



FICSI

Food Industry Capacity and Skill Initiative

Participant Handbook

Sector
Food Processing

Sub-Sector
Packaged Foods

Occupation
Processing-Packaged Foods

Reference ID: **FIC/Q1011,**
Version: 1.0, NSQF Level: 3



**Millets Products
Processor**



Shri Narendra Modi
Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”



Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

for

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **'Millets Products Processor'**

QP Code: 'FIC/Q1011, NSQF Level: 3'

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The industry feedback has been extremely encouraging from inception to conclusion & it is with their inputs that we have tried to bridge the skill gaps existing today in the Industry.

This participant handbook is dedicated to all the aspiring youth who desire to achieve special skills which would be a lifelong asset for their future endeavours and help them make a bright career in the Food Processing Sector.

About this book

This book is designed to provide skill training and/ or upgrade the knowledge and basic skills to take up the job of 'Millets Products Processor' in 'Food Processing' sector. All the activities carried out by a specialist are covered in this course. Upon successful completion of this course, the candidate will be eligible to work as a Millets Products Processor.

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational Standards (NOS) is covered across Unit/s.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

- FIC/N1038: Produce Millet Based Composite Flour
- FIC/N9026: Prepare for production
- FIC/N9906: Apply food safety guidelines in Food Processing
- FIC/N1039: Produce Millet Based Baked Products.
- FIC/N1040: Produce Instant Idli and Dosa Mix.
- FIC/N1040: Produce Millet Based Extruded Products
- DGT/VSQ/N0101: Employability Skills (30 Hours)

Symbols Used



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Unit
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Unit 1.5 Millet Based Business Opportunities and Government Initiatives



Key Learning Outcomes



At the end of this unit, you will be able to:

- 1 Discuss the size and scope of the food processing industry in brief.
- 2 Discuss the future trends and career growth opportunities available for Millet Product Processor in the food processing industry.
- 3 Summarise the key roles and responsibilities of 'Millet Product Processor'.
- 4 Explain the Legislative guidelines for millet base food products.
- 5 Discuss various government initiatives to support millet industry.

UNIT 1.1: Introduction to the Training Programme

Unit Objectives

At the end of this unit, you will be able to:

1. Explain the purpose of training
2. Discuss the National Occupational Standards and Qualification Pack

1.1.1 Purpose and Benefits of the Training Programme

This training programme is developed to impart specific skills to individuals who wish to be Millets Products Processor. The training programme is based upon the National Occupational Standards for the food processing sector. The National Occupational Standards have been described in the following subsection of this chapter.

The training program will enable an individual to:

- prepare and maintain work area and process machineries for operating a Millets Products Processor;
- prepare for production of products from various grains;
- Millets Products Processor
- complete documentation and record keeping related to operating a Millets Products Processor;
- ensure food safety, hygiene and sanitation for processing food products.

After successful completion of training and passing the assessment, you will be issued a certificate.



Fig 1.1 Skill Card Millets Products Processor

1.1.2 Introduction to QP and NOS

This training programme is intended for imparting basic skill and knowledge relevant to the job role, required to perform at a food processing industry. This programme is based on qualification pack called Millet Product Processor. The Qualification Pack Code for Millet Product Processor is FIC/Q1003. This is also called a QP.

A QP consists of a set of National Occupational Standards (NOS). NOS specify the standard competency a worker must achieve when carrying out a function at the workplace.

Under Millet Product Processor QP, there are five NOSs which detail the functions to be performed at work site as Millet Product Processor.

NOS Code	Major Function/Task
FIC/N1038	Produce Millet Based Composite Flour
FIC/N9026	Prepare for production
FIC/N9906	Apply food safety guidelines in Food Processing
FIC/N1039	Produce Millet Based Baked Products.
FIC/N1040	Produce Instant Idli and Dosa Mix.
FIC/N1040	Produce Millet Based Extruded Products
DGT/VSQ/N0101	Employability Skills (30 Hours)

UNIT 1.2: Overview of the Food Processing Industry

Unit Objectives

At the end of this unit, you will be able to:

1. List the various sectors of the food processing industry
2. Define food processing
3. Describe the various stages of food processing for converting raw materials to food products

1.2.1 Food Processing

Agriculture is the backbone of the Indian economy. The produce from various agriculture-based occupations is primarily used for consumption within the country. It is exported to different parts of the world as well. Agricultural produce is also used as raw material in the food processing industry.

Food processing is the method used to convert raw materials into food products. They could be processed foods, ready-to-eat foods, food additives or foods used to prepare other food products. Besides food processing, the food industry also relies on food preservation as an important method to store food products for longer periods of time.

The food processing industry in India is divided into several sub-sectors. They are:



Fig 1.2 Sub-Sectors of food processing industry

The Indian food industry is a star sector in India with bright prospects for growth and development. The Indian food and grocery market is the sixth-largest in the world. The food industry, particularly the food processing sector in India, has shown immense potential due to its quick-paced growth. Food processing ranks fifth in the country in terms of its production, growth, export, and consumption. One of the recent trends that is seen in this sector is online ordering of food. Even though this segment is still in its early stages of development, it is growing at an increasingly fast pace.

The food industry is implementing stringent food safety and quality measures in order to attract more investors and ensure the safety of its existing consumers. All these factors will have a positive impact on the way the sector functions and also on the job market in the country.

