Commonly known as Neem, the species belongs to the family Meliaceae and is native to the Indian subcontinent. Neem has been referred to as the “Village Pharmacy” because almost every part of the tree possesses medicinal significance. Scientific investigations have revealed the presence of biologically active compounds such as azadirachtin, nimbin, nimbidin, nimbolide, and quercetin, which contribute to its diverse pharmacological properties (Biswas et al., 2002).

Hanumangarh district, situated in the north-western region of Rajasthan, provides a suitable setting for ethnobotanical research due to its extensive agricultural activities and widespread presence of Neem trees. The species is commonly cultivated around farms, residential compounds, schools, religious sites, and public spaces. Rural households frequently employ Neem-based remedies for treating common ailments and maintaining environmental hygiene. These practices illustrate the continued dependence of local communities on traditional medicinal resources and highlight the significance of documenting indigenous knowledge before it disappears (Sharma & Kumar, 2021).

The present study seeks to examine the ethnobotanical knowledge associated with *Azadirachta indica* among rural communities of Hanumangarh district. The objectives include documenting traditional medicinal uses, understanding methods of preparation and administration, analyzing cultural significance, and evaluating the socio-economic and ecological contributions of the species. Through comprehensive investigation, the study aims to contribute to the preservation of indigenous knowledge systems and promote sustainable utilization of medicinal plant resources for future generations (Pandey et al., 2014).

2. REVIEW OF LITERATURE

Ethnobotanical studies have emerged as an important area of interdisciplinary research because they provide insights into the relationship between local communities and plant resources. Scholars have documented that traditional medicinal knowledge constitutes a significant component of primary

healthcare systems in developing countries where access to modern medical facilities remains limited. Early ethnobotanical investigations in India revealed that medicinal plants continue to play a crucial role in the treatment of common ailments and contribute substantially to community well-being. Researchers have emphasized that indigenous knowledge systems represent a valuable repository of information that can support biodiversity conservation and pharmaceutical innovation (Jain, 1991).

Several studies have highlighted the importance of documenting traditional medicinal practices before they disappear under the influence of modernization and socio-economic transformation. The oral transmission of ethnobotanical knowledge from one generation to another has historically ensured the continuity of folk healthcare traditions. However, increasing urbanization, formal education, migration, and changing lifestyles have weakened these traditional mechanisms of knowledge transfer. Consequently, scholars have advocated systematic recording of indigenous medicinal practices to preserve cultural heritage and facilitate scientific validation of traditional remedies (Cotton, 1996).

Research conducted across different regions of Rajasthan has demonstrated the extensive utilization of medicinal plants by rural and tribal communities. Ethnobotanical surveys have identified numerous plant species used for treating dermatological disorders, respiratory infections, gastrointestinal diseases, fever, and musculoskeletal ailments. These studies indicate that traditional healers possess detailed knowledge regarding plant identification, harvesting techniques, dosage determination, and methods of preparation. Such findings underscore the richness of indigenous healthcare systems and their continued relevance in contemporary rural society (Katewa et al., 2004).

Among medicinal plants, *Azadirachta indica* has received considerable scholarly attention due to its diverse pharmacological properties. Numerous scientific investigations have confirmed that Neem contains bioactive compounds including azadirachtin, nimbin, nimbidin, nimbolide, and quercetin. These compounds exhibit antimicrobial, antifungal, antiviral, anti-inflammatory, antioxidant, and insecticidal activities. The therapeutic potential of Neem has been validated through laboratory studies and clinical observations, thereby supporting many traditional claims regarding its medicinal efficacy (Biswas et al., 2002).

Studies focusing on Neem have reported its widespread use in traditional healthcare systems throughout South Asia. Leaves are commonly employed in the treatment of skin infections and fever, while bark extracts are utilized for digestive disorders and wound healing. Neem twigs are traditionally used as natural toothbrushes, contributing to oral hygiene and dental health. Researchers have observed that the versatility of Neem has enabled it to become an integral component of household healthcare practices across diverse cultural settings (Subapriya & Nagini, 2005).

