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Therapeutic potential of Indian spices as nutraceuticals: Ayurvedic & modern perspective

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Abstract
Indian spices have been an integral part of traditional medicine system, particularly Ayurveda, where they are used not only for their flavor enhancing properties but also for their profound therapeutic value. These species act as natural nutraceuticals. Ayurveda recognizes spices like *Haridra* (Turmeric),*Marich* (Black pepper), *Shunthi* (Ginger), *Twak* (Cinnamon), *Ela* (Cardamom) and other for their *Rasayana* (Rejuvenatin) & disease preventing qualities. They helps for balancing *Doshas*, enhance digestion (*Agni*) & support immunity (*Oja*).
Modern research supports these traditional uses demonstrating their anti-inflammatory, antioxidant, antimicrobial & immunomodulatory properties. These spices contribute to health maintenance by improving metabolic function, digestion & detoxification. In diseased condition, they serve as adjunct therapies in managing respiratory disorders, cardiovascular diseases & inflammatory conditions. This paper highlights the dual role of Indian spices as nutraceuticals, emphasizing their relevance in preventive health care & therapeutic applications through both Ayurvedic and modern scientific perspective.

Keywords: Indian spices, nutraceuticals, ayurvedic properties, pharmacological activities

Introduction
Spices have played a vital role in Indian culture for thousands of years, not only as culinary ingredients but also as therapeutic agents. In Ayurveda spices are recognized for their ability to balance three *doshas*, enhance digestion (*Agni*) & strengthen immunity (*Ojas*).
In recent decades the concept nutraceuticals has brought renewed scientific attention to these traditional ingredients. Many studies have confirmed the pharmacological action of Indian spices. These bioactive compound not only support health maintenance but also assist in managing chronic disease like respiratory illness, diabetes, cardiovascular disorders & digestive disturbances.
Indian spices can be considered functional foods that bridge the gap between nutrition & medicine. Integrating traditional wisdom with modern insight this review underscores the relevance of Indian spices in preventive & holistic healthcare.

Material & Method
A comprehensive review of various Ayurvedic texts, modern literature, journals, & scientific publications concerning nutraceuticals & their role in Ayurveda was conducted. The collected data were systematically complied, analyzed & discussed.

Classification of Nutraceuticals [1]
Nutraceuticals is a broad term it means substance that is a food or part of food that provides medical or healthy benefits, including the prevention & treatment of disease. It may include isolated nutrients, dietary supplements, herbal products, specific diets, or processed food.
Nutraceuticals are classified as-
1. Dietary supplements
2. Functional foods
3. Recombinant food
4. Medical foods

Table 1: Classification of nutraceuticals

Category	Definition	Examples
Dietary Supplements	Dietary Supplements	a) **Nutrients** - Vitamins, minerals, amino acids, fatty acids, antioxidants. b) **Herbals** - Derived from medicinal plants, provide nutrition + therapeutic effects. c) **Phytochemicals** - Polyphenols, flavonoids, terpenoids, carotenoids, alkaloids, tannins, phytosterols (disease-protective). d) **Probiotics** - Live microbes that improve gut balance. e) **Prebiotics** - Non-digestible carbs (inulin, pectin, garlic); support beneficial gut bacteria, reduce diarrhea, improve mineral absorption. f) **Enzymes** - Help manage hypoglycemia, hyperglycemia, digestive problems, obesity. g) **Dietary Fibers** - Cellulose, hemicellulose, pectin, lignin; slow gastric emptying, improve satiety, gut health.
Functional Foods	Ordinary foods fortified with components that provide medical or health benefits beyond basic nutrition	Milk fortified with vitamin D, iron-fortified milk powders, Cereals flour added with fiber and folic acid, Soy protein (cholesterol-lowering)
Recombinant Nutraceuticals	Products obtained from genetically engineered crops with enhanced nutritional or therapeutic properties.	Golden rice (rich in β-carotene).
Medical Foods	Specially formulated foods for dietary management of specific diseases, consumed under medical supervision. Regulated by FDA.	Formulas for metabolic disorders, nutrition supplements.

Spices in functional food and Nutraceuticals

Spices are unique food ingredients that have traditionally been used to add color, flavor, and preserve food. For centuries, they have also been recognized for their healing and medicinal value. Their role in traditional healing systems has been well established. In recent years, scientific research has paid more attention to their health promoting properties due to advances in spice processing, as well as better understanding of their chemical composition and therapeutic compounds.