Women have always been associated with preparing food for the family or the household, but today, women are breaking this stereotype and turning entrepreneurs in this sector. Women are also becoming professional chefs and bakers, and contributing to the economy and towards the sector.

1.2.2 Journey of Food from Harvest to Consumer

The following chart shows the journey that food material goes through to become a final, consumable product to various customers.

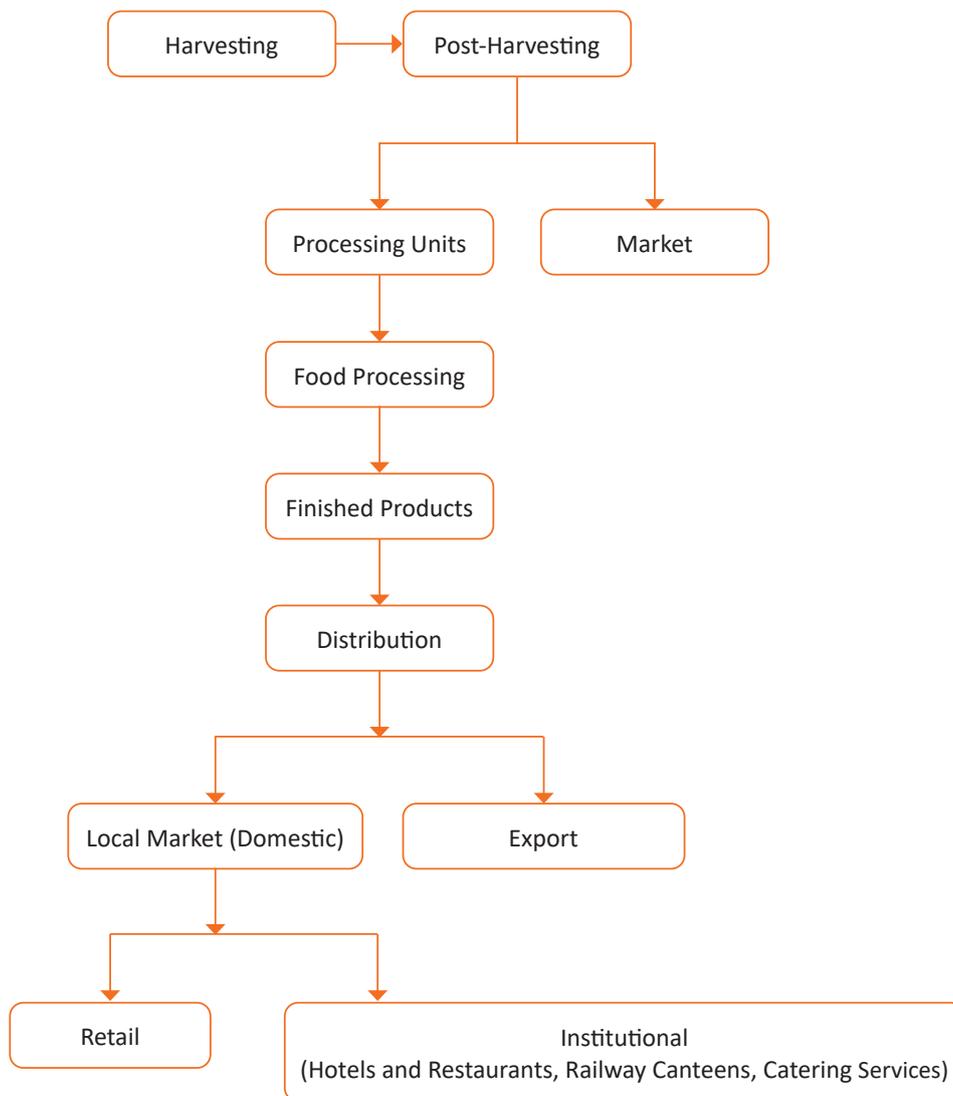


Fig 1.3 Journey of harvested food

Unit 1.3: Millet uses in various recipe forms

Unit Objectives



At the end of this unit, you will be able to:

1. Describe nutritional composition of common Millet varieties.
2. Explain the uses of various millet in different recipe forms.

1.3.1 Different types of millets and its nutritional value

In a world where health and wellness have become a supreme lifestyle, nutrition-oriented food items like Millets and other cereals are gaining popularity. Every dietician and nutritionist is vouching for the remarkable benefits that Millets have on human health. Apart from being gluten-free, they can enhance your health and promote weight loss. If you are someone who likes to eat rice and wheat in your meals every day, it might help integrate organic millets into your diet in more than one way. However, many individuals do not know the various types of millets to choose from, as well as their nutrient value and calories. Let's check out the list of millets with names that one should know about.