Despite extensive research on Neem at the national level, relatively few studies have specifically examined its ethnobotanical significance within the rural communities of Hanumangarh district. Existing literature provides limited information regarding local preparation methods, cultural beliefs, patterns of utilization, and community perceptions associated with the species. Therefore, the present study seeks to bridge this gap by documenting traditional knowledge related to *Azadirachta indica* among rural populations of Hanumangarh and contributing to the broader ethnobotanical literature (Sharma & Kumar, 2021).

3. STUDY AREA: HANUMANGARH DISTRICT, RAJASTHAN

Hanumangarh district is situated in the northern part of Rajasthan and forms an important agricultural region of the state. Geographically, the district lies between the Thar Desert and the fertile plains influenced by canal irrigation systems. The district shares boundaries with Punjab and Haryana, resulting

in significant cultural and agricultural interactions with neighboring regions. The environmental conditions of Hanumangarh have contributed to the development of unique relationships between local communities and plant resources, particularly drought-resistant species such as Neem (Government of Rajasthan, 2024).

The climate of Hanumangarh is characterized by extreme seasonal variations, with hot summers, cool winters, and relatively low annual rainfall. Such climatic conditions have encouraged the cultivation and preservation of hardy tree species capable of surviving under water-limited environments. Neem has adapted exceptionally well to these conditions and is commonly found throughout villages, agricultural fields, roadsides, and public spaces. Its resilience and multiple uses have made it an indispensable component of the local landscape (National Research Council, 1992).

Agriculture constitutes the primary occupation of the majority of residents in Hanumangarh district. Crops such as wheat, mustard, cotton, gram, and guar are cultivated extensively under irrigated conditions. Farmers frequently utilize traditional plant-based knowledge for crop protection, grain preservation, and livestock management. Neem plays an important role in these practices because of its natural pesticidal properties and environmental benefits. Consequently, the species enjoys widespread acceptance among farming communities (Singh & Sharma, 2018).

The social structure of Hanumangarh consists predominantly of rural settlements where traditional cultural values continue to influence daily life. Elderly community members, traditional healers, and experienced farmers often serve as custodians of indigenous knowledge regarding medicinal plants. This knowledge encompasses plant identification, harvesting methods, preparation techniques, and therapeutic applications. Such traditional practices remain particularly important in villages where healthcare infrastructure may be limited or distant (Jain, 1991).

Religious and cultural traditions also contribute to the significance of Neem within the district. The tree is frequently planted near temples, community centers, schools, and residential compounds. Many households regard Neem as a symbol of purity, protection, and well-being. Its presence in both domestic and public spaces reflects the deep cultural attachment that local communities maintain with the species and reinforces its importance beyond medicinal applications (Kirtikar & Basu, 2019).

The selection of Hanumangarh district as the study area is justified by the widespread occurrence of Neem and the continued reliance of rural communities on traditional medicinal practices. The district provides an appropriate setting for examining the ethnobotanical dimensions of *Azadirachta indica* because it combines ecological suitability, agricultural dependence, cultural continuity, and rich indigenous knowledge systems. These characteristics make Hanumangarh an ideal region for documenting and analyzing traditional medicinal utilization of Neem (Sharma & Kumar, 2021).

4. RESEARCH METHODOLOGY

The present study adopts a qualitative ethnobotanical research design to investigate the traditional medicinal uses and cultural significance of *Azadirachta indica* among rural communities of Hanumangarh district. Qualitative approaches are particularly suitable for ethnobotanical investigations because they facilitate comprehensive understanding of indigenous knowledge systems, local perceptions, and community practices. The methodology emphasizes direct interaction with knowledge holders and documentation of traditional experiences associated with Neem utilization (Cotton, 1996).

Primary data for the study were collected through field visits conducted in selected villages of Hanumangarh district. Interviews were undertaken with traditional healers, elderly residents, farmers,

homemakers, and community elders who possessed knowledge regarding medicinal plants. Respondents were selected through purposive sampling to ensure inclusion of individuals with substantial experience and familiarity with traditional healthcare practices. This approach enabled the collection of detailed and context-specific information regarding Neem utilization (Martin, 1995).

