The Bioscan
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
2020(3): S.I (3), 934-937, 2025 www.thebioscan.com

AN OVERVIEW OF COMMON HERBS AND SPICES IN INDIAN CULINARY PRACTICES

Suganthi S [1], Monish Raj R [2], B Devasena[3], Pradeepa A K[4], Paranthaman [5]

[1]Department of Electrical and Electronics, PERI Institute of Technology, Chennai-48

[2]Department of Pharmacy, PERI College of Pharmacy, Chennai-48

[3]Department of Physiotherapy, PERI College of Physiotherapy, Chemnai-600048

[4]Department of Nursing, PERI College of Nursing – Chennai-600048

[,5]Department of Microbiology, PERI College of Arts and Science, Chennai-48.

Corresponding mail id: publications@peri.ac.in

DOI: 10.63001/tbs. 2025.v20.i03.S.I(3).pp934-937

KEYWORDS
Indian cuisine, herbs, spices, phytochemicals, functional food, culinary practices, bioactive compounds, antioxidant, food technology
Received on:

20-07-2025

Accepted on:

18-08-2025

Published on:

24-09-2025

ABSTRACT

Indian culinary practices are deeply rooted in the use of a diverse array of herbs and spices, which not only contribute to flavor and aroma but also offer significant nutritional, therapeutic, and preservative properties. This review explores the historical, cultural, and functional significance of herbs and spices widely used in Indian cooking. Drawing from recent phytochemical, nutritional, and technological studies, the paper highlights the bioactive compounds responsible for the antioxidant, anti-inflammatory, antimicrobial, and metabolic regulatory activities of these culinary agents. Additionally, modern innovations in spice processing and quality control, along with emerging applications in AI-driven food systems, are discussed. The review emphasizes the growing relevance of these natural ingredients in enhancing food safety, promoting health, and preserving cultural culinary heritage. By consolidating findings from 25 key research papers, this work offers a comprehensive perspective on the evolving role of herbs and spices in Indian gastronomy.

INTRODUCTION

India, often referred to as the land of spices, boasts a rich culinary heritage where herbs and spices play a central role in defining the flavor, aroma, and identity of regional dishes. Beyond their sensory attributes, these natural ingredients have been revered for centuries in traditional medicine systems like Ayurveda and Siddha for their healing and preventive properties. From turmeric's anti-inflammatory action to cumin's digestive benefits, each spice holds cultural, nutritional, and pharmacological significance.

In recent years, there has been a resurgence of scientific interest in these age-old culinary components, particularly due to their bioactive constituents such as flavonoids, phenolics, alkaloids, and essential oils. These compounds exhibit a wide range of health benefits, including antioxidant, antimicrobial, antidiabetic, and cardioprotective effects. As consumers increasingly seek natural, plant-based alternatives in food and medicine, the integration of herbs and spices into functional food systems has gained momentum.

Furthermore, advancements in processing technologies and analytical tools have enhanced the safety, authenticity, and quality of spice products. At the same time, AI and data-driven models are providing novel insights into food pairing principles and ingredient interactions in Indian cuisine. This review aims to consolidate current knowledge on the phytochemical properties, culinary roles, health benefits, and industrial applications of common Indian herbs and spices, offering a holistic view of their importance in contemporary food science and public health.

2. OVERVIEW

Herbs and spices are integral to Indian culinary traditions, playing a vital role in shaping the flavor, aroma, and nutritional value of food. India is globally recognized as both a major producer and consumer of a wide array of spices such as turmeric, cumin, coriander, black pepper, cardamom, and many others. These ingredients are not only essential for taste enhancement but also contribute significantly to food preservation, digestion, and disease prevention.

Traditionally, Indian households have relied on the therapeutic properties of spices, rooted in ancient medicinal systems like Ayurveda, to maintain health and treat common ailments. In modern contexts, these spices are gaining renewed scientific attention due to their rich phytochemical content and potential as functional food components. Key bioactive compounds such as curcumin (turmeric), piperine (black pepper), eugenol (clove), and gingerol (ginger) exhibit antioxidant, antimicrobial, anti-

inflammatory, and metabolic regulatory activities, making them valuable in preventive nutrition and pharmacology.

Furthermore, recent advancements in spice processing technologies—such as cryogenic grinding and infrared spectroscopy—have improved the safety, quality, and efficacy of spice products. Meanwhile, digital innovations, including AI-based recipe systems and food pairing analyses, are reshaping how spices are understood and used in culinary science.

This review consolidates findings from scientific literature covering the historical background, phytochemical profiles, culinary applications, health benefits, technological processing methods, and contemporary innovations involving Indian herbs and spices. It offers a multidimensional perspective on how these natural agents contribute to food systems, healthcare, and cultural continuity.