Vernacular Names of Millets

English Name	Sanskrit	Tamil	Kannada	Telugu	Malayalam	Punjabi	Gujarati	Hindi
Foxtail Millet	Kanguni	Thinai	Navane	Korra	Thina	Kangni	Kang	Kangni
Little Millet	-	Saamai	Saame	Saama	Chaama	Swank	Gajro, Kuri	Kutki
Barnyard Millet	Shyama	Kuthiravaali	Oodhalu	Odal	Kavadapullu	Swank	Sama	Jhangora, Sanwa
Proso Millet	China	Panivaragu	Baragu	Varigulu	Pani varak	Cheena	Cheno	Barri
Kodo Millet	Kodara	Varagu	Arka	Arikelu	Koovarugu	Kodra	Kodra	Koden, Kodra
Pearl Millet	-	Kambu	Sajje	Sajjalu, Gantilu	Kambam	Bajra	Bajri	Bajra
Finger Millet	Nandimukhi, Madhuli	Ragi/ Kelvaragu	Ragi	Ragulu	Koovarugu, Panji Pullu	Mandhuka, Mandhal	Nagli, Bavto	Mandua, Nachani
Brown Top Millet	-	Kula Samai	Korale	Andu Korralu	Chama Pothaval	-	-	Chhoti Kangni
Sorghum	-	Cholam	Jola	Jonnalu	Cholam	-	Juar	Jowar

Source: Adapted from Dayakar Rao B., Bhaskarachary K., Arlene Christina G.D., Sudha Devi G., Vilas, A. Tonapi, 2017, *Nutritional and Health benefits of Millets*. ICAR_Indian Institute of Millets Research (IIMR) Rajendranagar, Hyderabad, PP 112

Fig 1.4 Different millets and its vernacular names

Sorghum (Jowar)

Sorghum (*Sorghum bicolor*), also known as great millet, Indian millet, milo, durra, orshallu is a cereal grain plant of the grass family (Poaceae) and bears edible starchy seeds.

Nutritional Value of Sorghum

Every 100g of Sorghum contains a total of 339 kcal of energy, 74.3 grams of Carbohydrates, 6.3 grams of dietary fibre, 11.3 grams of protein, 3.3 grams of total fat out of which saturated fat is 0.5 grams, monounsaturated fat is 1.0 grams, polyunsaturated fat is 1.4 grams, Omega-3 fatty acids is 65 milligrams, Omega-6 fatty acids is 1305 milligrams and zero cholesterol.

Let check out sorghum nutrition benefits, it also contains Vitamin B1 or Thiamine (0.2 mg), Vitamin B2 or Riboflavin (0.1 mg), Vitamin B3 or Niacin (2.9 mg), Vitamin B5 or Pantothenic acid (0.367 mg), Vitamin B6 (0.443 mg), Vitamin B9 or Folate (20.0 mcg), Vitamin E or Alpha tocopherol (0.50 mg), Calcium (28.0 mg), Iron (4.4 mg), Magnesium (165 mg), Phosphorus (287 mg), Potassium (350 mg), Sodium (6.0 mg), Zinc (1.7 mg), Copper (0.284 mg), Selenium (12.2 mcg)

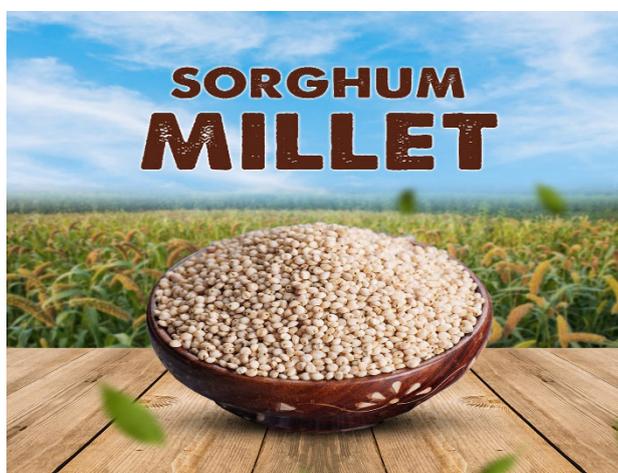


Fig 1.5 Sorghum Millet

Pearl Millet (Bajra)

The **Pearl Millet's scientific name** is *Cenchrus americanus*; it is also referred to as African Millet or Spiked Millet in different regions.

Pearl millet commonly known as Bajra, which is perhaps the most famous and widely available variety among millets.

Nutritional Value of Pearl Millet

Here's a table outlining the **Pearl millet nutritional** value per grams:

Nutrient	Amount
Energy	1456 KJ
Carbohydrates	61.78 gm
Protein	10.96 gm
Fat	5.43 gm
Fibre	11.49 gm

Finger Millet (Mandua)

Finger millet has been used across Africa and Southeast Asia for thousands of years. It's used to make bread, beer, and cereal. Today, finger millet can be found in health food stores and large supermarkets throughout the world, and it's widely used as an alternative to wheat or other grains.



Fig 1.6 Finger Millet

Nutritional Value of Finger Millet

The vitamins, minerals, and fiber found in finger millet can provide important health benefits. The potassium found in finger millet can help keep your kidneys and heart functioning properly. Potassium also helps your nerves transmit signals, which allows your brain and your muscles to work together smoothly.

Finger millet is also an excellent source of B vitamins, which play a role in everything from brain function to healthy cell division. B vitamins are even connected to a reduction in fatigue.

Nutrition type	Value
Protein	7.6 g
Fat	1.5 g
Carbohydrate	88 g
Calcium	370 mg
Vitamin (A)	0.48 mg
Thiamine (B1)	0.33 mg
Riboflavin (B2)	0.11 mg
Niacin (B3)	1.2 mg
Fiber	3 g

Foxtail Millet (kangni)

Foxtail millets, magical millets or miracle grains are natively known as Kangni, Kang and kakum. These are tiny seeds covered in a thin, crispy hull and are available in a light yellow-brownish colour.

