



महर्षि दयानंद सरस्वती स्वदेशी कंसोर्टियम

MAHARSHI DAYANAND SARASWATI SWADESHI CONSORTIUM

(A Joint Venture of MDSU and CHARGE)

BASICS OF SPICE MILLING

From Spice to Flavor



UNDERSTAND
SPICES



MILLING
FUNDAMENTALS



SIZE
REDUCTION



QUALITY &
SAFETY



PROCESS
OPTIMIZATION



PRACTICAL
APPLICATION



THE SPICE MILLING PROCESS



1. SELECT
Quality Spices



2. CLEAN
& SORT



3. DRY
(If Required)



4. MILL
Size Reduction



5. SIEVE
& CLASSIFY



6. PACK
& STORE

WHAT YOU WILL LEARN

- ✓ Fundamentals of spice milling
- ✓ Types of equipment and their use
- ✓ Factors affecting grind quality
- ✓ Ensuring safety and hygiene
- ✓ Best practices for efficiency



Model Curriculum

Course Name: Basics of Spice Milling

Course Code: MDSSC/004

Course Duration: 3 Month



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MDSU : -Maharshi Dayanand Saraswati University

CHARGE : - Choyal Hub for Agribusiness, Research, Growth, and Entrepreneurship





Programme Overview

The Basics of Spice Milling programme is designed to create industry-ready professionals capable of handling spice procurement, cleaning, grading, storage, milling, blending, packaging, quality control, food safety, and spice-based entrepreneurship. The programme integrates traditional Bharatiya spice processing practices with modern grinding technologies and digital business tools.

The curriculum has been designed in accordance with the objectives of skill development, entrepreneurship promotion, rural industrialization, startup creation, and employment generation. It aims to develop technical competencies as well as business capabilities among learners interested in establishing spice-based enterprises or pursuing careers in food processing industries.

The programme combines classroom learning, laboratory training, industrial exposure, and project-based learning to ensure practical competency and entrepreneurial readiness.

India accounts for a very significant share of global spice production, consumption and trade, and spice processing from cleaning and grading through to milling, blending, packaging and export generates employment across rural and semi-urban regions. Graduates of this programme may find opportunities as machine operators, quality control assistants, production supervisors and warehouse executives in organised spice-processing companies, or may establish their own spice grinding, masala manufacturing or spice export enterprises.

Training Outcomes

Upon successful completion of the programme, learners shall be able to:

Technical Competencies

- Identify major spices and their characteristics.
- Assess spice quality and storage suitability.
- Conduct spice cleaning and grading operations.
- Operate spice processing and milling equipment.
- Perform spice grinding and blending operations.
- Apply food safety and quality management systems.
- Conduct packaging and storage operations.
- Maintain production records and documentation.

Entrepreneurial Competencies

- Prepare project reports for spice processing units.
- Estimate capital and operational requirements.
- Understand government support schemes.
- Develop spice-based startup concepts.



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- Conduct market analysis and pricing decisions.

Digital Competencies

- Use AI tools for business operations.
- Create digital marketing campaigns.
- Manage digital payments.
- Utilize e-commerce platforms.
- Develop online sales channels.

Programme Delivery Mode

The programme shall be delivered through a blended approach comprising classroom theory sessions, hands-on laboratory and workshop practice, structured industrial visits, and mentored project work. Theory sessions introduce concepts using presentations, samples, charts and videos, while practical sessions provide direct hands-on experience with cleaning, grading, milling, packaging and quality-testing equipment under trainer supervision. Industrial visits and project work in the final module ensure that learners are exposed to real operating environments before completing the programme.

Proposed Compulsory Modules

Module	Theory	Practical	Total
Introduction to Spice Processing Industry	10	10	20
Production Planning & Workplace Preparation	15	25	40
Spice Science & Raw Material Management	20	20	40
Spice Cleaning, Grading & Storage	20	40	60
Spice Milling Operations	30	60	90
Quality Control & Food Safety	15	25	40
Packaging, Warehousing & Logistics	10	20	30
Entrepreneurship & MSME Development	15	15	30
AI, Digital Marketing & E-Commerce	15	15	30
Industrial Exposure & Project Work	0	60	60
Total	150	290	440



Elective Modules

Elective 1

Production of Chilli and Turmeric Powder

Learners specialise in the drying, cleaning, grinding and colour/pungency retention techniques specific to chilli and turmeric, two of India's highest-volume and highest-value ground spices, and study the standards used to grade and export them.

Elective 2

Whole Spice Grading and Export Preparation

This elective focuses on the grading, cleaning and export documentation requirements for whole spices such as pepper, cardamom and cumin, including packaging and certification practices required by international buyers.

Elective 3

Masala and Blended-Spice Product Development

Learners study the formulation, standardisation and manufacture of regional masala blends, including recipe development, blending equipment operation and shelf-life considerations for blended products.

Elective 4

Spice Oil and Oleoresin Extraction Basics

This elective introduces the principles of essential oil distillation and oleoresin solvent extraction from spices, and their applications in the food, flavour, fragrance and pharmaceutical industries.

Overview

The 360-hour programme is designed for delivery over approximately three months, at an average of six training hours per day, six days per week. The indicative month-wise distribution of modules is given below; actual pacing may be adjusted by the training institute based on batch size and equipment availability.

Month	Modules Covered	Approximate Hours
Month 1	Module 1: Introduction to Spice Processing Industry; Module 2: Production Planning & Workplace Preparation; Module 3: Spice Science & Raw Material Management	100 Hours



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Month	Modules Covered	Approximate Hours
Month 2	Module 4: Spice Cleaning, Grading & Storage; Module 5: Spice Milling Operations	150 Hours
Month 3	Module 6: Quality Control & Food Safety; Module 7: Packaging, Warehousing & Logistics; Module 8: Entrepreneurship & MSME Development; Module 9: AI, Digital Marketing & E-Commerce; Module 10: Industrial Exposure & Project Work	110 Hours

Unique Programme Components

In addition to the core technical modules, the programme will include:

Startup Development

Students will learn:

- Business Opportunity Identification
- Spice Grinding Unit Establishment
- Masala Manufacturing Unit Setup
- Rural Enterprise Development
- Startup Registration
- Investor Pitch Preparation