Many of these commonly used spices have been shown positive health effect in human and animal studies. These includes antioxidant property, ant diabetic property, digestive stimulating property, ant carcinogenic property, anti-inflammatory potential, etc. Some spices specially possess antioxidant property which offers significant health advantages and support treatment for many diseases.

These properties make spices important in the field of nutraceuticals. A variety of Indian spices - like cinnamon, clove, black pepper, cardamom, fenugreek, garlic, ginger, turmeric are now being studied and used not only in cooking but also in disease prevention and health improvement as nutraceuticals agent.

In the present review, the nutritive value and pharmacological activities of selected Indian spices are summarized. For clarity, only ten commonly used spices- Rason (*Allium sativum*), *Jeeraka (Cumium cyminum), Dhanyak (Coriandrum sativum), Marich (Piper nigrum), Haridra (Curcuma longa), Lavang (Syzygium aromaticum), Shunthi (Zingiber officinale), Methika (Trigonella foenum-graecum), Jatiphala (Myristica fragrans) and Ela (Elettaria cardamomum)* have been included, and their details are presented in the following tables.

Each spice is discussed with respect to its proximate composition (carbohydrate, protein, fat, and energy), vitamin and mineral content, along with its pharmacological properties reported in the literature. This focused selection provides a representative overview without attempting an exhaustive account of all spices.

Table 2: Showing Ayurvedic properties of selected Indian spices [2]

Dravya	***Guna***	***Rasa***	***Vipaka***	***Virya***	***Karma***
Rason (Allium sativum)	*Tikshna,Singdha*	*Katu*	*Katu*	*Ushna*	*Brihana, Vrushya,Varnakara, Kanthya, Medhya, Rasayana*
Jeeraka (Cumium cyminum)	*Ruksha, Laghu*	*Katu*	*Katu*	*Ushna*	*Pachan, Grahi, Medhya, Vrushya, Balya, Chakshushya, Garbhashayashudhhikar*
Dhanyak (Coriandrum sativum)	*Laghu, Singdha*	*Kashaya, Tikta, Madhura Katu*	*Madhura*	*Ushna*	*Deepan, Grahi, Rochana, Jwarghna, Krumighna, Vrushya, Mutral*
Marich (Piper nigrum)	*Tikshna, Ruksha, Laghu*	*Katu*	*Katu*	*Ushna*	*Deepana,Krimihara,shoolhara, swashara*
Haridra (Curcuma longa)	*Ruksha, Laghu*	*Katu, Tikta*	*Katu*	*Ushna*	*Varnya, Vranaropak, Mehaghna, Vishaghna, Kandughna*
Lavang (Syzygium aromaticum)	*Laghu, Singdha*	*Katu, Tikta*	*Katu*	*Sheet*	*Deepana, Pachana, Rochana, Shoolnashak, Chardi vinashak*
Shunthi (Zingiber officinale)	*Laghu, Singdha*	*Katu*	*Madhura*	*Ushna*	*Pachan, Vrushya, Swarya, Shoolprashaman*
Ardak (Zingiber officinale)	*Guru, Ruksha, Tikshna*	*Katu*	*Katu*	*Ushna*	*Bhedan, Deepana*
Methika (Trigonella foenum-graecum)	*Laghu, Singdha*	*Katu*	*Katu*	*Ushna*	*Deepan, Arochakahara, Jwarnashini*
Jatiphala (Myristica fragrans)	*Laghu, Tikshna*	*Tikta, Katu*	*Katu*	*Ushna*	*Rochan,Grahi, Swarya, Krumighna*
Ela (Elettaria cardamomum)	*Laghu, Ruksha*	*Katu, Madhura*	*Madhura*	*Sheet*	*Rochan, Deepana, Hrudya, Kaas-shwasghni*

Table 3: Showing macronutrient profile of selected Indian spices [3]

