

Harnessing Nutraceutical Potential and Market Opportunities of spice sector in India

India is redefining its historic legacy as the world's spice hub by pivoting from raw commodity exports to high-value, processed derivatives. Producing 12 million tonnes annually, the sector is undergoing a massive transformation driven by changing global consumer demands for wellness, sustainability, and quality assurance. The traditional export of ground powders is rapidly giving way to sophisticated, high-margin products like essential oils, oleoresins, nutraceuticals, and specialty ingredients. By blending innovation with advanced processing technology, India's spice value chain is unlocking immense economic wealth, ensuring global market premium pricing, and securing its position in modern agro-industrial development.

Keywords: Health and Nutrition; Nutraceutical Potential; Spices; Value addition

INDIA has been the world's spice hub for centuries. Today, the country produces approximately 12 million tonnes of spices annually on 4.69 million hectares, exporting around 1.8 million tonnes worth billions of rupees. However, India's spice sector is undergoing a significant transformation. The days of exporting raw spices and ground powders are gradually giving way to high-value processed products that command premium prices in global markets.

Modern consumers worldwide are no longer satisfied with spices as mere flavoring agents. They seek health benefits, guaranteed quality, consistent taste, and sustainable sourcing. This shift in consumer expectations is reshaping India's spice value chain from a commodity-based industry into a sophisticated, innovation-driven sector generating substantial wealth through value addition, particularly in oils, oleoresins, nutraceuticals, and specialty ingredients.

Understanding spice value addition in India

Value addition means transforming raw spices into refined, concentrated or processed products that fetch higher prices and serve diverse applications. The Indian spice sector's private industry is increasingly investing in advanced technologies to extract, concentrate, and process spice bioactives into premium products. This is happening across three major product categories:

- **Oils and oleoresins:** Concentrated extracts that preserve spice flavor and bioactive compounds in stable, shelf-stable forms.
- **Nutraceuticals and health supplements:** Spice-derived capsules, powders, and formulations targeting specific health benefits.
- **Specialty ingredients:** Flavoring compounds, natural colorants, and functional food ingredients for industrial applications.

The private sector boom: Oils and oleoresins leading the way

India's private spice processing industry has witnessed explosive growth in recent years, particularly in extracting and processing oils and oleoresins. These high-value products are the future of India's spice trade. Recent export data (2024-25) paints a clear picture of this transformation:

Leading value-added spice exports (2024-25): During 2024-25, India's spice exports achieved an all-time high, with total shipments valued at ₹39,99,448 lakh (₹17,99,267 tonnes), marking a 8.21% increase in value terms from 2023-24. Key value-added products like spice oils and oleoresins accounted for over ₹4,53,324 lakh in 2024-25, while chilli, turmeric, ginger and cumin constitute 41.54% of total export volume.

As processed oils and oleoresins command 3-5 times higher prices than raw spices, are shelf-stable without the need for extensive packaging, and can be directly used by food manufacturers, pharmaceutical companies, and

Top performing spice extracts in export during 2024-25

HS code	Commodity	Export (ton) 2024-25	Percentage growth
33019022	Chilli oleoresin	6015	18
33019014	Turmeric oleoresin	2129	-2
33012949	Turmeric oil	122.4	250
33019012	Ginger oleoresin	234	18
33012926	Ginger oil	39.06	8
33019024	Cumin oleoresin	138.2	43
33012945	Cumin oil	20.41	28

Source: Indiatat, 2025

cosmetic makers, the private firms are keen to invest in the spice extract based product.

Public sector interventions for spice value chain development

ICAR institutions, have significantly strengthened India's spice sector. ICAR-IISR has developed high-yielding varieties rich in bioactive compounds *viz.* curcumin, piperine, oleoresins, and essential oils, widely adopted by farmers and industries. Notable examples include IISR Prathibha turmeric, cultivated across India from Himachal Pradesh to Kanyakumari. The production technologies— micronutrient mixtures, crop management practices, plant protection formulations, and sustainable production methods have enhanced productivity and quality. Its research spans high-value varieties, post-harvest technologies, bioactives, and value-added product development. Several commercialized products demonstrate IISR's impact, most notably Golden Milk Mix through MILMA, which gained widespread acceptance during COVID-19. Currently, IISR is developing liquid oleoresin blends for culinary applications (Sambhar, rasam, paneer butter masala, tea mixes) to replace conventional powders, ensuring instant, uniform flavor, consistency, and quality in food preparation.

How India's spice value chain is evolving

Traditionally, India exported bulk quantities of raw, dried spices and simple ground powders. This commodity approach meant competing on volume and accepting low margins. Today's landscape is fundamentally different:

From bulk to extracts: Instead of exporting 1000 tonnes of raw turmeric, processors now extract and export concentrated turmeric oleoresin. The same bioactive compounds are preserved, but in a product 10 times more concentrated, requiring less storage space, no quarantine requirements, no microbial spoilage due to absence of moisture content and commanding premium prices.

From generic to specialized: Raw spice exports serve generic purposes. Value-added products serve specific industries. A pepper oleoresin supplier, for instance, can target meat processing units, spice blend manufacturers, or pharmaceutical companies, each willing to pay different premiums based on purity and specifications.

From domestic to global supply chains: Large multinational food, pharma, and cosmetic companies increasingly source oils and oleoresins from India rather than processing raw spices in-house. This has created a structured supply chain where quality, consistency, and documentation matter more than volume.