AI for Small Business

Practical use of:

- ChatGPT
- Canva
- Google Gemini
- WhatsApp Business
- AI-based Marketing

Activities:

- Creating advertisements
- Social media content
- Product descriptions
- Customer communication

Digital Commerce



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Students will learn:

- UPI Business Setup
- ONDC Registration
- Digital Catalogues
- Online Customer Acquisition
- Inventory Tracking

Industrial Exposure

Visits may include:

- Spice Grinding Units
- Spice Warehouses
- Masala Manufacturing Units
- MSMEs
- Farmer Producer Organizations (FPOs)
- Spice Markets (Mandis)

Project Work

Every student will prepare one of the following:

Option 1

Detailed Project Report (DPR) for a Spice Grinding Unit

Option 2

Masala Manufacturing Enterprise Plan

Option 3

Chilli/Turmeric Powder Processing Unit Proposal

Option 4

Digital Spice Business Startup Plan

Option 5

Village Spice Processing Cluster Model



MODULE 1- Introduction to Spice Processing Industry

This module introduces learners to the structure, scale and significance of the spice processing industry in India and globally. India is one of the largest producers, consumers and exporters of spices in the world, and spice processing forms a vital link between farm-level production and the food, pharmaceutical, cosmetic and export markets. Learners will study the classification of spices, the organisations that regulate and promote the sector, and the range of career and entrepreneurial pathways available to them.

Mapped Area: Spice Processing and Value-Addition Sector

Terminal Outcomes

The learner will be able to:

- Describe the spice processing industry.
- Explain the importance of spices in the Indian and global economy.
- Identify major spice-producing regions and spice categories.
- Understand employment opportunities in spice processing.
- Explain the role of entrepreneurship in the spice sector.

Theory Duration- 10 Hours

Practical Duration- 10 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain the significance of the spice industry in India.
- Describe the structure of the Indian spice processing industry.
- Explain the contribution of spice processing to the rural and export economy.
- Describe the spice value chain from farm to consumer.
- Identify major spice categories: seed spices, rhizome spices, bark spices, leaf spices, fruit spices and blended spices.
- Explain the role of the Spices Board of India.
- Describe major spice-growing states and regions of India.
- Explain processing industries for chilli, turmeric, coriander and cumin.
- Explain processing industries for pepper, cardamom, ginger and garlic.
- Describe masala and spice-blend manufacturing industries.
- Explain emerging trends in spice processing.
- Discuss automation and mechanisation in spice grinding.
- Explain opportunities in rural spice-based enterprises.
- Discuss employment opportunities in the spice sector.



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- Explain startup opportunities in spice processing and export.

Practical – Key Learning Outcomes

The learner should be able to:

- Identify different whole spices.
- Classify spices based on processing characteristics.
- Prepare a spice industry map.
- Analyze local spice markets.
- Identify spice-processing enterprises.
- Visit local spice grinding units.
- Document spice value chains.
- Conduct basic market surveys.
- Present industry observations.
- Prepare industry reports.

Key Concept Notes

Spices are broadly classified by the plant part from which they are derived. Seed spices include coriander, cumin, fennel, fenugreek and mustard; rhizome spices include turmeric and ginger; bark spices include cinnamon; leaf spices include curry leaf and bay leaf; fruit spices include chilli, pepper and cardamom; and blended spices include masalas made by combining two or more single spices. Each category demands different harvesting, drying, cleaning and processing techniques.

The Spices Board of India, functioning under the Ministry of Commerce and Industry, plays a central role in the development and export promotion of the spice sector. It supports quality improvement, organic certification, geographical indication registration, and export documentation for spice exporters and processors, and is an important point of contact for entrepreneurs entering this industry.

India's major spice-growing regions include Kerala and Karnataka for pepper and cardamom, Andhra Pradesh and Telangana for chilli and turmeric, Rajasthan and Gujarat for cumin and fennel, and the North-Eastern states for ginger and turmeric. Understanding regional production patterns helps entrepreneurs plan sourcing strategies for their processing units.

Classroom Aids

- Whiteboard
- Marker
- LCD Projector
- Laptop
- PowerPoint Presentations



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- Whole Spice Samples
- Industry Videos
- Charts and Posters

Tools, Equipment and Other Requirements

- Sample spice kits
- Measuring containers
- Display charts
- Computer system
- Internet connectivity

MODULE 2- Production Planning and Workplace Preparation

Effective spice processing depends on careful production planning and disciplined workplace preparation. This module trains learners to plan daily and batch-wise production, organise manpower and materials, and prepare the workplace in line with hygiene, safety and Good Manufacturing Practice requirements. Special emphasis is placed on dust control and pungency management, which are unique challenges in spice-handling environments compared to other grain-based processing units.

Terminal Outcomes

The learner will be able to:

- Plan production activities for a spice processing unit.
- Organize manpower and materials.
- Prepare equipment for operation.
- Implement workplace hygiene practices.
- Maintain production schedules.

Theory Duration- 15 Hours

Practical Duration- 25 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain production planning principles for spice units.
- Describe workflow management in spice processing.
- Explain production scheduling.
- Identify manpower requirements.
- Estimate raw material requirements for spice batches.



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- Explain equipment utilization planning.
- Describe production records.
- Explain inventory planning for perishable and volatile spice stocks.
- Describe preventive maintenance.
- Explain workplace organization systems.
- Explain sanitation procedures, with special attention to dust and pungency control.
- Describe standard operating procedures.
- Explain GMP requirements applicable to spice units.
- Explain workplace safety requirements, including capsaicin and dust exposure control.
- Explain quality assurance procedures.

Practical – Key Learning Outcomes

The learner should be able to:

- Prepare daily production plans.
- Estimate material requirements.
- Conduct equipment inspection.
- Prepare workplace sanitation checklists.
- Organize workstations.
- Perform pre-operational checks.
- Maintain production records.
- Assign workforce responsibilities.
- Monitor production schedules.
- Implement cleaning procedures.
- Verify safety compliance including use of dust masks and eye protection.
- Prepare production reports.