Dravya	**Carbohydrate**	**Protein**	**Fat**	**Total Fiber**	**Energy(KJ)**
Rason (Allium sativum)	21.93±0.82	6.92±0.26	0.16± 0.04	5.22± 0.41	518±12
Jeeraka (Cumium cyminum)	22.62±1.05	13.91±0.51	16.64±0.15	30.35±0.71	1274±19
Dhanyak (Coriandrum sativum)	12.98±2.62	10.66±0.33	17.47±0.22	44.81±2.36	1125±38
Marich (Piper nigrum)	36.22±0.45	10.12±2.36	2.74±0.02	33.160.29	9910±8
Haridra (Curcuma longa)	49.22±0.55	7.66±0.44	5.03±0.07	21.38±0.29	1174±7
Lavang (Syzygium aromaticum)	18.73±0.39	5.86±0.21	8.41±0.15	34.52±0.48	781±6
Shunthi (Zingiber officinale)	8.97±0.28	2.22±0.16	0.85±0.03	5.36±0.40	230±4
Methika (Trigonella foenum-graecum)	10.57±0.57	25.41±0.24	5.72±0.02	47.55±0.54	983±10
Jatiphala (Myristica fragrans)	27.64±0.70	6.30±0.24	36.52±0.04	11.999±0.18	1940±11
Ela (Elettaria cardamomum)	47.76±0.47	8.10±0.41	2.60±0.15	23.10±0.14	1076±16

*All values are expressed per 100 g of edible portion.

Table 4: Showing Vitamin profile of selected Indian spices [3]

Dravya	Vit. B1	Vit. B2	Vit. B3	Vit. B5	Vit. B6	Vit. B7	Vit. B9	Vit. E	Vit. K1
Rason (Allium sativum)	0.20±0.029	0.25±0.0026	0.38±0.05	1.57±0.16	0.56±0.039	2.55±0.34	85.77±15.61	1.88±0.37	2.80±1.70
Jeeraka (Cumium cyminum)	0.52±0.05	0.13±0.022	2.87±0.38	0.22±0.01	0.39±0.010	1.20±0.22	27.79±2.55	1.49±0.05	146±2.2
Dhanyak (Coriandrum sativum)	0.19±0.018	0.23±0.022	1.20±0.16	0.28±0.02	0.04±0.002	1.46±0.34	22.07±4.23	0.91±0.07	35.70±2.52
Marich (Piper nigrum)	0.06±0.012	0.09±0.013	0.85±0.02	0.30±0.03	0.27±0.013	3.49±0.38	21.89±2.08	0.59±0.15	171±31.5
Haridra (Curcuma longa)	0.06±0.004	0.01±0.00	1.55±0.10	0.13±0.02	0.13±0.006	0.76±0.14	13.86±2.38	2.63±0.67	12.80±1.26
Lavang *(Syzygium aromaticum)*	0.53±0.122	0.22±0.022	1.15±0.12	0.36±0.03	0.03±0.003	2.41±0.23	32.81±1.90	0.46±0.21	161±36.7
Adrak *(Zingiber officinale)*	0.04±0.005	0.04±0.003	0.42±0.05	0.24±0.02	0.02±0.025	1.07±0.15	10.82±1.61	0.28±0.03	25.55±2.45
Methika (Trigonella foenum-graecum)	0.28±0.029	0.14±0.026	1.19±0.10	0.27±0.03	0.77±0.128	1.54±0.29	51.11±4.69	0.02±0.00	1.50±0.84
Jatiphala (Myristica fragrans)	0.04±0.015	0.05±0.011	0.51±0.06	0.33±0.06	0.10±0.008	1.59±0.27	74.78±6.70	1.18±0.07	60.92±1.42
Ela (Elettaria cardamomum)	0.12±0.016	0.07±0.013	1.13±0.13	0.27±0.05	0.15±0.007	4.94±0.39	2.85±1.05	0.14±0.02	6.81±0.55

*All values are expressed per 100 g of edible portion.

Table 5: Showing Mineral Composition of selected Indian spices.