From seasonal to year-round production: Advanced extraction and processing technologies allow companies to process spices continuously, smoothing production cycles and ensuring consistent supply to global markets regardless of harvest seasons.

Technology advances and emerging trends in spice value-chains

To cope up with the changing scenario in the global market and ever changing consumer preferences the spice value chain systems has also emerged to shift its strategy to

match the global need. This can be summarised as follows:

Adaptation in production

- Climate-smart production through GIS mapping and precision farming for optimized resource use under changing climatic conditions.
- Vertical farming, controlled-environment plant factories, and protected cultivation for consistent, pesticide-free spice production.
- Organic and residue-free spice certification meeting stringent international food safety standards and premium market requirements.

Adaptation in processing

- Nano-encapsulation and nano-formulation improve bioavailability and stability of spice compounds like curcumin to enable targeted delivery and enhanced therapeutic efficiency.
- Advanced extraction technologies including supercritical fluid extraction and nano-encapsulation to enhance bioavailability of spice compounds.
- Smart packaging solutions with extended shelf life, ensuring product stability and consumer appeal.
- Blockchain-enabled supply chain traceability providing end-to-end documentation from farm to consumer.
- Improved (greener) extraction and purification techniques enabling production of specialty oleoresins and bio-flavours allowing development of specialty ingredients for diverse industries.
- Artisanal and gourmet spice blends catering to ethnic cuisine markets and premium consumer segments globally.

Adaptation in quality evaluation

- AI-powered quality assessment using multispectral imaging and electronic nose systems for rapid adulteration detection and purity verification.
- DNA barcoding and molecular tools for scientific authentication of spices and their bioactive profiles.
- Development of non-invasive and greener methods for quality analysis in spices.
- Electronic nose (E-nose) systems and sensor-based technologies for contamination detection replacing laborious conventional methods.
- Real-time assessment of intrinsic quality and contamination levels to reduce export rejection rate.

Emerging market opportunities

Global markets for spice-derived products are expanding at 8-12% annually. Key growth areas include:

- **Nutraceuticals and functional foods:** Turmeric for joint health, black pepper for nutrient absorption, ginger for digestion
- **Cosmeceuticals and skincare:** Spice bioactives in face creams, serums, and anti-aging products
- **Pharmaceutical applications:** Curcumin formulations for inflammation, piperine for bioavailability enhancement
- **Beverage industry:** Health drinks, immunity boosters, and wellness teas incorporating spice extracts
- **Meat and poultry processing:** Natural antimicrobial

and antioxidant agents replacing synthetic additives

Future prospects and strategic interventions in spice value chains

In the near future, spices are expected to evolve beyond traditional culinary ingredients into multifunctional products with applications in health, wellness, pharmaceuticals, cosmetics, functional foods, and personalized nutrition, thereby creating new opportunities for innovation and global market expansion.

Increasing emphasis is also being placed on the "wealth from waste" approach, wherein spice by-products and processing residues are efficiently utilized for the production of value-added products such as bioactive extracts, natural colorants, essential oils, pectin, dietary fibre, biodegradable packaging materials, and other functional ingredients. Such approaches not only improve profitability but also promote sustainability and circular bio-economy concepts within the spice sector.

Future development should focus on the establishment of rapid, reliable, non-invasive, greener and cost-effective technologies for quality assessment, adulteration detection, traceability, and food safety management. Simultaneously, consumer-oriented studies focusing on market trends, sensory preferences, clean-label products, and sustainable packaging solutions will be essential for improving the global acceptance and commercial success of spice products.

Geographic indications certificates issued for spices and spice products have not yet resulted in effective capture of premium markets. This needs special attention as their exploitation can generate significantly more foreign exchange. Another promising sector for development is spice-based aromatherapy. At present, the use of essential oils from spices in aromatherapy, despite their innate medicinal properties, remains limited. Low infrastructure requirements and the absence of strict regulations offer advantages for this sector, enabling high expansion potential.

SUMMARY

India stands at a pivotal moment in its spice sector history. The convergence of scientific research validating spice health benefits, technological advancements enabling efficient processing, supportive government policies, and rising global demand for natural and functional ingredients creates an unprecedented opportunity to transform spices from a commodity into premium, value-added products.

Institutional coordination and equitable benefit sharing among stakeholders will be critical for strengthening spice value chains. Mechanisms such as contract farming,



Oil pulling with Cardamom Oil blend

Golden milk with spice oleoresins



Garam Masala flavored oil



Nutmeg Oil



Clove oil



Cinnamon Essential oil



farmer-producer organizations (FPOs), cooperatives, and public-private partnerships can improve aggregation, value addition, marketing efficiency, and financial access for spice farmers.

For India to become a global hub for processed spice products, stronger collaboration among public research institutions, universities, private industries, farmer organizations, and policymakers is essential. This collaboration will facilitate faster technology transfer, commercialization, and innovation in areas such as extraction technologies, flavor blending, industrial processing, and nutraceutical product development.

The private sector is already leading this transformation. Whether it is turmeric oleoresins commanding premium prices globally or artisanal spice blends finding niche markets, the evidence is clear: The future of India's spice sector lies not in exporting more raw spices, but in exporting fewer tonnes of higher-value products. This shift promises greater profitability, sustainability, and global competitiveness for all stakeholders in the Indian spice value chain.

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