Key Concept Notes

Workplace preparation in a spice unit differs from other food-processing environments primarily because of the airborne dust generated during handling and grinding of pungent materials such as chilli and pepper. Effective ventilation, dust-extraction systems and the routine use of respiratory and eye protection are essential not only for regulatory compliance but for worker health and comfort. Production planning must also account for batch-wise cleaning of equipment between different spices to avoid cross-contamination of flavour and colour.

Classroom Aids

- SOP Manuals
- Production Charts



- Projector
- Whiteboard
- Demonstration Videos

Tools, Equipment and Other Requirements

- Cleaning equipment
- PPE kits
- Production logbooks
- Inspection checklists
- Maintenance registers

MODULE 3- Spice Science and Raw Material Management

A sound understanding of spice botany, chemistry and physical properties is essential for consistent product quality. This module covers the classification of spices into seed, rhizome, bark, leaf, fruit and blended categories, and examines the active compounds — such as curcumin, piperine, capsaicin and gingerol — that determine flavour, colour, pungency and market value. Learners will also study raw-material evaluation, sampling and procurement practices that safeguard quality from the point of purchase.

Terminal Outcomes

The learner will be able to:

- Understand the structure and composition of major spices.
- Evaluate spice quality.
- Conduct spice sampling.
- Assess moisture and storage suitability.
- Manage raw materials effectively.

Theory Duration- 20 Hours

Practical Duration- 20 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain the botanical classification of spices (seed, rhizome, bark, leaf, fruit and blended spices).
- Describe the physical properties of common spices.
- Explain the chemical composition of spices, including volatile (essential) oils and oleoresins.



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- Discuss active compounds: curcumin in turmeric, piperine in pepper, capsaicin in chilli, gingerol in ginger.
- Explain moisture content significance in spice quality and shelf life.
- Describe maturity and harvesting indicators for major spices.
- Explain common spice defects, including insect damage, mould and discolouration.
- Describe grading parameters such as size, colour, volatile oil content and extraneous matter.
- Explain procurement standards for whole spices.
- Explain spice storage behaviour and respiration.
- Discuss spice deterioration mechanisms, including aflatoxin risk.
- Explain pest infestation risks in stored spices.
- Describe quality inspection methods.
- Explain sampling procedures for bulk spice lots.
- Explain BIS, Agmark, FSSAI and Spices Board quality standards.
- Explain traceability systems for spice procurement.
- Discuss procurement documentation.
- Explain inventory management principles for spice raw materials.

Practical – Key Learning Outcomes

The learner should be able to:

- Identify major spice varieties by appearance and aroma.
- Conduct spice sampling from bulk lots.
- Measure moisture content using a moisture meter.
- Perform visual inspection for foreign matter and damage.
- Identify damaged or adulterated spices.
- Grade spice samples by size and colour.
- Calculate impurity and extraneous matter percentages.
- Record quality observations.
- Conduct storage suitability assessments.
- Prepare procurement records.

Key Concept Notes

The quality of ground spice is governed largely by the quality of the raw material entering the mill. Two critical chemical parameters used across the industry are volatile oil content, which determines aroma strength, and non-volatile ether extract or oleoresin content, which determines flavour intensity and pungency. Both parameters decline over time and with poor storage, which is why raw material freshness and correct moisture levels — typically between 8 and 12 percent depending on the spice — are essential.



Active compounds define the commercial and culinary value of individual spices: curcumin gives turmeric its characteristic yellow colour and is measured as a key quality indicator; piperine determines the pungency of black pepper; capsaicin determines the heat level of chilli, commonly measured on the Scoville scale; and gingerol contributes to the pungency of fresh and dried ginger. Understanding these compounds allows processors to select raw material suited to specific end products.

MODULE 4- Spice Cleaning, Grading and Storage Management

Before any spice can be milled or blended, it must be thoroughly cleaned of physical and biological contaminants and graded to meet market and regulatory standards. This module covers the equipment and procedures used for pre-cleaning, destoning, air classification, sieving and colour sorting, as well as scientific storage practices that protect spices from moisture, pests, mould and aflatoxin contamination during the period between procurement and processing.

Mapped Area: Spice Handling and Pre-Processing Operations

Terminal Outcomes

The learner will be able to:

- Explain spice cleaning and grading principles.
- Identify impurities and contaminants present in spices.
- Operate spice cleaning and grading equipment.
- Apply storage management practices.
- Monitor spice quality during storage.
- Prevent storage losses caused by pests, moisture and improper handling.

Theory Duration- 20 Hours

Practical Duration- 40 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain the importance of spice cleaning before processing.
- Identify different types of impurities found in raw spices.
- Describe physical contaminants such as stones, stalks, dust and foreign matter.
- Explain biological contaminants including insects, rodent excreta and fungal infestation.
- Describe the working principle of pre-cleaners for spices.
- Explain the operation of destoners and air classifiers used in spice cleaning.



- Describe the working of sieves, sifters and vibratory graders.
- Explain the operation of colour sorters used for chilli and other spices.
- Describe spice grading principles.
- Explain spice size and colour classification systems.
- Discuss grading standards for chilli, turmeric, pepper and cardamom.
- Explain moisture management during storage.
- Describe respiration and volatile oil loss during storage.
- Explain causes of storage losses in spices.
- Discuss warehouse management systems for spice stock.
- Explain stack formation and storage practices to protect aroma and colour.
- Describe scientific spice storage methods, including cool, dry, dark conditions.
- Explain pest management techniques specific to spices.
- Discuss fumigation principles and precautions.
- Explain warehouse sanitation practices.
- Describe inventory management methods.
- Explain FIFO and FEFO systems for spice stock rotation.
- Discuss digital inventory systems.
- Explain spice quality monitoring during storage, including aflatoxin risk control.
- Describe warehouse safety procedures.

Practical – Key Learning Outcomes

The learner should be able to:

- Identify foreign materials in spice samples.
- Operate spice cleaning equipment.
- Perform spice grading operations.
- Conduct impurity analysis.
- Measure moisture content before storage.
- Prepare spice stacks and bin storage.
- Maintain warehouse records.
- Conduct warehouse inspection.
- Identify insect infestation in stored spices.
- Monitor storage conditions (temperature, humidity, light).
- Implement sanitation procedures.
- Demonstrate spice sampling from storage lots.
- Prepare stock registers.
- Conduct quality assessment during storage.