2.1 HISTORICAL AND CULTURAL RELEVANCE

Spices have played a profound role in shaping Indian civilization, from influencing ancient trade routes to defining regional identities through cuisine. According to Tripathi [5], spices like turmeric, cardamom, and pepper were not only culinary agents but also commodities of high religious and medicinal value. The traditional Indian kitchen reflectscenturies of knowledge where food was intertwined with healing and seasonal adaptations. Chattopadhyay and Bhattacharyya [15] emphasized that many herbal spices were used as early food preservatives, demonstrating deep-rooted scientific foresight in traditional culinary wisdom. The Ebers Papyrus and Ayurveda both reference herbs such as cumin and fennel, establishing their longevity in therapeutic and ritualistic use.

2.2 CULINARY APPLICATION AND FOOD PAIRING

The science of food pairing in Indian cuisine, as revealed by Jain et al. [4], shows a strong reliance on spices to create contrasting flavor combinations. Their research suggested that Indian recipes avoid overlapping flavor compounds, instead leveraging the unique phytochemistry of each spice. This principle, known as "negative food pairing," is exemplified in dishes like garam masala, where ingredients are distinct yet complementary. The INDoRI dataset developed by Khanna et al. [6] provides a comprehensive framework to study how ingredients interact across regional cuisines, enhancing our understanding of food design in Indian gastronomy. Such data-driven insights are valuable for chefs, nutritionists, and food technologists alike.

Table 1: Common Herbs and Spices in Indian Culinary Practices and Their Culinary Uses

Herb/Spice	Botanical Name	Part Used	Culinary Application
Turmeric	Curcuma longa	Rhizome	Curries, rice dishes, pickles
Cumin	Cuminum cyminum	Seeds	Spice blends, tadka, stews
Coriander	Coriandrum sativum	Seeds, leaves	Garnish, spice blends, chutneys
Cardamom	Elettaria cardamomum	Pods, seeds	Desserts, chai, rice dishes
Clove	Syzygium aromaticum	Flower buds	Spice mixes, biryani, meat marinades
Black Pepper	Piper nigrum	Dried berries	Curries, rasam, spice blends
Ginger	Zingiber officinale	Rhizome	Curries, masala chai, gravies
Fenugreek	Trigonella foenum-graecum	Seeds, leaves	Curries, lentils, pickles
Mustard	Brassica juncea	Seeds	Tadka, pickling, regional spice pastes
Asafoetida	Ferula assafoetida	Resin	Lentils, tempering (especially in South India)

2.3FUNCTIONAL AND NUTRACEUTICAL BENEFITS

Spices are increasingly recognized not only for their taste but also for their role in disease prevention and health promotion. Kaur et al. [1] and Sharma [10] documented that herbs and spices contain high levels of antioxidants, polyphenols, flavonoids, and volatile oils. These bioactive constituents help reduce oxidative stress and inflammation, supporting immune function and reducing the risk of chronic diseases. Singh et al. [11] focused on cinnamon's antimicrobial and anti-diabetic properties, while Wani and Kumar [12] demonstrated fenugreek's impact on glucose regulation and gastrointestinal health. Such properties have led to the integration of spices into functional food formulations and dietary supplements.

Table 3: Health Benefits of Indian Herbs and Spices

Spice/Herb	Health Benefit	References
Turmeric	Reduces inflammation and joint pain	[1], [10], [11]
Cumin	Enhances digestion, antioxidant activity	[5], [8]
Fenugreek	Improves insulin sensitivity, reduces cholesterol	[9], [12], [20]
Clove	Natural antiseptic, relieves dental pain	[16], [23]
Black Pepper	Improves metabolism, supports respiratory health	[11], [23]
Cinnamon	Lowers blood sugar levels	[11], [13]
Ginger	Alleviates nausea and gastrointestinal discomfort	[1], [10]
Garlic	Cardiovascular support, antimicrobial action	[9], [23]

Spice/Herb	Health Benefit	References
Mustard	Detoxifies body, stimulates appetite	[12], [24]
Coriander	Relieves bloating and improves digestion	[3], [5], [9]

2.4 PHYTOCHEMICAL AND ANTIOXIDANT ACTIVITY

The phytochemical complexity of spices contributes significantly to their therapeutic properties. Shareef et al. [2] conducted in-depth phytochemical screenings of Ayurvedic remedies and found that compounds like curcumin, eugenol, and thymoquinone exhibit notable anticancer, antidiabetic, and antimicrobial effects. Rubió et al. [16] reviewed antioxidant and anti-inflammatory compounds in herbs, emphasizing their role in combating metabolic syndromes and aging. Advanced techniques like FTIR and UV-Vis spectroscopy, as noted by Kaavya et al. [18], are now being used to quantify these bioactives, allowing for more precise application in nutraceutical product development.