Semi-structured interviews constituted the principal method of data collection. Interview schedules included questions relating to local names of the plant, medicinal uses, preparation techniques, dosage patterns, methods of administration, and perceived effectiveness. Participants were encouraged to share personal experiences and community traditions associated with Neem. The flexibility of semi-structured interviews facilitated deeper exploration of indigenous perspectives while maintaining consistency across respondents (Alexiades, 1996).

Participant observation was employed to supplement interview findings and enhance data reliability. Researchers observed the preparation of traditional remedies, methods of harvesting plant materials, and household applications of Neem. Such observations provided valuable insights into practical aspects of ethnobotanical knowledge that may not always be adequately captured through interviews alone. Observation also contributed to verification of information obtained from respondents (Bernard, 2017).

Secondary data were obtained from books, peer-reviewed journals, ethnobotanical reports, government publications, and scientific studies concerning Neem and traditional medicinal systems. Literature review facilitated contextualization of field findings within broader academic discussions and enabled comparison between local practices and documented ethnomedicinal uses reported in other regions. The integration of primary and secondary sources strengthened the overall validity of the research (Biswas et al., 2002).

Data collected during field investigations were systematically organized and analyzed through thematic categorization. Information relating to medicinal applications, cultural significance, agricultural uses, environmental contributions, and socio-economic benefits was classified into distinct themes. This analytical approach facilitated identification of recurring patterns and enabled comprehensive interpretation of the ethnobotanical importance of *Azadirachta indica* within the rural communities of Hanumangarh district (Martin, 1995).

5. TRADITIONAL MEDICINAL USES OF *AZADIRACHTA INDICA* AMONG RURAL COMMUNITIES OF HANUMANGARH DISTRICT

The rural communities of Hanumangarh district have traditionally relied upon *Azadirachta indica* as an important source of household medicine for the treatment of a wide range of ailments. Elderly villagers and traditional healers possess extensive knowledge regarding the therapeutic properties of Neem and continue to transmit such information through oral traditions. The widespread availability of the tree, coupled with its perceived effectiveness and affordability, has contributed to its continued utilization in rural healthcare systems. Local communities consider Neem a natural remedy capable of addressing both minor and chronic health conditions without significant economic burden. The use of Neem is deeply embedded within everyday life and reflects the long-standing relationship between people and their surrounding environment. Traditional knowledge associated with the species demonstrates the practical application of indigenous wisdom in disease prevention and health promotion. Respondents frequently described Neem as a “village doctor” because of its versatility and accessibility. Such perceptions indicate the enduring importance of the species within community healthcare practices. The reliance on Neem also reflects trust in traditional remedies that have been tested over generations. In many villages, Neem-based treatments are often employed before seeking professional medical assistance. This pattern highlights the

continuing relevance of ethnomedicinal knowledge in contemporary rural society. The findings correspond with earlier studies that recognize Neem as one of the most significant medicinal plants utilized in traditional Indian healthcare systems (Biswas et al., 2002).

Neem leaves represent the most frequently utilized component of the tree for medicinal purposes within Hanumangarh district. Fresh leaves are commonly crushed into a paste and applied externally for treating skin infections, rashes, itching, boils, acne, and wounds. Villagers believe that Neem leaves possess powerful cleansing and disinfectant properties capable of preventing infection and accelerating healing. Leaf decoctions are also prepared and consumed in small quantities to reduce fever, improve digestion, and purify the blood. During seasonal outbreaks of infectious diseases, households often place Neem leaves near entrances and sleeping areas as a preventive measure. Women frequently use Neem leaf infusions for bathing children suffering from skin-related ailments. Traditional healers recommend regular application of leaf preparations for chronic dermatological conditions. The bitterness of Neem leaves is commonly associated with their medicinal strength and detoxifying effects. Community members often emphasize that regular consumption of Neem leaves contributes to overall health maintenance. Such practices reveal the broad therapeutic scope attributed to Neem within local healthcare traditions. Scientific investigations have similarly reported significant antimicrobial and anti-inflammatory activities in Neem leaf extracts. These findings support many traditional applications documented among rural populations (Subapriya & Nagini, 2005).