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- Demonstrate fumigation safety practices.

Key Concept Notes

Cleaning equipment used in spice units typically follows a sequence: a pre-cleaner removes large trash and dust, a destoner separates stones and heavy foreign material using vibration and airflow, an air classifier or aspirator removes light impurities such as husk and chaff, and sieves or vibratory graders separate the spice into size fractions. Colour sorters, using optical or camera-based sensors, are increasingly used to remove discoloured, damaged or foreign-coloured particles from chilli and other spices before milling.

Storage losses in spices arise mainly from moisture regain, insect infestation and mould growth. Maintaining spices at recommended moisture levels, using pest-proof storage structures, following First-In-First-Out (FIFO) or First-Expiry-First-Out (FEFO) stock rotation, and conducting periodic fumigation under trained supervision are standard practices used to minimise storage losses in commercial and small-scale spice warehouses alike.

Classroom Aids

- Computer
- Projector
- PowerPoint Presentations
- Storage Management Charts
- Warehouse Layout Diagrams
- Spice Samples
- BIS/Agmark Quality Standards Manual

Tools, Equipment and Other Requirements

- Spice Cleaner
- Destoner
- Air Classifier
- Colour Sorter (Demonstration)
- Moisture Meter
- Storage Bins
- Warehouse Registers
- Sampling Spears
- Weighing Scale
- PPE Kits

MODULE 5- Spice Milling Operations



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Spice milling is the technological core of the industry, converting cleaned whole spices into powders, blends, oils and oleoresins. This is the largest module of the programme and covers grinding technologies ranging from traditional stone mills to modern hammer mills, pin mills and cryogenic grinding systems. Learners will study crop-specific processing for chilli, turmeric, coriander, cumin, pepper, cardamom, ginger and garlic, along with the principles of masala formulation, blending, and spice oil and oleoresin extraction, with strong emphasis on preserving colour, aroma and pungency during processing.

Mapped Area: Spice Grinding and Value-Added Product Manufacturing

Terminal Outcomes

The learner will be able to:

- Understand spice milling principles.
- Operate spice milling equipment.
- Produce spice powder and blends according to specifications.
- Optimize milling efficiency and volatile-oil retention.
- Maintain milling machinery.
- Monitor spice powder quality and yield.

Theory Duration- 30 Hours

Practical Duration- 60 Hours

Theory – Key Learning Outcomes

The learner should be able to:

Introduction to Spice Milling

- Explain the objectives of spice milling.
- Describe the history of spice grinding technologies.
- Explain traditional stone-grinding (chakki) systems for spices.
- Describe modern hammer mill and pin mill systems.
- Explain spice-milling terminology.

Chilli Processing

- Explain chilli pod structure and drying.
- Describe de-stemming and cleaning of chilli.
- Explain chilli grinding operations and heat control.
- Describe colour and pungency retention during grinding.
- Explain chilli powder particle-size management.

Turmeric Processing



- Explain turmeric rhizome curing and polishing.
- Describe turmeric drying operations.
- Explain turmeric grinding and curcumin retention.
- Describe turmeric powder colour standards.

Coriander and Cumin Processing

- Explain coriander seed cleaning and grading.
- Describe cumin seed processing operations.
- Explain grinding parameters for coriander and cumin powder.

Pepper, Cardamom, Ginger and Garlic Processing

- Explain black pepper processing and grinding.
- Describe cardamom handling and grading.
- Explain ginger and garlic drying and powdering operations.
- Discuss dehydration methods for ginger and garlic.

Cryogenic and Low-Temperature Grinding

- Explain the principle of cryogenic grinding using liquid nitrogen or CO₂.
- Describe advantages of cryogenic grinding for volatile-oil retention.
- Explain temperature-controlled ambient grinding methods.
- Discuss comparison between ambient and cryogenic grinding.

Spice Blending and Masala Manufacturing

- Explain principles of masala formulation.
- Describe blending equipment and ribbon blenders.
- Explain standardisation of spice-blend recipes.
- Discuss regional masala types and formulations.

Spice Oil and Oleoresin Extraction

- Explain the concept of essential oil extraction from spices.
- Describe the principle of oleoresin extraction using solvents.
- Discuss applications of spice oils and oleoresins.

Milling Plant Management

- Explain process flow diagrams for spice grinding units.
- Describe plant layout planning for dust and cross-contamination control.
- Explain equipment utilization.
- Discuss energy efficiency in grinding operations.
- Explain preventive maintenance systems.



- Describe troubleshooting procedures for grinding equipment.
- Explain safety precautions in spice milling plants, including dust explosion hazards.

Practical – Key Learning Outcomes

The learner should be able to:

Milling Operations

- Operate stone-grinding (chakki) units for spices.
- Operate hammer mills and pulverizers.
- Demonstrate spice feeding procedures.
- Monitor grinding operations and temperature rise.
- Perform powder collection procedures.
- Measure powder yield.

Equipment Handling

- Start and shut down milling systems safely.
- Conduct equipment inspection.
- Adjust grinding settings for particle-size control.
- Monitor machine performance.
- Perform routine maintenance.

Product Quality Assessment

- Conduct spice powder quality inspection.
- Measure particle size using sieves.
- Assess powder colour, aroma and texture.
- Record quality observations.

Production Management

- Calculate extraction/recovery rates.
- Calculate milling efficiency.
- Prepare production records.
- Maintain batch records.
- Monitor production losses.

Safety and Maintenance

- Use PPE during milling operations, especially for chilli dust and capsaicin exposure.
- Demonstrate machine cleaning procedures.
- Conduct preventive maintenance checks.
- Report machine faults.



- Follow emergency procedures.

Key Concept Notes

Grinding generates frictional heat, which can drive off the volatile oils responsible for a spice's aroma and can also darken sensitive pigments such as curcumin. This is why temperature control during grinding is one of the most important process parameters in spice milling. Ambient grinding relies on batch cooling, controlled feed rates and short grinding cycles, while cryogenic grinding uses liquid nitrogen or solid CO₂ to hold the product below its glass-transition temperature throughout grinding, substantially reducing volatile-oil loss for high-value spices such as pepper, cardamom and nutmeg.