Dravya	**Mg**	**P**	**K**	**Na**	**Zn**	**Ca**	**Fe**
Rason (Allium sativum)	0.05±0.02	119±10.9	430±84	9.42±0.07	0.89±0.18	20.08±5.73	1.05±0.15
Jeeraka *(Cumium cyminum)*	442±65.7	382±6.4	1886±139	125±31.1	4.29±0.23	878±78.0	20.58±4.24
Dhanyak (Coriandrum sativum)	343±25.5	293±54.4	1473±59.2	34.41±0.39	3.91±0.32	718±43.0	17.64±6.74
Marich (Piper nigrum)	196±68.8	144±14.8	1487±178	24.08±3.85	1.24±0.43	405±40.9	11.91±3.48
Haridra (Curcuma longa)	260±16.2	276±33.1	2374±172	24.41±2.48	2.64±0.25	122±20.9	46.08±1.83
Lavang (Syzygium aromaticum)	334±42.2	83.10±18.56	1434±86.6	183±23.9	1.13±0.14	567±70.8	9.41±2.10
Shunthi (Zingiber officinale)	54.66±7.12	44.36±2.16	407±49.5	10.03±1.91	0.39±0.17	18.88±2.87	1.90±0.55
Methika (Trigonella foenum-graecum)	167±35.6	435±115	891±11.5	40.20±0.06	3.80±0.93	135±17.2	8.47±1.90
Jatiphala (Myristica fragrans)	212±25.0	207±37.2	474±15.2	14.31±0.28	1.45±0.10	148±12.1	2.33±0.20
Ela (Elettaria cardamomum)	7.76±1.45	132±14.8	1262±14.4	15.51±0.70	3.71±0.31	378±40.7	8.33±1.44

*All values are expressed per 100 g of edible portion.

Table 6: Showing active constituent and pharmacological activity of selected Indian spices

Dravya	**Active constituent**	**Pharmacological Activity**
Rason (Allium sativum)	Allicin	1. Antibacterial effect [4] 2. Antifungal effect [5] 3. Antioxidant effect [5] 4. Antiviral effect [6] 5. Antiprotozoal effect [7] 6. Immunomodulatory effect [8] 7. Anti-inflammatory effect [9] 8. Anti-cancer effect [10] 9. Anti-obesity and Hypolipidemic effect [11] 10. Anti-diabetic effect [12] 11. Anti- atherosclerotic [13] 12. Antithrombotic effect [14] 13. Antihypertensive effect [15]
Jeeraka (Cumium cyminum)	Cuminaldehyde Pyrazines	1. Anti-microbial effect [16, 17] 2. Anti-diabetic effect [18] 3. Hypolipidemic & weight reduction effect [19, 20] 4. Anti-cancer effect [21] 5. Anti-oxidant effect [22] 6. Antihypertensive effect [23] 7. Anti-inflammatory & analgesic activity [24, 25]

		8. Anti-stress and Memory enhancing effect [26] 9. Anti-ulcer activity [27] 10. Anti-diarrheal activity [28] 11. Hepatoprotective effect [29] 12. Nephroprotective effect [30] 13. Antitussive effect [31] 14. Immunomodulatory effect [32]
Dhanyak (Coriandrum sativum)	Citronelol	1. Anxiolytic effect [33] 2. Anticonvulsant effect [34] 3. Neuroprotective effect [35] 4. Antibacterial, antifungal, anthelmintic & insecticidal effect [36, 37, 38] 5. Antioxidant effect [39] 6. Anticancer effect [40] 7. Hypolipidemic effect [41] 8. Anti-inflammatory [42] 9. Analgesic activity [43] 10. Anti-diabetic effect [44] 11. Cardio protective effect [45] 12. Hepato-protective effect [46] 13. Diuretic effect [47]
Marich (Piper nigrum)	Piperine	1. Antioxidant activity, Antibacterial activity, Antimutagenic activity [48] 2. Analgesic potential, Anti-inflammatory activity [49] 3. Immunomodulatory potential [50] Hepatoprotective effect Antifungal activity [51] 4. Anti-convulsing activity [52] 5. Anti-obesity activity [53, 54] 6. Antidepressant,Anxiolytic, Antipyretic, Thrombolytic activity [55] 7. Bronchodilator effect [56]
Haridra (Curcuma longa)	Curcumin	1. Anti-inflammatory [57] 2. Anticancer activity [58] 3. Antioxidant activity [59] 4. Anti-microbial effect [60, 61] 5. Cardioprotective activity [62] 6. Hepatoprotective effect [63] 7. Anti-ulcer activity [64] 8. Anti-diabetic effect [65, 66] 9. Nephroprotective activity [67] 10. Anti-asthamatic activity [68] 11. Neuroprotective effect [69] 12. Radioprotective effect [70]
Lavang (Syzygium aromaticum)	Eugenol	1. Antimicrobial effect [71] 2. Anti-oxidant effect [72] 3. Antifungal acrivity [73] 4. Anti-inflammatory [74] 5. Anti-cancer effect [75] 6. Gastro protective activity [76] 7. Analgesic activity [77] 8. Hypolipidemic activity and Hepatoprotective activity [78] 9. Neuroprotective effect [79] 10. Immunomodulatory effect [80]
Shunthi (Zingiber officinale)	Gingerol	1. Anti-oxidant,Anti-cancer, Antimicrobial activity [81] 2. Anti-inflammatory activity [82, 83] 3. Analgesic, Hypoglycemic activity [84] 4. Anticoagulant effect [85] 5. Antiemetic activity [86, 87] 6. Cardiotonic effect [88] 7. Antitussive effect [89] 8. Immunomodulatory effect [90]