Neem bark is another important medicinal resource employed by rural communities for the treatment of gastrointestinal disorders and oral health problems. Bark decoctions are prepared by boiling small pieces of bark in water and administering the resulting liquid as a traditional remedy for stomach discomfort, diarrhea, and digestive disturbances. Traditional healers frequently prescribe bark extracts to improve appetite and regulate digestive functions. Some respondents reported using bark preparations for managing symptoms associated with fever and general weakness. In addition to internal uses, bark extracts are applied externally to promote wound healing and prevent infection. The astringent properties of Neem bark are highly valued in folk medicine and are believed to strengthen body tissues. Villagers often combine bark with other medicinal plants to enhance therapeutic efficacy. The preparation and administration of bark-based remedies vary among communities but generally follow established traditional practices. Knowledge concerning appropriate dosage and duration of treatment is usually possessed by experienced elders or healers. Such knowledge reflects generations of empirical observation and experimentation. Modern pharmacological studies have confirmed the presence of biologically active compounds in Neem bark that contribute to antimicrobial and anti-inflammatory effects. These scientific findings lend credibility to traditional medicinal applications documented in the study area (Pandey et al., 2014).

The use of Neem twigs for maintaining oral hygiene constitutes one of the most enduring ethnobotanical practices observed in Hanumangarh district. Fresh twigs are chewed and utilized as natural toothbrushes, locally regarded as an effective means of cleaning teeth and strengthening gums. Rural residents believe that daily use of Neem twigs prevents dental caries, gum infections, bad breath, and oral diseases. Elderly respondents frequently emphasized that traditional chewing sticks were widely used before the availability of commercial dental products and continue to remain effective alternatives. The fibrous structure of the twig assists in mechanical cleaning while medicinal compounds released during chewing provide additional antimicrobial benefits. Many villagers consider Neem twigs superior to synthetic toothbrushes because they combine cleaning and therapeutic functions. Traditional healers often recommend Neem

twigs for individuals experiencing gum bleeding or oral infections. The practice also reflects sustainable utilization of locally available natural resources. Younger generations, although increasingly influenced by modern products, continue to observe this tradition in many rural households. Scientific studies have reported antibacterial activities associated with Neem extracts that contribute to oral health improvement. Such evidence supports the continued relevance of traditional dental practices involving Neem twigs (Wolinsky et al., 1996).

Neem seeds and seed oil possess considerable medicinal significance within the traditional healthcare practices of Hanumangarh district. Seed oil is commonly applied externally for the treatment of skin disorders, fungal infections, joint pain, and insect bites. Rural households frequently use Neem oil to protect against lice infestation and other parasitic conditions affecting both humans and livestock. Traditional healers regard Neem oil as a potent remedy capable of reducing inflammation and promoting skin recovery. The oil is typically extracted through traditional processing methods and stored for household use throughout the year. Respondents reported that Neem oil is particularly effective in managing chronic skin conditions that do not respond adequately to conventional treatments. Some communities utilize diluted formulations of Neem oil for massage therapy aimed at relieving muscular discomfort. The application of Neem oil also extends to veterinary medicine, where it is employed to protect animals from external parasites. Such multifunctional utilization demonstrates the versatility of the species within rural healthcare systems. Scientific investigations have identified several biologically active constituents in Neem seeds that contribute to their medicinal properties. These findings provide pharmacological support for traditional therapeutic practices involving Neem oil (National Research Council, 1992).

Apart from direct medicinal applications, Neem plays a significant preventive role in community health management. Villagers commonly store dried Neem leaves with grains, clothing, and household items to protect them from insects and microbial contamination. During seasonal changes and disease outbreaks, Neem leaves are frequently burned or dispersed around homes as part of traditional sanitation practices. Community members associate Neem with purification, disease prevention, and environmental cleanliness. Such preventive applications reflect a holistic understanding of health that extends beyond treatment of illness to include maintenance of hygienic living conditions. Traditional beliefs regarding the protective powers of Neem contribute to its widespread presence within domestic environments. The integration of medicinal, hygienic, and environmental functions illustrates the comprehensive role of Neem in rural life. Knowledge relating to preventive uses is generally shared among all members of the community and forms part of everyday household management. These practices demonstrate how ethnobotanical knowledge contributes to public health at the community level. The continued reliance on Neem for preventive purposes highlights its cultural acceptance and practical utility. Contemporary scientific research has increasingly recognized the antimicrobial and insecticidal properties of Neem that underpin many of these traditional applications. Consequently, Neem remains an indispensable component of rural healthcare and environmental management systems in Hanumangarh district (Biswas et al., 2002).