Particle size distribution directly affects the sensory and functional performance of a spice powder. Coarser grinds are often preferred for products such as sambar powder that are used in slow-cooked dishes, while finer grinds are preferred for instant-mixing masalas. Sieving after grinding, using graded test sieves, allows processors to classify powder into consistent particle-size fractions and to recycle oversize material back into the mill.

Masala and blended-spice manufacturing requires precise formulation and consistent blending to ensure that every batch matches the target flavour profile. Ribbon blenders and paddle mixers are commonly used for dry blending, and batches are typically validated by sensory panels and by chemical markers such as total ash and acid-insoluble ash content, in addition to visual and aroma checks.

Spice oils are obtained through steam distillation of the volatile fraction of a spice, while oleoresins are obtained through solvent extraction of both the volatile and non-volatile flavour and colour compounds. Both products are used extensively by the food, flavour, fragrance and pharmaceutical industries as standardised, concentrated alternatives to whole or ground spices, and represent a significant value-addition opportunity for larger processing units.

Classroom Aids

- Milling Process Flow Charts
- PowerPoint Presentations
- Industry Videos
- Ground Spice Samples
- Whole Spice Samples
- Process Manuals
- Equipment Catalogues

Tools, Equipment and Other Requirements

Milling Equipment

- Chakki Mill
- Pulverizer



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- Hammer Mill
- Pin Mill (Demonstration Unit)
- Sifter
- Spice Feeder
- Conveyors

Testing Equipment

- Moisture Meter
- Digital Weighing Scale
- Test Sieves
- Sample Containers

Safety Equipment

- Safety Goggles
- Ear Protection
- Gloves
- Dust Masks / Respirators
- Safety Shoes

Documentation

- Production Registers
- Maintenance Logs
- Quality Control Forms

MODULE 6- Quality Control and Food Safety

The spice industry is particularly vulnerable to adulteration and quality fraud, ranging from artificial colouring agents in chilli and turmeric powder to the use of foreign starches and inert fillers in ground spices. This module equips learners with the knowledge and skills to test, verify and document spice quality in line with BIS, Agmark, FSSAI and Spices Board of India standards, and to implement GMP, GHP and HACCP-based food safety systems that protect consumers and support export readiness.

Mapped Area: Spice Quality Assurance and Regulatory Compliance

Terminal Outcomes

The learner will be able to:

- Evaluate spice and spice-powder quality.
- Apply food safety principles.



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- Conduct quality inspections.
- Maintain quality records.
- Implement GMP, GHP and HACCP systems.

Theory Duration- 15 Hours

Practical Duration- 25 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain quality management principles for spice processing.
- Describe spice quality parameters: colour value, volatile oil content, extraneous matter.
- Explain spice-powder quality standards.
- Discuss BIS and Agmark specifications for spices.
- Explain FSSAI regulations applicable to spices and masalas.
- Explain Spices Board of India quality and export certification requirements.
- Describe GMP requirements for spice units.
- Explain GHP principles.
- Discuss HACCP concepts applied to spice processing.
- Explain common adulteration practices (e.g., artificial colours in chilli/turmeric powder, foreign starch, brick powder) and detection methods.
- Explain contamination risks, including aflatoxin and heavy metals.
- Describe allergen management.
- Explain microbiological safety concerns, including Salmonella control.
- Explain traceability systems.
- Discuss food recall procedures.
- Explain sanitation requirements.
- Describe quality documentation systems.
- Explain audit procedures, including export-oriented certifications such as ASTA cleanliness specifications.

Practical – Key Learning Outcomes

The learner should be able to:

- Conduct spice quality testing.
- Measure moisture content.
- Perform basic adulteration screening tests.
- Perform spice-powder quality checks (colour, aroma, particle size).
- Complete quality records.



- Conduct sanitation inspections.
- Demonstrate GMP practices.
- Prepare HACCP records.
- Conduct workplace hygiene audits.
- Maintain traceability records.
- Report quality deviations.

Key Concept Notes

Adulteration is a persistent challenge in the spice trade because of the high value and visual similarity of powdered products. Common adulterants include artificial dyes such as metanil yellow and lead chromate added to turmeric powder, Sudan dyes and brick powder added to chilli powder, and starch or husk added to bulk up ground spices. Basic screening tests, along with laboratory analysis for colour value, ash content and heavy metals, are used by quality control teams to detect such practices before products reach the market.

Aflatoxin contamination, caused by moulds such as *Aspergillus flavus* growing on spices under warm, humid conditions, is a serious food-safety concern, particularly for chilli and dried ginger. Preventing aflatoxin risk requires proper drying to safe moisture levels, clean storage conditions, and regular testing, since aflatoxins are heat-stable and cannot be eliminated by grinding or cooking.

MODULE 7- Packaging, Warehousing and Logistics

Ground and whole spices are highly susceptible to loss of aroma, colour and pungency if not packaged and stored correctly. This module covers the selection of aroma-barrier packaging materials, labeling compliance, nitrogen flushing and vacuum packing techniques, along with warehousing practices that maintain controlled temperature and humidity. Learners will also study inventory control, transportation and export logistics that ensure spice products reach the market with their quality intact.

Mapped Area: Post-Processing Operations and Supply Chain Management

Terminal Outcomes

The learner will be able to:

- Select suitable packaging materials for spice and masala products.
- Apply packaging and labeling standards.
- Manage warehousing operations.
- Maintain inventory records.
- Coordinate transportation and logistics activities.

Theory Duration- 10 Hours



Practical Duration- 20 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain the importance of packaging in preserving spice aroma, colour and pungency.
- Describe different packaging materials used for spice products.
- Explain characteristics of HDPE, LDPE, PP, foil-laminate and metallised packaging materials.
- Discuss food-grade and aroma-barrier packaging requirements.
- Explain packaging standards for whole and ground spice products.
- Describe labeling requirements under FSSAI regulations.
- Explain barcode and QR code applications.
- Discuss packaging defects and preventive measures.
- Explain nitrogen flushing and vacuum packing for volatile-oil retention.
- Explain warehousing principles for spices.
- Describe warehouse layout planning with humidity and temperature control.
- Explain stock management systems.
- Discuss inventory control methods.
- Explain FIFO and FEFO inventory practices.
- Describe transportation requirements for spice products.
- Explain logistics management systems.
- Discuss supply chain management principles.
- Explain export packaging basics and Spices Board export documentation.
- Describe warehouse safety standards.