Foxtail millets are packed with the goodness of proteins, carbohydrates, vitamins like Vitamin A and E and minerals like phosphorus, calcium, magnesium, sodium, etc. The nutrients in foxtail millets are mentioned in the table below:

Nutritional Facts	per 100g
Energy (Kcal)	351
Carbohydrates (g)	60.2
Protein (g)	12.3
Fat (g)	4.2
Minerals (g)	4
Fibre (mg)	6.7
Calcium (mg)	31
Phosphorous (mg)	290
Iron (mg)	2.8
Thiamin (mg)	0.59
Niacin (mg)	3.1

Kodo Millet (Koden)

In India, Kodo Millet (*Paspalum scrobiculatum*) grown mostly in the Deccan region and the cultivation extends to the foothills of Himalayas. Kodo millet is rich in dietary fiber and minerals like iron, antioxidant. The phosphorus content in kodo millet is lower than any other millet and its antioxidant potential is much higher than any other millet and major cereals. Higher amount of antioxidants helps against oxidative stress and maintain glucose concentrations in type-2 diabetes. Kodo millet is useful in curing asthma, migraine, blood pressure, heart attack and atherosclerosis, diabetic heart disease and for postmenopausal in females.

Nutrient per 100g	
Energy (Kcal)	302
Protein	8.03 g
Carbohydrate	69.9 g
Fibre	8.5 mg
Calcium	22.0mg
Iron	9.9mg

Barnyard Millet (Jhangora)

Barnyard Millet (*Echinochloa crusgalli*, *E. colona*), is a short duration crop that can grow in adverse environmental conditions with almost no input and can withstand various biotic and abiotic stresses. In addition to these agronomic advantages, the grains are valued for their high nutritional value and lower expense as compared to major cereals like rice, wheat, and maize. It contains a rich source of protein, carbohydrates, fiber, and, most notably, micronutrients like iron (Fe) and zinc (Zn) that are related to numerous health benefits. These features make barnyard millet an ideal supplementary crop for subsistence farmers and also as an alternate crop during the failure of monsoons in rice/major crop cultivating areas.

Nutrient per 100g	
Energy (Kcal)	341
Protein	7.7 g
Carbohydrate	67.0 g
Fibre	7.6 mg
Calcium	22.0mg
Iron	9.9mg

Proso Millet (Barri)

Proso-millet (*Panicum miliaceum L.*) is an underutilized crop which is highly nutritious cereal grain used for human consumption, bird seed, and/or ethanol production. Grains of proso Millet are a rich source of vitamins (niacin, B-complex vitamins, and folic acid), minerals (PCa, Zn, Fe) and essential amino acids (methionine and cysteine), starch, and phenolic compounds like antioxidants and Beta-glucan. Seeds also contain components with healing benefits, which decrease the level of low-density lipoprotein cholesterol in blood and injury to the liver and high lecithin content which supports the neural health system.



Fig 1.7: Proso Millet

Nutrient per 100g	
Energy (Kcal)	309
Protein	8.30 g
Carbohydrate	65.90 g
Fibre	9.0 mg
Calcium	27.0mg
Iron	0.50 mg

1.3.2 EXPLORING MILLET USES IN VARIOUS RECIPE FORMS

Sl.No.	Type of Millet	Millet Forms	Applicability	Recipe	Remarks
1	Sorghum	Grain	Semolina/ Rava	Khichdi/Upma/Pongal/ Idli Mix	
		Flour	Bakery	Cookies/Biscuits/Cake/ Muffins	Suitable Varieties of Sorghum for Millet Pasta and Vermicelli - CSV-15, CSV-20, CSV-1253, SPV-1383, SPV-1808
		Flour	RTC	Noodles/Ladoos/Pasta/ Extruded Flakes	
		Grain	Puffs	Snacks/RTE	
		Flour	Composite Flour	Roti	
		Grain	Flakes	Snacks/RTE/Poha	
2	Pearl Millet	Grain	Puffs	Snacks/RTE	
		Flour	Composite Flour	Roti/Ladoos	Shelf Life of Pearl Millet is less. The shelf life of pearl millet flour can be improved by variety of treatments, which includes pearling, fermentation, germination, blanching, microwave treatment, dry heat treatment, steaming, defatting
3	Finger Millet/ Ragi	Grain	Malt	Baby Foods/Porridge	Sprouting - Increases the bio-availability of nutrients in the body
		Flour	Bakery	Cookies/Biscuits/Cake/ Muffins	
		Flour	RTC	Noodles/Ladoos/Pasta/ Extruded Flakes	
		Grain	Flakes	Snacks/RTE/Poha	
		Grain	Beverages	Millet Milk	Soaking & Blending
		Flour	Composite Flour	Idli Mix	
		Grain	Flakes	Snacks/RTE/Poha	