6. CONCLUSION AND RECOMMENDATIONS

The present study demonstrates that *Azadirachta indica* occupies a central position within the ethnobotanical traditions of rural communities in Hanumangarh district, Rajasthan. The findings reveal that Neem continues to serve as an accessible, affordable, and culturally accepted source of healthcare for a significant proportion of the rural population. Traditional knowledge concerning the medicinal uses of

leaves, bark, seeds, flowers, and twigs has been preserved through generations and remains actively practiced despite increasing access to modern medical facilities. Such continuity reflects the resilience and adaptability of indigenous healthcare systems. The widespread utilization of Neem highlights its importance not only as a medicinal plant but also as a symbol of cultural identity and ecological sustainability. The study confirms that traditional knowledge remains a valuable resource for addressing local healthcare needs. Documentation of such knowledge is therefore essential for preserving cultural heritage and promoting sustainable utilization of biological resources. The findings contribute to the growing body of ethnobotanical literature emphasizing the significance of indigenous medicinal systems. Furthermore, the research underscores the necessity of integrating traditional wisdom into broader strategies of public health and biodiversity conservation. Recognition of local knowledge systems can strengthen community participation in sustainable development initiatives. Consequently, Neem represents both a biological resource and a repository of cultural knowledge deserving continued attention and protection (Jain, 1991).

The investigation highlights the remarkable diversity of medicinal applications associated with Neem within the study area. Community members utilize different plant parts for treating dermatological disorders, digestive ailments, fever, oral diseases, wounds, and parasitic infections. These applications reflect extensive empirical knowledge accumulated through generations of observation and practical experience. The consistency of reported uses across villages suggests a high degree of cultural consensus regarding the therapeutic value of the species. Such findings are particularly significant because many traditional applications correspond closely with pharmacological properties identified through modern scientific research. This convergence between indigenous knowledge and scientific evidence strengthens confidence in the medicinal potential of Neem. Traditional practices documented during the study illustrate the sophisticated understanding of plant-based therapies possessed by rural communities. Recognition of these contributions can facilitate greater appreciation of indigenous healthcare systems. Furthermore, ethnobotanical documentation can support future research aimed at developing safe and effective plant-derived medicines. Preservation of traditional knowledge therefore has implications extending beyond cultural conservation to include public health and pharmaceutical innovation. The study reinforces the need to treat indigenous medicinal knowledge as an important scientific and cultural asset (Biswas et al., 2002).

One of the major concerns identified during the research relates to the gradual erosion of traditional ethnobotanical knowledge. Younger generations are increasingly influenced by modernization, urbanization, formal education systems, and technological change. As a result, opportunities for intergenerational transmission of medicinal knowledge are declining. Elderly community members who possess extensive understanding of traditional practices may not always find interested successors willing to learn and preserve such information. This situation creates the risk of irreversible loss of valuable cultural and medicinal knowledge. Documentation initiatives therefore assume particular importance in safeguarding ethnobotanical heritage for future generations. Educational institutions, research organizations, and government agencies should collaborate with local communities to record traditional medicinal practices systematically. Community-based knowledge preservation programs can encourage youth participation and strengthen cultural continuity. Such efforts should respect intellectual property rights and ensure recognition of local contributions. Preservation strategies must be participatory and culturally sensitive to maintain authenticity and community trust. Without timely intervention, substantial

portions of indigenous knowledge may disappear permanently. Therefore, conservation of ethnobotanical knowledge should be considered a priority within rural development policies (Cotton, 1996).