Practical – Key Learning Outcomes

The learner should be able to:

- Identify suitable packaging materials.
- Demonstrate filling and sealing operations.
- Prepare product labels.
- Maintain stock registers.
- Conduct warehouse inspections.
- Demonstrate inventory tracking.
- Prepare dispatch records.
- Implement warehouse safety measures.
- Record incoming and outgoing stock.



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- Monitor product storage conditions.

Key Concept Notes

Because volatile oils are lost through evaporation, ground spices are best protected using packaging with low oxygen and moisture transmission rates, such as metallised or foil-laminated pouches, often combined with nitrogen flushing to displace oxygen inside the pack. Warehousing of both raw and finished spice products should maintain cool, dry and dark conditions, since heat, humidity and light all accelerate the degradation of colour and aroma.

Classroom Aids

- Packaging Samples
- Labeling Manuals
- Warehouse Layout Charts
- Inventory Software Demonstrations
- PowerPoint Presentations
- Videos on Packaging Operations

Tools, Equipment and Other Requirements

- Packaging Machine
- Heat Sealer
- Weighing Scale
- Packaging Materials
- Labels and Stickers
- Storage Racks
- Inventory Registers
- Barcode Scanner (Demonstration)

MODULE 8- Entrepreneurship and MSME Development

The spice sector offers strong entrepreneurial potential, from small-scale local grinding units to branded masala businesses and export enterprises. This module guides learners through opportunity identification, business registration, government schemes and financial planning specific to spice-based ventures, culminating in the preparation of a bankable business plan or detailed project report.

Mapped Area: Enterprise Creation and Business Development

Terminal Outcomes

The learner will be able to:



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- Identify business opportunities in spice processing.
- Prepare business plans and DPRs.
- Understand MSME registration procedures.
- Access government support schemes.
- Develop sustainable spice-based enterprises.

Theory Duration- 15 Hours

Practical Duration- 15 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain entrepreneurship concepts.
- Describe characteristics of successful entrepreneurs.
- Identify spice-processing business opportunities.
- Explain spice-grinding unit business models.
- Discuss masala and blended-spice business opportunities.
- Explain spice export enterprises.
- Describe branded retail spice enterprises.
- Explain business registration procedures.
- Discuss Udyam Registration.
- Explain GST basics.
- Describe PMEGP scheme.
- Explain Mudra Loan scheme.
- Discuss Startup India initiatives.
- Explain Spices Board of India registration and support schemes.
- Discuss APEDA and export promotion support.
- Explain market research methods.
- Describe customer analysis techniques.
- Explain costing and pricing concepts for spice products.
- Discuss break-even analysis.
- Explain working capital requirements.
- Describe project report preparation.
- Explain risk management in MSMEs.

Practical – Key Learning Outcomes

The learner should be able to:



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- Identify local business opportunities.
- Conduct market surveys.
- Prepare cost estimates.
- Develop pricing strategies.
- Prepare business plans.
- Prepare DPRs for spice grinding units.
- Estimate machinery requirements.
- Calculate profitability projections.
- Complete MSME registration exercises.
- Present startup proposals.

Key Concept Notes

Spice-based enterprises can be established at multiple scales, from a small local grinding unit serving a village or town market, to a branded masala manufacturing company selling through retail and e-commerce channels, to an export-oriented enterprise supplying whole or processed spices to international buyers. Each model has different capital requirements, regulatory obligations and growth pathways, and entrepreneurs should evaluate local raw-material availability, market access and their own capital and skill base before selecting a business model.

Government support for spice-sector MSMEs is available through several channels, including Udyam Registration for formal recognition as a micro, small or medium enterprise, the Prime Minister's Employment Generation Programme (PMEGP) for subsidised project loans, Mudra loans for working capital and machinery, and Spices Board of India schemes that support quality improvement, export promotion and infrastructure development specifically for spice processors and exporters.

Classroom Aids

- Business Plan Templates
- DPR Samples
- Government Scheme Brochures
- Financial Planning Worksheets
- Case Studies
- Entrepreneur Success Stories

Tools, Equipment and Other Requirements

- Computer Systems
- Internet Connectivity
- Calculator



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- DPR Formats
- Project Planning Software
- Financial Worksheets

MODULE 9- AI, Digital Marketing and E-Commerce

Digital tools have become essential for small and medium spice enterprises to reach customers, build brands and manage operations efficiently. This module introduces learners to practical applications of artificial intelligence, social media marketing, e-commerce platforms and digital payment systems to help them market and sell spice products online and build sustainable digital-first businesses.

Mapped Area: Digital Enterprise Management

Terminal Outcomes

The learner will be able to:

- Utilize AI tools for business operations.
- Develop digital marketing campaigns.
- Create online product catalogues.
- Manage e-commerce sales channels.
- Implement digital payment systems.

Theory Duration- 15 Hours

Practical Duration- 15 Hours

Theory – Key Learning Outcomes

The learner should be able to:

- Explain the role of AI in business.
- Describe applications of ChatGPT in MSMEs.
- Explain content creation using AI tools.
- Discuss digital branding concepts for spice products.
- Explain social media marketing.
- Describe Facebook and Instagram marketing.
- Explain WhatsApp Business applications.
- Discuss search engine optimization basics.



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- Explain digital customer engagement.
- Describe e-commerce business models.
- Explain ONDC ecosystem.
- Discuss Amazon and Flipkart seller systems.
- Explain online inventory management.
- Describe digital payment systems.
- Explain UPI and QR payment systems.
- Discuss cyber security basics.
- Explain customer data protection.
- Describe digital analytics tools.

Practical – Key Learning Outcomes

The learner should be able to:

- Create AI-generated content.
- Prepare social media campaigns.
- Design product catalogues using Canva.
- Create WhatsApp Business profiles.
- Set up digital payment systems.
- Register products on e-commerce platforms.
- Prepare digital advertisements.
- Analyze customer engagement metrics.
- Generate AI-based business reports.
- Demonstrate online product selling.