		9. Antidiabetic and Hypolipidemic effect [91] 10. Anti obesity effect [92] 11. Antiarthritic activity [93] 12. Radio protective activity [94] 13. Gastroprotective effect [95]
Methika (Trigonella foenum-graecum)	Saponins, 4-hydroxyisoleucine, Trigonelline, Galactomannan, Trigoneosides	1. Antidiabetic activity [96, 97] 2. Anti-oxidant effect [98] 3. Anticancer activity [99] 4. Anti-inflammatory activity [100] 5. Hypolipidemic, Antiobesity activity [101, 102, 103] 6. Gastroprotective effect [104] 7. Anti-microbial effect [105] 8. Hepatoprotective activity [106] 9. Anti-asthamatic activity [107, 108] 10. Anti-cataract activity [109, 110] 11. Cardioprotective effect [111] 12. Effective in treatment of PCOS [112]
Jatiphala (Myristica fragrans)	Eugenol, Myristicin	1. Anti-oxidant effect [113] 2. Radio protective activity [114] 3. Immunomodulatory effect [115] 4. Anti-bacterial effect [116] 5. Anti-inflammatory activity [117] 6. Anticancer activity [118] 7. Hepatoprotective activity [119] 8. Aphrodisiac activity [120] 9. Memory enhancing effect [121] 10. Anti-depressant activity [122] 11. Antidiarrheal activity [123] 12. Hypolipidemic effect [124] 13. Anti-diabetic effect [125] 14. Anticonvulsant effect [126]
Ela (Elettaria cardamomum)		1. Anti-inflammatory and anti-oxidant effects [127] 2. Antibacterial activity [128] 3. Cardioprotective effect [129] 4. Gastroprotective effect [130] 5. Anticancer activity [131] 6. Chemoprotective effect [132] 7. Immunomodulatory effect [50] 8. Anti-depressant activity [134] 9. Anxiolytic activity [135]

Discussion

The present review highlights the role of Indian spices as nutraceuticals, demonstrating that apart from enhancing flavor, they provide essential nutrients such as carbohydrates, proteins, fats, vitamins, and minerals, along with phytochemicals like flavonoids, terpenoids, and polyphenols that impart pharmacological activities. The selected nine spices show a wide range of health-promoting properties including antioxidant, anti-inflammatory, digestive, and respiratory protective effects, which align with both Ayurvedic concepts of Rasa, Guna, Virya, Vipaka, and Karma, as well as modern nutritional science. Although limited to ten spices, the findings emphasize their potential in preventing lifestyle-related disorders such as obesity, diabetes, and cardiovascular diseases, while promoting overall wellbeing, thus establishing them as valuable dietary components with therapeutic relevance.

Conclusion

Spices which are among the commonly used flavoring and aromatic agents in the human diet, are gaining increased recognition for their multifunctional roles. In addition to their traditional culinary use, they are now extensively explored for their nutritional and nutraceuticals benefits, especially in the development of functional foods and beverages. The bioactive compounds, often referred to as active principles for a range of pharmacological and therapeutic effects. These compounds have demonstrated potential in the prevention and management of several diseases, including metabolic, inflammatory and infectious conditions. Given their natural origin and low toxicity profile, spices can be safely incorporated in diet without adverse health effects. Despite their primary use as flavor enhancers, spices possess considerable health- promoting properties. Their long-standing inclusion in traditional diets now finds validation in modern scientific research, supporting their role as nutraceuticals.

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