The study further indicates that Neem contributes significantly to environmental sustainability and agricultural resilience within Hanumangarh district. Farmers utilize Neem-based products for pest management, grain storage, and crop protection, thereby reducing dependence on synthetic chemicals. Such practices support environmentally friendly agricultural systems and contribute to long-term ecological health. The tree also provides shade, improves microclimatic conditions, assists in soil conservation, and supports biodiversity. Its ability to thrive under arid and semi-arid conditions makes it particularly valuable in regions facing environmental challenges associated with climate variability. Conservation and plantation of Neem can therefore contribute to sustainable land management strategies. Government agencies and local institutions should encourage large-scale plantation programs involving community participation. Awareness campaigns highlighting ecological and economic benefits can further promote conservation efforts. Sustainable utilization of Neem resources should be integrated into broader environmental management policies. Such initiatives would simultaneously support biodiversity conservation, climate adaptation, and rural livelihoods. Consequently, Neem represents an important resource for achieving environmental sustainability in the region (National Research Council, 1992).

Based on the findings of the study, several practical recommendations can be proposed. First, comprehensive ethnobotanical surveys should be conducted throughout Rajasthan to document traditional medicinal knowledge before it disappears. Second, educational programs should be introduced at local levels to encourage awareness regarding the value of indigenous healthcare traditions. Third, scientific institutions should undertake further pharmacological and clinical investigations to validate traditional uses of Neem and identify new therapeutic applications. Fourth, local communities should be actively involved in conservation initiatives and benefit-sharing mechanisms related to medicinal plant resources. Fifth, policies should be developed to protect indigenous knowledge from unauthorized commercial exploitation while ensuring fair recognition of community contributions. Sixth, traditional healers should be included in healthcare awareness programs to facilitate constructive dialogue between indigenous and modern medical systems. Implementation of these measures can strengthen the preservation and sustainable utilization of ethnobotanical knowledge. Such efforts will contribute to cultural conservation, scientific advancement, and community development simultaneously. The recommendations therefore have relevance for researchers, policymakers, educators, and healthcare practitioners alike. Collaborative action is essential for ensuring that valuable traditional knowledge remains available for future generations (Alexiades, 1996).

In conclusion, *Azadirachta indica* remains one of the most important medicinal plant species utilized by rural communities of Hanumangarh district. Its extensive therapeutic applications, cultural significance, ecological contributions, and economic value collectively underscore its exceptional importance within local society. The study demonstrates that Neem functions not merely as a medicinal resource but also as an integral component of traditional knowledge systems and sustainable rural livelihoods. Preservation of this knowledge is essential for maintaining cultural identity, supporting biodiversity conservation, and promoting community well-being. Future research should continue to explore the ethnobotanical dimensions of Neem and other medicinal plants in Rajasthan to enhance understanding of indigenous healthcare traditions. Integration of traditional knowledge with scientific research can generate innovative approaches to health, agriculture, and environmental management. Such integration should be based upon mutual respect, ethical collaboration, and recognition of community rights. The continued relevance of

Neem illustrates the enduring value of indigenous wisdom in addressing contemporary challenges. By documenting and conserving ethnobotanical knowledge, society can benefit from centuries of accumulated experience and promote sustainable development pathways rooted in local traditions. Therefore, Neem stands as a powerful example of the intersection between nature, culture, health, and sustainability in rural Rajasthan (Sharma & Kumar, 2021).

REFERENCES:

1. Alexiades, M. N. (1996). *Selected guidelines for ethnobotanical research: A field manual*. New York Botanical Garden.
2. Bernard, H. R. (2017). *Research methods in anthropology: Qualitative and quantitative approaches* (6th ed.). Rowman & Littlefield.
3. Biswas, K., Chattopadhyay, I., Banerjee, R. K., & Bandyopadhyay, U. (2002). Biological activities and medicinal properties of neem (*Azadirachta indica*). *Current Science, 82*(11), 1336–1345.
4. Chopra, R. N., Nayar, S. L., & Chopra, I. C. (2006). *Glossary of Indian medicinal plants*. National Institute of Science Communication and Information Resources.
5. Cotton, C. M. (1996). *Ethnobotany: Principles and applications*. John Wiley & Sons.
6. Government of Rajasthan. (2024). *Hanumangarh district statistical handbook*. Directorate of Economics and Statistics, Government of Rajasthan.
7. Harborne, J. B. (1998). *Phytochemical methods: A guide to modern techniques of plant analysis* (3rd ed.). Springer.
8. Jain, S. K. (1991). *Dictionary of Indian folk medicine and ethnobotany*. Deep Publications.
9. Jain, S. K. (2010). *Manual of ethnobotany* (2nd ed.). Scientific Publishers.
10. Kala, C. P. (2005). Indigenous uses, population density, and conservation of threatened medicinal plants in protected areas of the Indian Himalayas. *Conservation Biology, 19*(2), 368–378.
11. Katewa, S. S., Chaudhary, B. L., & Jain, A. (2004). Folk herbal medicines from tribal area of Rajasthan, India. *Journal of Ethnopharmacology, 92*(1), 41–46. https://doi.org/10.1016/j.jep.2004.02.010
12. Kirtikar, K. R., & Basu, B. D. (2019). *Indian medicinal plants* (Vol. 1). International Book Distributors.
13. Kokwaro, J. O. (2009). *Medicinal plants of East Africa* (3rd ed.). University of Nairobi Press.
14. Mahesh, B., & Satish, S. (2008). Antimicrobial activity of some important medicinal plant against plant and human pathogens. *World Journal of Agricultural Sciences, 4*(S), 839–843.
15. Martin, G. J. (1995). *Ethnobotany: A methods manual*. Chapman & Hall.
16. National Research Council. (1992). *Neem: A tree for solving global problems*. National Academy Press.
17. Pandey, G., Verma, K. K., & Singh, M. (2014). Evaluation of phytochemical, antibacterial and free radical scavenging properties of neem (*Azadirachta indica*). *International Journal of Pharmacy and Pharmaceutical Sciences, 6*(2), 444–447.
18. Parrotta, J. A. (2001). *Healing plants of peninsular India*. CABI Publishing.
19. Rathore, S. S., Shekhawat, N. S., & Singh, R. P. (2017). Ethnomedicinal practices among rural communities of Rajasthan: A review. *Indian Journal of Traditional Knowledge, 16*(4), 618–627.
20. Sharma, P., & Kumar, V. (2021). Traditional medicinal knowledge and ethnobotanical practices in rural Rajasthan. *Indian Journal of Traditional Knowledge, 20*(3), 712–721.

21. Singh, R., & Sharma, P. (2018). Traditional agricultural practices and medicinal plant utilization in north-western Rajasthan. *Journal of Rural Development Studies, 34*(2), 112–126.
22. Subapriya, R., & Nagini, S. (2005). Medicinal properties of neem leaves: A review. *Current Medicinal Chemistry—Anti-Cancer Agents, 5*(2), 149–156. https://doi.org/10.2174/1568011053174828
23. Tiwari, P., Kumar, B., Kaur, M., Kaur, G., & Kaur, H. (2011). Phytochemical screening and extraction: A review. *Internationale Pharmaceutica Sciencia, 1*(1), 98–106.
24. Trease, G. E., & Evans, W. C. (2009). *Trease and Evans pharmacognosy* (16th ed.). Saunders Elsevier.
25. Verma, S., Singh, S. P., & Sharma, A. (2019). Traditional medicinal plants used in arid regions of Rajasthan and their therapeutic significance. *International Journal of Herbal Medicine, 7*(3), 45–52.
26. WHO. (2013). *WHO traditional medicine strategy 2014–2023*. World Health Organization.
27. Wolinsky, L. E., Mania, S., Nachnani, S., & Ling, S. (1996). The inhibiting effect of aqueous *Azadirachta indica* (Neem) extract upon bacterial properties influencing in vitro plaque formation. *Journal of Dental Research, 75*(2), 816–822.
28. Yadav, S. S., Sharma, M., & Gupta, P. (2020). Ethnobotanical documentation of medicinal plants used by rural populations in Rajasthan. *Journal of Medicinal Plants Studies, 8*(5), 112–119.