Key Concept Notes

Digital platforms have opened new routes to market for small spice enterprises that would previously have relied solely on wholesale or local retail. Open Network for Digital Commerce (ONDC) registration allows small sellers to list products across multiple buyer applications without dependence on a single platform, while marketplaces such as Amazon and Flipkart provide access to a nationwide customer base for branded spice products. AI tools such as ChatGPT and Canva are increasingly used by small businesses to generate product descriptions, design packaging artwork and create marketing content at low cost.

Classroom Aids

- Computer Lab
- Internet Access
- Projector
- AI Tool Demonstrations



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- Digital Marketing Videos
- E-Commerce Platform Demonstrations

Tools, Equipment and Other Requirements

- Computers
- Internet Connectivity
- Smartphone
- Canva Account
- ChatGPT Access
- Social Media Accounts
- Digital Payment Apps

MODULE 10- Industrial Exposure and Project Work

This capstone module bridges classroom learning and real-world industry practice. Learners will undertake structured visits to spice processing units, warehouses and markets, interact with practicing entrepreneurs, and apply their technical and business knowledge to develop a comprehensive project a detailed project report or enterprise plan that consolidates the competencies gained throughout the programme.

Mapped Area: Industry Integration and Applied Learning

Terminal Outcomes

The learner will be able to:

- Understand industrial spice processing operations.
- Observe best industry practices.
- Apply classroom knowledge in real-life settings.
- Prepare industry reports.
- Develop a viable business proposal.

Practical Duration- 60 Hours

Practical – Key Learning Outcomes

The learner should be able to:

- Observe spice grinding unit operations.
- Observe spice cleaning systems.
- Study storage management practices.
- Analyze packaging operations.



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- Record industrial workflows.
- Interact with spice-industry entrepreneurs.
- Prepare industrial visit reports.
- Conduct market studies.
- Identify operational challenges.
- Recommend process improvements.
- Develop project proposals.
- Present business plans.

Suggested Industrial Visits

- Spice Grinding Units
- Spice Warehouses
- Masala Manufacturing Units
- Spice Board Regional Offices
- Spice Export Houses
- Farmer Producer Organizations (FPOs)
- Spice Markets (Mandis)
- Agro-Based MSMEs

PROJECT WORK

Every learner shall complete one project from the following:

Option 1

Detailed Project Report for a Spice Grinding Unit

Option 2

Masala/Blended-Spice Manufacturing and Marketing Enterprise

Option 3

Chilli/Turmeric Powder Processing Unit

Option 4

Village-Level Spice Processing Centre

Option 5

Digital Spice Products Marketplace

Option 6



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Integrated Spice Processing and Export Startup

Key Concept Notes

The industrial exposure and project work module is designed to consolidate all technical and business learning from the previous nine modules into a single applied outcome. Learners are expected to select a realistic, locally relevant project such as a small-scale spice grinding unit or a masala brand and to develop it into a project report that includes a market assessment, machinery and cost estimate, and an operating plan, mirroring the process a real entrepreneur would follow before approaching a bank or investor.

ANNEXURE: COMMON SPICES PROCESSED IN INDIA

The table below summarises the botanical category, primary processing method and key quality parameter for major spices covered in this programme.

Spice	Category	Primary Processing	Key Quality Parameter
Chilli	Fruit Spice	Drying, de-stemming, grinding	Colour value, pungency (Scoville units)
Turmeric	Rhizome Spice	Curing, drying, polishing, grinding	Curcumin content, colour
Black Pepper	Fruit Spice	Drying, grading, grinding	Piperine content, volatile oil
Coriander	Seed Spice	Cleaning, grading, grinding	Volatile oil content, moisture
Cumin	Seed Spice	Cleaning, grading, grinding	Volatile oil content, purity
Cardamom	Fruit Spice	Curing, drying, grading	Volatile oil, capsule size and colour
Ginger	Rhizome Spice	Washing, drying, grinding/dehydration	Gingerol content, moisture
Garlic	Bulb Spice	Peeling, drying/dehydration, powdering	Allicin content, moisture
Fenugreek	Seed Spice	Cleaning, grading, grinding	Moisture, purity
Fennel	Seed Spice	Cleaning, grading, grinding	Volatile oil content



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Spice	Category	Primary Processing	Key Quality Parameter
Cinnamon	Bark Spice	Drying, grading, grinding	Volatile oil, bark thickness
Clove	Flower Bud Spice	Drying, grading	Eugenol (volatile oil) content
Mustard	Seed Spice	Cleaning, grading, grinding	Oil content, purity
Nutmeg	Seed Spice	Drying, grading, grinding	Volatile oil content
Blended Masala	Blended Spice	Formulation, blending, packing	Consistency of recipe, moisture

ANNEXURE: KEY EQUIPMENT USED IN SPICE MILLING

Equipment	Function
Pre-Cleaner	Removes large trash, stalks and dust from raw spice before processing
Destoner	Separates stones and heavy foreign material using vibration and airflow
Air Classifier / Aspirator	Removes light impurities such as husk, chaff and dust
Colour Sorter	Removes discoloured, damaged or foreign-coloured particles optically
Chakki Mill	Traditional stone-grinding mill used for small-batch spice powdering
Hammer Mill	High-speed mill using swinging hammers for coarse to medium grinding
Pin Mill	Mill using rotating pins for fine, uniform grinding
Cryogenic Grinding System	Low-temperature mill using liquid nitrogen or CO ₂ to preserve volatile oils
Ribbon Blender	Mixes multiple spice powders into a uniform masala blend
Vibratory Sifter	Separates ground powder into consistent particle-size fractions
Moisture Meter	Measures moisture content of raw and processed spices



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Equipment	Function
Heat Sealer / Packaging Machine	Fills and seals packaging materials for finished products

CAREER PATHWAYS

Learners completing this programme may pursue a range of career pathways in the spice processing sector, either as employed professionals in organised spice-processing companies or as independent entrepreneurs. Typical roles and pathways include the following.