Sl.No.	Type of Millet	Millet Forms	Applicability	Recipe	Remarks
4	Little Millet	Dehulled grains	Replacement of Rice	Khichdi/Upma/Pongal/Biriyani/Pulao	Care should be taken while primary processing. Ensuring the retention of bran layer
		Dehulled grains	Semolina/Rava	Idli Mix	
		Flour	RTC	Noodles	
		Dehulled grains	Flakes	Snacks/Poha	
		Flour	RTC	Vermicelli	
		Dehulled grains	Semolina/Rava	Idli Mix	
5	Foxtail Millet	Dehulled grains	Puffs	RTE/Snacks	Process of Foxtail Millet Puffs: https://www.youtube.com/watch?v=KeNRYM-MHkU
		Dehulled grains	Replacement of Rice	Khichdi/Upma/Pongal/Biriyani/Pulao	Care should be taken while primary processing. Ensuring the retention of bran layer
		Dehulled grains	Semolina/Rava	Idli Mix	
		Flour	RTC	Noodles	
		Dehulled grains	Flakes	Snacks/Poha	
		Flour	RTC	Vermicelli	
		Dehulled grains	Semolina/Rava	Idli Mix	
		Panicles	Millet Spray	Bird Feed	
6	Kodo Millet	Dehulled grains	Replacement of Rice	Khichdi/Upma/Pongal/Biriyani/Pulao/Idli	Care should be taken while primary processing. Ensuring the retention of bran layer. Kodo Millet are frequently infested with <i>Aspergillus tamarii</i> Kita, which produced substantial amount of a mycotoxin, cyclopiazonic acid (CPA) and causes poisoning. Care should be taken during pre and post harvest of the grains.
		Flour	Bakery	Cookies	
		Dehulled grains	Flakes	RTE/Snacks	
		Dehulled grains	Semolina/Rava	Khichdi/Upma/Pongal/Idli Mix	
		Flour	RTC	Noodles/Pasta	

Sl.No.	Type of Millet	Millet Forms	Applicability	Recipe	Remarks
7	Barnyard Millet	Dehulled grains	Replacement of Rice	Khichdi/Upma/Pongal/Biriyani/Pulao	Care should be taken while primary processing. Ensuring the retention of bran layer
		Flour	RTC	Noodles/Pasta	
		Flour	Bakery	Cookies	
8	Proso Millet	Dehulled grains	Replacement of Rice	Khichdi/Upma/Pongal/Biriyani/Pulao	Care should be taken while primary processing. Ensuring the retention of bran layer
		Flour	RTC	Noodles/Pasta	
		Flour	Bakery	Cookies	
9	Browntop Millet	Dehulled grains	Replacement of Rice	Khichdi/Upma/Pongal/Biriyani/Pulao	Care should be taken while primary processing. Ensuring the retention of bran layer
		Dehulled grains	Flakes	RTE/Snacks	
		Flour	RTC	Noodles	
		Flour	RTC	Roti	

Measures need to be considered from the Perspective of New Product Development:

1. **Texture:** Texture is different for each of the millet. While replacing particular millet with other, texture is to be taken into consideration.
2. **Appearance:** There are many varieties of Sorghum. The colour of the grain is different for different varieties. Some are white, yellow, cream, hetero-yellow, hetero-white, bronze, orange, dark-red, reddish-brown, white-brown, lemon yellow, chalky-white, intensified red, pearly-white, etc. While new product development the colour of the grain of Sorghum must be taken into consideration. It is also found in Finger Millet and Pearl Millet.
3. **Nutritional Value:** Every millet is unique in terms of nutritional value. The nutrient content of millets must be taken into consideration while developing a new millet product. While labeling a millet product, mentioning the nutritional value gives the millet product an advantage. Focusing on the rich content of the particular millet and building a product will attract more consumers and an association will develop gradually. Here are the nutritive values of millets:

Sl. No.	Nutrient	Millet	Nutritive value per 100 g.
1	Protein	Proso Millet	12.5 g
		Foxtail Millet	12.3 g
2	Iron	Pearl Millet	6.42 mg
		Barnyard Millet	5 mg
3	Zinc	Barnyard Millet	3 mg
4	Magnesium	Proso Millet	153 mg
5	Calcium	Finger Millet	364 mg
6	Fat	Pearl Millet	5.43 g
7	Dietary Fiber	Pearl Millet	11.4 g
8	Folic acid	Kodo Millet	39.4 µg
		Sorghum	39.42
9	Phosphorous	Foxtail Millet	290 mg
10	Carbohydrates	Foxtail Millet	60.2 g

Quality: To maintain the uniformity and consistency in millet products, the selection of a particular variety is important as there are many varieties among the 9 types of millets which differ in taste, texture, nutrition and appearance. Suppose, we need to select a Pearl Millet variety. There is a variety of Pearl Millet which is rich in iron and zinc named, DhanaShakti.

4. **Shelf Life of Millets:** Once the millets are processed into flour or the husk is removed, the shelf life of millet starts deteriorating. So, while developing a millet product, precaution measures must be taken to improve the shelf life of millets. It can be improved by variety of treatments, which includes pearling, fermentation, germination, blanching, microwave treatment, dry heat treatment, steaming, defatting and even the packaging material helps in improving the shelf life.
5. **Flavour:** Flavour of millets differ from each other. So, while developing a millet product, flavor must be considered.

Unit 1.4 Legislative guidelines for millet based food products

Unit Objectives

At the end of this unit, you will be able to:

- 1 Describe the regulatory requirements for millet base products.
- 2 Discuss the export potential for millet base products.
- 3 Explain the tools for Millet Export from India

1.4.1 Regulatory Requirement

Manufacturers of millet-based extruded products in India are required to obtain registration and a licence from the Food Safety & Standards Authority of India (FSSAI). The FSSAI certification is mandatory before commencing operations, as millet-based extruded snack products are considered non-standardized food items by the FSSAI. The certification signifies compliance with food safety standards, and the central government has the authority to monitor companies involved in processing such food items. The FSSAI conducts thorough and efficient testing of various renowned millet-based extruded product brands.