2.5 TECHNOLOGICAL INNOVATIONS IN SPICE PROCESSING

With increasing demand for quality and safety, modern processing technologies have revolutionized spice preservation. Cryogenic grinding, as described by Saxena et al. [14] and Balasubramanian et al. [17], helps retain volatile oils and aroma by minimizing heat exposure. Such methods are crucial for sensitive compounds like menthol and capsaicin. Oliveira et al. [13] discussed the use of non-targeted analytical tools such as NIR spectroscopy for authenticity verification, essential for combating spice adulteration. These technological advancements not only improve product quality but also support traceability and standardization in global spice markets.

Table 2: Major Bioactive Compounds Present in Common Spices

Herb/Spice	Major Bioactive Compounds	Biological Property
Turmeric	Curcumin	Antioxidant, anti-inflammatory
Black Pepper	Piperine	Enhances nutrient absorption, anti-cancer
Ginger	Gingerol, shogaol	Anti-inflammatory, nausea relief
Cinnamon	Cinnamaldehyde	Antidiabetic, antimicrobial
Clove	Eugenol	Antimicrobial, analgesic
Fenugreek	Diosgenin, galactomannan	Blood sugar regulation
Garlic	Allicin	Antibacterial, cardioprotective
Coriander	Linalool, borneol	Digestive stimulant, antimicrobial
Mustard	Glucosinolates, isothiocyanates	Antioxidant, cancer-preventive
Cardamom	Cineole, alpha-terpineol	Gastroprotective, anti-inflammatory

2.6OBESITY AND METABOLIC HEALTH

Spices like turmeric, black pepper, and ginger have demonstrated anti-obesity effects by modulating lipid metabolism, improving insulin sensitivity, and reducing inflammation [8]. Manodra and Singh [9] elaborated on the therapeutic effects of spices in metabolic syndromes and gastrointestinal health. With the rise in non-communicable diseases, incorporating these culinary agents into daily diets presents a sustainable and culturally appropriate health intervention.

2.7 AI AND MACHINE LEARNING IN CULINARY INFORMATICS

Emerging technologies such as AI and machine learning are now being applied to analyze, classify, and recommend Indian recipes based on spice profiles. Nilesh et al. [19] developed an AI-based cuisine recommendation engine, while Arvindaraj et al. [22] implemented a smart ingredient planner using ML algorithms. Kadiwal et al. [21] employed CNNs to identify medicinal plant species, promoting digital herbariums and biodiversity research. These innovations bridge tradition and technology, helping preserve culinary heritage while modernizing its application.

2.8. GLOBAL AND INDUSTRIAL PERSPECTIVES

Globally, spices are valued not just for flavor but also for their role in food preservation and wellness. Myszka et al. [23] highlighted pepper essential oil's effectiveness as a natural antimicrobial agent. Salgueiro et al. [24] addressed concerns about raw material quality and contamination risks in the spice industry. Goshme and Ayele [25] provided a socioeconomic perspective, noting production and marketing challenges in spice-exporting countries like Ethiopia—paralleling issues in Indian spice trade dynamics.

2.9 QUALITY, SAFETY, AND STANDARDIZATION

Standardizing spice quality is vital for both domestic use and export. Peter [reference in original paper] emphasized the need for regulatory frameworks to prevent adulteration and ensure consistency. Kaavya et al. [18] noted the importance of infrared-based quality assessment in modern quality assurance systems. These approaches ensure that spices retain their therapeutic potency while meeting safety standards.

CONSLUSION

This comprehensive review underscores the multifaceted value of herbs and spices in Indian culinary traditions. Beyond flavor, they represent an intersection of culture, nutrition, medicine, and technology. The literature highlights their historical significance, functional bioactivities, and evolving role in modern health science and food systems. With the advancement in analytical and AI-based tools, their potential can be harnessed more effectively to enhance both public health and global culinary innovation. Future research should focus on sustainable cultivation, standardized processing, and clinical validation of health claims to unlock their full potential.