Employment Pathways

- Spice Grinding Machine Operator
- Quality Control / Quality Assurance Assistant
- Production Supervisor in a Spice Processing Unit
- Warehouse and Inventory Executive
- Packaging Line Operator
- Field Procurement Assistant for Spice Sourcing

Entrepreneurial Pathways

- Owner-Operator of a Local Spice Grinding Unit
- Masala and Blended-Spice Brand Owner
- Spice Export Entrepreneur
- Village-Level Spice Processing Cluster Promoter
- Digital-First Spice Products Business Owner

TRAINER REQUIREMENTS

Qualification	Industry Experience	Training Experience
B.Sc./B.Tech. Food Technology, Food Engineering, Agriculture, Agricultural Engineering, Spice/Grain Processing	Minimum 3 Years	Minimum 1 Year
M.Sc./M.Tech. Food Technology, Food Engineering, Agriculture, Agricultural Engineering, Spice/Grain Processing	Minimum 2 Years	Minimum 1 Year



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Qualification	Industry Experience	Training Experience
10 Years and Above Experience in the Spice Milling Sector	Minimum 10 Years	Minimum 1 Year

Trainer Competencies

The trainer should possess knowledge of:

- Spice Processing Technology
- Food Safety Systems
- Spice Milling Operations
- Storage Management
- Entrepreneurship Development
- Digital Business Operations

ASSESSOR REQUIREMENTS

Qualification	Industry Experience	Assessment Experience
B.Sc./B.Tech. Food Technology, Food Engineering, Agriculture, Agricultural Engineering	Minimum 4 Years	Minimum 1 Year
M.Sc./M.Tech. Food Technology, Food Engineering, Agriculture, Agricultural Engineering	Minimum 3 Years	Minimum 1 Year

ASSESSMENT STRATEGY

Mid-Term Assessment

- Theory Test
- Practical Assessment
- Assignments

Final Assessment

Written Examination (30%)

Assessment Components:

- Multiple Choice Questions
- True/False Questions



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- Matching Questions
- Short Answer Questions

Practical Examination (40%)

Assessment Components:

- Equipment Operation
- Spice Quality Assessment
- Milling Operations
- Packaging Operations
- Food Safety Compliance

Project Work (20%)

Assessment Components:

- Project Report
- Financial Viability
- Technical Feasibility
- Presentation

Viva Voce (10%)

Assessment Components:

- Technical Understanding
- Problem Solving Ability
- Entrepreneurial Awareness

Grading Criteria

Marks Range	Grade	Description
90 – 100%	A+	Outstanding
75 – 89%	A	Excellent
60 – 74%	B	Good
50 – 59%	C	Satisfactory
Below 50%	F	Not Yet Competent

GLOSSARY



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Term	Description
Spice Processing	Activities involved in cleaning, grading, milling, blending and packaging spices
Milling	Size-reduction process used to produce spice powder
Oleoresin	Concentrated flavour and colour extract obtained from spices using solvent extraction
Cryogenic Grinding	Low-temperature grinding process using liquid nitrogen or CO ₂ to preserve volatile oils
GMP	Good Manufacturing Practices
GHP	Good Hygiene Practices
HACCP	Hazard Analysis and Critical Control Point
DPR	Detailed Project Report
FPO	Farmer Producer Organization
MSME	Micro, Small and Medium Enterprise
OJT	On-the-Job Training
Traceability	Ability to track product movement throughout the supply chain
Curcumin	The primary yellow pigment and active compound found in turmeric
Piperine	The alkaloid compound responsible for the pungency of black pepper
Capsaicin	The active compound responsible for the pungency (heat) of chilli
ASTA Cleanliness Specifications	US-based standards defining permissible extraneous matter in spices for export
Extraneous Matter	Foreign material such as stalks, stones, dust or insect fragments present in raw spice
Aflatoxin	A toxic compound produced by certain moulds that can contaminate improperly stored spices

ACRONYMS AND ABBREVIATIONS



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Acronym	Full Form
AI	Artificial Intelligence
APEDA	Agricultural and Processed Food Products Export Development Authority
ASTA	American Spice Trade Association
BIS	Bureau of Indian Standards
DPR	Detailed Project Report
FEFO	First Expiry First Out
FIFO	First In First Out
FPO	Farmer Producer Organization
FSSAI	Food Safety and Standards Authority of India
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Point
MSME	Micro, Small and Medium Enterprise
NSQF	National Skills Qualification Framework
OJT	On-the-Job Training
SOP	Standard Operating Procedure
UPI	Unified Payments Interface
ISO	International Organization for Standardization
PPE	Personal Protective Equipment
DPR	Detailed Project Report

SUGGESTED REFERENCES AND STANDARDS

Learners and trainers may refer to the following standards, organisations and resources for further study:

- Spices Board of India — spicesboard.gov.in



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- Food Safety and Standards Authority of India (FSSAI) regulations for spices and condiments
- Bureau of Indian Standards (BIS) specifications for individual spices
- Agricultural and Processed Food Products Export Development Authority (APEDA) export guidelines
- American Spice Trade Association (ASTA) cleanliness specifications
- Udyam Registration Portal for MSME registration
- Prime Minister's Employment Generation Programme (PMEGP) guidelines



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MDSSC

Maharshi Dayanand Saraswati
Swadeshi Consortium



ABOUT US

Maharshi Dayanand Saraswati University, Ajmer proposes the establishment of the Maharshi Dayanand Saraswati Swadeshi Consortium as a multidisciplinary and collaborative institutional ecosystem dedicated to innovation-driven education, Bharatiya research traditions, startup culture, skill development, and sustainable national development rooted in Indian ethos.

The Consortium shall be the first and the only initiative of its kind in the State and among a select few in the country integrating innovation, incubation, research, entrepreneurship, indigenous knowledge systems, and community engagement under a unified institutional framework.



MDSU



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CHARGE



CHARGE – Choyal Hub for Agribusiness, Research, Growth & Entrepreneurship – is a hub focused on agribusiness, skill development, innovation, and entrepreneurship. Established as CSMT, CHARGE now offers technical training, certified courses, research, incubation, and business support. A CSR initiative of **R.S. Choyal Group**, CHARGE works on a no-profit, no-loss basis to connect education, industry, and entrepreneurship. We aim to empower young entrepreneurs and industry professionals with practical knowledge and real-world opportunities. Through hands-on learning and industry exposure, CHARGE supports the growth of a skilled and innovative agribusiness ecosystem.

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