To operate as a food processing company and produce millet-based products in India, several requirements must be fulfilled to obtain permission and a food licence:

1. **Safe and Hygienic Premises:** The manufacturing company must ensure that its premises provide a safe and hygienic environment for production. This is the initial step taken by the FSSAI to ensure compliance. The company is required to fill out Form B of the FSSAI as per the legal requirements.
2. **Complete Documentation:** The company must submit all the necessary documents to obtain a certificate of authenticity. Having all the required documentation simplifies the process of obtaining the certificate. details about the required documents can be found on <https://foscoss.fssai.gov.in/>
3. **Standard Packaging:** The packaging of the finished product must adhere to the standards set by the licensing authority. Packaging plays a crucial role as it is the first thing consumers notice. The packaging industry should ensure that the packs meet the expected quality standards. Companies involved in food product packaging must apply for the relevant licence in their area of specialisation.
4. **Qualified Professionals:** The professionals employed by the extruded snack-making company must possess the necessary qualifications for food product manufacturing. Only qualified engineers should undertake the required tasks. FSSAI approves their qualifications, ensuring that the company has the expertise required to maintain high manufacturing standards.
5. **Product Testing and Quality Assurance:** Authorised licensing bodies have the right to conduct constant checks, tests, and quality inspections within the premises of the millet-based extruded products manufacturing factory. They also test the taste-maker to ensure the safety of spices and ingredients. Even large companies in the industry must comply with these stringent regulations and demonstrate their product quality. If the FSSAI is not satisfied with a product, it has the authority to impose a ban.

6. **Reliable and Quality Equipment:** The equipment used in the production of millet-based extruded products must be reliable and of superior quality to ensure the safe manufacturing of the products.
7. **Inspection and Approval:** Once the FSSAI is satisfied with the documentation submitted for the licence, they conduct a stringent inspection to ensure compliance with all laws and premises safety standards before granting the licence to the company.
8. **Compliance and Consequences:** Companies found violating FSSAI rules are subject to punishment.

After the licence expires, the company must undergo the renewal procedure to reapply for the licence. However, once the licence is obtained, food manufacturing operators can operate with confidence, knowing that their product quality will not be rejected. The strict regulations governing the food processing industry in India aim to safeguard public health.

In addition to the requirements for obtaining a licence, there are sanitary and hygienic requirements that food manufacturers, processors, and handlers must follow:

1. **Sanitary Location:** The premises where food is manufactured, processed, or handled should be located in a sanitary area, free from unclean surroundings, and maintain an overall hygienic environment. New units should be set up away from environmentally polluted areas.
2. **Adequate Space:** The premises conducting food manufacturing should have sufficient space for manufacturing and storage, ensuring an overall hygienic environment.
3. **Clean and Well-Maintained Premises:** The premises should be clean, well-lit, and adequately ventilated, with enough free space for movement. Floors, ceilings, and walls should be in good condition, with a smooth surface that is easy to clean, free from flaking paint or plaster.
4. **Insect and Pest Control:** The premises should be kept free from insects and pests. Effective disinfectants should be used to wash the floors and skirted walls. Windows, doors, and other openings should be fitted with appropriate nets or screens to prevent insects from entering the premises. No spraying should be done during food processing, and fly swats or flaps should be used instead.
5. **Potable Water:** The water used in manufacturing should be safe and potable. Regular chemical and bacteriological examinations of the water should be conducted at recognized laboratories. Continuous and adequate potable water supply should be ensured, and suitable arrangements should be made for storage if there is intermittent water supply.
6. **Equipment and Machinery:** The equipment and machinery used should be designed for easy cleaning. Adequate arrangements should be in place for cleaning containers, tables, working parts of machinery, etc. Vessels, containers, and equipment that may cause metallic contamination harmful to health should not be used, unless they have proper linings.
7. **Cleanliness of Equipment:** All equipment should be kept clean, washed, dried, and stacked after use to prevent the growth of mould, fungi, and infestation. Equipment should be placed away from walls to allow for proper inspection.
8. **Proper Drainage and Refuse Disposal:** An efficient drainage system should be in place, and provisions for proper refuse disposal should be made.

9. **Hygiene of Workers:** Workers involved in processing and preparation should wear clean aprons, hand gloves, and headwear. People suffering from infectious diseases should not be allowed to work. Cuts or wounds should be covered, and workers should not come in direct contact with food.
10. **Personal Hygiene:** Food handlers should maintain clean and trimmed fingernails. They should wash their hands with soap or detergent and water before starting work and after using the toilet. They should avoid scratching their bodies or hair during food handling processes. False nails, loose jewellery, and touching the face or hair should be avoided.
11. **Prohibited Activities:** Eating, chewing, smoking, spitting, and nose blowing are strictly prohibited within the premises, especially while handling food.
12. **Proper Storage:** All articles stored or intended for sale should be fit for consumption and adequately covered to avoid contamination.
13. **Vehicle Maintenance:** Vehicles used for transporting food must be kept in good repair and cleanliness.
14. **Temperature Maintenance:** Packaged foods or containers should maintain the required temperature during transport.
15. **Insecticides/Disinfectants:** Insecticides and disinfectants should be stored separately and away from food manufacturing, storage, and handling areas.