REFERENCES

- R. Kaur, S. Zhang, B. Berwal et al., “From Phytochemicals to Recipes: Health Indications and Culinary Uses of Herbs and Spices,” arXiv preprint arXiv:2410.17286, Oct. 2024.
- T. H. M. Ahadu Shareef, I. Navabshan, M. D. Masood et al., “Investigation of phytochemicals of chosen Ayurvedic remedies,” arXiv preprint arXiv:2412.17005, Dec. 2024.
- “Traditional Indian spices and their health significance,” Asia Pac. J. Clin. Nutr., vol. 17, Suppl. 1, 2008.
- A. Jain, R. N. K., and G. Bagler, “Spices form the basis of food pairing in Indian cuisine,” arXiv preprint arXiv:1502.03815, Feb. 2015.
- R. Tripathi, “Spices in Indian history: A multifaceted exploration of trade, medicine and religious practices,” *Int. J. All Res.**, vol. 10, no. 8A, pp. 4–11, 2024.
- S. Khanna, C. Chattopadhyay, and S. Kundu, “INDoRI: Indian Dataset of Recipes and Ingredients and its Ingredient Network,” arXiv preprint arXiv:2309.10403, Sep. 2023.
- “Herbs and spices as functional food ingredients: mechanisms and applications,” Trends in Food Scie. & Tech., 2025.
- “Effects of culinary herbs and spices on obesity,” Food Quality and Safety, 2021.
- R. Manodra and S. P. Singh, “A review on clinical application of Indian spices,” Biochem. J., vol. 8, no. 3S, 2024, doi: 10.33545/26174693.2024.v8.i3Sa.706.
- M. Sharma, “A review on herbs, spices and functional food used in diseases,” Int. J. Res. Rev., vol. 4, issue 1, Jan. 2017.
- Singh, N., Rao, A. S., Nandal, A., Kumar, S., Yadav, S. S., Ganaie, S. A., & Narasimhan, B. (2021). Phytochemical and pharmacological review of Cinnamomum verum J. Presl-a versatile spice used in food and nutrition. Food Chemistry, 338, 127773.
- Wani, S. A., & Kumar, P. (2018). Fenugreek: A review on its nutraceutical properties and utilization in various food products. Journal of the Saudi Society of Agricultural Sciences, 17(2), 97-106.
- Oliveira, M. M., Cruz-Tirado, J. P., & Barbin, D. F. (2019). Nontargeted analytical methods as a powerful tool for the authentication of spices and herbs: A review. Comprehensive reviews in food science and food safety, 18(3), 670-689.
- Saxena, S. N., Barnwal, P., Balasubramanian, S., Yadav, D. N., Lal, G., & Singh, K. K. (2018). Cryogenic grinding for better aroma retention and improved quality of Indian spices and herbs: A review. Journal of Food Process Engineering, 41(6), e12826.
- Chattopadhyay, R. R., & Bhattacharyya, S. K. (2007). Phcog Rev.: Review Article Herbal spices as alternative antimicrobial food preservatives: An update. Pharmacogn. Rev, 1, 3-5.
- Rubió, L., Motilva, M. J., & Romero, M. P. (2013). Recent advances in biologically active compounds in herbs and spices: a review of the most effective antioxidant and anti-inflammatory active.
- Balasubramanian, S., Gupta, M. K., & Singh, K. K. (2012). Cryogenics and its application with reference to spice grinding: a review. Critical reviews in food science and nutrition, 52(9), 781-794.
- Kaavya, R., Pandiselvam, R., Mohammed, M., Dakshayani, R., Kothakota, A., Ramesh, S. V., ... & Ashokkumar, C. (2020). Application of infrared spectroscopy techniques for the assessment of quality and safety in spices: a review. Applied Spectroscopy Reviews, 55(7), 593-611.
- N. Nilesh, M. Kumari, P. Hazarika and V. Raman, "Recommendation of Indian Cuisine Recipes Based on Ingredients," 2019 IEEE 35th International Conference on Data Engineering Workshops (ICDEW), Macao, China, 2019, pp. 96-99, doi: 10.1109/ICDEW.2019.00-28.
- R. Sharma and J. Sohal, "Empowering Indian Agriculture: Fenugreek Variety Classification through CNN and Ensemble Learning," 2024 15th International Conference on Computing Communication and Networking Technologies (ICCCNT), Kamand, India, 2024, pp. 1-5, doi: 10.1109/ICCCNT61001.2024.10725067.
- S. M. Kadiwal, V. Hegde, N. Shrivathsa, S. Gowrishankar, A. H. Srinivasa and A. Veena, "Deep Learning based Recognition of the Indian Medicinal Plant Species," 2022 4th International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2022, pp. 762-767, doi: 10.1109/ICIRCA54612.2022.9985746.
- G. Arvindaraj, B. Manikandan, R. Rokesh and M. Abinaya, "AI-Automated System for Ingredient Planner using Machine Learning Algorithms," 2023 7th International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Kirtipur, Nepal, 2023, pp. 511-515, doi: 10.1109/I-SMAC58438.2023.10290305.
- Myszka, K., Leja, K., & Majcher, M. (2019). A current opinion on the antimicrobial importance of popular pepper essential oil and its application in food industry. Journal of Essential Oil Research, 31(1), 1-18.
- Salgueiro, L., Martins, A. P., & Correia, H. (2010). Raw materials: the importance of quality and safety. A review. Flavour and Fragrance Journal, 25(5), 253-271.
- Goshme, D., & Ayele, T. (2019). Factors affecting production and marketing of spices in Ethiopia: A review. International Journal of Forestry and Horticulture (IJFH), 5(2), 14-18.