By adhering to these sanitary and hygienic requirements, food manufacturers, processors, and handlers can maintain a safe and hygienic environment throughout the production process, ensuring the quality and safety of millet-based extruded product.

1.4.2 Export Potential

India, proudly holding the first position in millet production, plays a significant role in nourishing the world with these ancient grains. With a production of approximately 173 lakh metric tonnes, India accounts for 80% of Asia's millet production and 20% of global production, as per the Department of Agriculture and Farmers Welfare, Government of India.

Adding to its accolades, India ranks among the top five millet exporters worldwide. In the year 2019-20, India exported 0.08 million metric tonnes of millets, valued at INR 205.2 crores (USD 28.75 million), according to the Directorate General of Commercial Intelligence and Statistics (DGCIS) report.



2030P INDIA EXPORT VALUE	Bajra	Ragi	Sorghum	Other Millets
Grain	60	4	27	2
Flour	70	32	31	6
Malt	0	7	0	0
Biscuits	168	168	168	168
RTC Mixes - Vada, Dosa, Cake	20	50	20	50
Noodles, Vermicelli, Pasta	67	67	67	67
Snacks Mixtures	101	101	101	101
Beverages Mix	60	101	60	101

Fig 1.8 Millet Export

The global export of millets has witnessed substantial growth, soaring from USD 400 million in 2020 to USD 470 million in 2021, as reported by the ITC Trade Map. Riding this wave, India's millet exports reached a value of USD 64.28 million in the year 2021-22, surpassing the previous year's USD 59.75 million.

Let's explore the major importers of Indian millets in the respective years:

Sl.No.	Country	2020-21		2021-22	
		Qty in MT	US \$(in Million)	Qty in MT	US \$(in Million)
1	UAE	27892.7	11.77	33394.47	11.51
2	Saudi Arab	20354.7	6.13	20154.19	6.64
3	Nepal	22474.1	6.56	21328.91	5.98
4	USA	2915.07	3.27	3308.83	4.49
5	Japan	5482.88	2.6	6106.88	2.94
6	Germany	2770.09	2.81	2738.63	2.58
7	Bangladesh	6423.4	2.06	7812.02	2.35
8	Egypt	1233.27	0.6	2349.6	2.16
9	Iran	928	0.61	4601.55	1.96
10	Oman	3164.17	0.94	6296.82	1.89
11	Others	53862.75	22.4	51240.4	21.78
	Total	147501.1	59.75	159332.2	64.28

Table 1.1 : major millet importers

As we observe, the United Arab Emirates (UAE), Saudi Arabia, and Nepal secured the top three spots as the major importers of Indian millets in both years. Notably, Japan, Germany, Bangladesh, Egypt, Iran, and Oman also demonstrated significant demand for these nutritious grains.

Now, let's delve into the demand for various types of millet products:

Sl.No.	Product	2020-21		2021-22	
		Qty in MT	US \$(in Million)	Qty in MT	US \$(in Million)
1	Bajra	58,407	17.69	64,467	20
2	Sorghum	41,398	17.06	48,818	18.65
3	Ragi	25,408	7.69	23,264	6.99
4	Jawar	941	0.65	1,655	1.52
5	Canary	1,189	0.51	3,625	1.54
6	Buckwheat	1,612	0.93	708	0.47
7	Other Cereals (including Foxtail, Kodo, Barnyard, Proso, Little Millet etc)	18,037	14.29	15,974	13.88

Table 1.2: Types of millet products

Bajra, known for its versatility and nutritional value, held the top position in demand, closely followed by sorghum and ragi. These millet products garnered significant attention from both domestic and international markets.

With a strategic focus on promoting millet exports, the Agricultural and Processed Food Products Export Development Authority (APEDA) has been at the forefront of facilitating shipments and fostering new markets for Indian millet exporters. Despite the challenges posed by the COVID-19 pandemic, APEDA successfully organized virtual trade fairs and buyer-seller meets to foster interaction among exporters, producer organizations, and international buyers.



Fig 1.9 Millet Export Potential

Moreover, APEDA's Nutri Cereals Export Promotion Forum, in collaboration with the Indian Institute of Millets Research (IIMR), has formulated strategies to refine the millet value chain for export markets. Additionally, the forum has conducted sensitization programs to familiarize millet start-ups with the vast export opportunities.

Encouragingly, the Indian government has also stepped in to support millet production and exports. In the Union Budget for 2022-23, Finance Minister Smt. Nirmala Sitharaman announced assistance for post-harvest value addition and branding of millet products, both in domestic and global markets.

As India's millet exports continue to thrive and satisfy the increasing global demand, these resilient grains hold immense potential to nourish populations worldwide and contribute to a sustainable and healthy future.

1.4.3 Authentic Tools for Millet Export from India: Simplifying the Process

If you aspire to venture into the thriving millet export business from India, it is essential to equip yourself with the necessary tools and documentation. To ensure a smooth and legitimate export process, here are the key requirements:

Registration of the Firm:

Before embarking on millet export, it is crucial to register your firm. This step establishes your business as a legal entity and facilitates various operational aspects. Make sure to complete the registration process as per the applicable regulations and guidelines.

1. Bank Account Details:

Having a dedicated bank account for your export transactions is vital. This account will serve as a hub for managing financial transactions related to millet exports, including receiving payments from international buyers.

2. Goods and Services Tax (GST):

Ensure that your firm is registered under the Goods and Services Tax (GST) regime. Obtaining a GST number is essential for complying with tax regulations and facilitating smooth export operations.

3. Permanent Account Number (PAN):

Acquire a Permanent Account Number (PAN) issued by the Income Tax Department. PAN serves as a unique identification number for your firm and is required for various financial and legal purposes.

Importer-Exporter Code (IEC):

The Importer-Exporter Code (IEC) is a mandatory requirement for engaging in import and export activities. The Directorate General of Foreign Trade (DGFT) grants the IEC number, which is a unique identifier for your firm's import-export transactions.

Obtaining the IEC number involves registering on the DGFT portal (<https://www.dgft.gov.in>). Visit the website and locate the "Apply for IEC" section. Fill in the required details accurately and submit the application. Within a few days, you will receive your IEC Code, allowing you to initiate millet export operations with confidence.

The screenshot displays the registration interface on the Directorate General of Foreign Trade (DGFT) portal. On the left, a blue banner features the DGFT logo and the text "Glad to see you" above an illustration of two people interacting with a computer screen. On the right, the "REGISTER" form is visible, with a "LOGIN" tab also present. The form includes a dropdown menu for "Register User As*", a mandatory field notice, and input fields for "First Name", "Last Name", "Email ID", "Mobile No.", "Pincode", "District", "State", and "City". A CAPTCHA code "ZN75R" is shown, followed by a text input field for the code. At the bottom, there is a checkbox for "By registering you are agreeing to our terms & conditions".

Fig 1.10

By fulfilling these requirements and obtaining the necessary documentation, you lay a solid foundation for your millet export endeavors. Linking back to the previous discussion on millet export, it is evident that these tools and authentic documentation are crucial for participating in the flourishing millet export market.

With your firm's registration, bank account, GST, PAN, and IEC number in place, you can navigate the export landscape with ease and compliance. Armed with these authentic tools, you are ready to seize the abundant opportunities and contribute to meeting the global demand for nutritious millets.

The Next Step: Determining the HSN Code for Millet Export

Once you have gathered the essential tools for millet export from India, the next crucial task is to determine the Harmonized System of Nomenclature (HSN) code for the specific commodity you intend to export. Here's a step-by-step guide on how to find the HSN code for millets:

1. Visit the website of the Directorate General of Commercial Intelligence and Statistics (<http://dgciskol.gov.in>) to access the necessary information.

2. On the right side of the screen, locate the section labeled “8 Digit Commodity Classification” and click on it. This action will redirect you to the Indian Trade Classification (Harmonized System)-2017.
3. Once you have accessed the Indian Trade Classification, navigate to Section II, which pertains to Vegetable Products.
4. Within Section II, you will find Chapter 10, which is specifically dedicated to cereals.
5. Millets, being a type of cereal, will be listed under Chapter 10. This is where you will discover the appropriate HSN code for millets.

Heading No.	HS Code	ITC (HS)	Description	Units
			Grain Sorghum	
	100710	10071000	Seed	KGS
		10079000	Other	KGS
1008	100821		Millet Seed	
		10082110	Jawar	KGS
		10082120	Bajra	KGS
		10082130	Ragi	KGS
	100829		Other	
		10082910	Jawar	KGS
		10082920	Bajra	KGS
		10082930	Ragi	KGS

Table 1.3: HCN code for millets

By following these steps, you will be able to identify the accurate HSN code for millets, enabling you to complete the necessary documentation and ensure compliance with customs and trade regulations. This process aligns seamlessly with the earlier discussion on the tools required for millet export, emphasizing the importance of understanding the HSN code for your specific commodity.

Knowing the HSN code for millets plays a vital role in accurately classifying your product during export, facilitating smooth customs clearance and enhancing transparency in international trade. By linking the HSN code search to the previous discussion, you can seamlessly progress in your millet export journey, equipped with the knowledge to navigate the regulatory landscape with confidence.

After obtaining the HS Code for millets, the next step is to delve into the recent trends of millet export from India. This includes identifying the importing countries, understanding the quantity of export, and evaluating the value of the products. While there are various sources available, obtaining authentic data without any additional cost is crucial.

To access reliable and up-to-date information, follow these steps:

1. Visit the website of the Department of Commerce and Industry, Government of India, available at (<https://tradestat.commerce.gov.in>).
2. Look for the section titled “Exports” and click on “Commodity-wise All Countries.”
3. Select the relevant year for which you want to gather data, in this case, 2021-22 and 2022-23.
4. Enter the specific HS Code for millet for Instance, Ragi, which is “10082130,” in the provided field.
5. Choose the appropriate sorting option based on your preference, such as sorting by value or quantity.
6. Click on the “Submit” button to retrieve the comprehensive data you are seeking.

By following these steps, you will gain access to the desired information on millet exports, including details on importing countries, export quantities, and the value of the products. Utilizing the website of the Department of Commerce and Industry ensures you acquire authentic data directly from reliable government sources, eliminating the need to rely on paid platforms or private entities.

Obtaining accurate and up-to-date information is crucial for understanding market trends, identifying potential growth opportunities, and making informed decisions regarding millet exports. By linking this process with the previous discussion on obtaining the HSN code, you can create a seamless flow of information, enabling you to navigate the export landscape efficiently and effectively.

India is fortunate to have esteemed organizations supporting millet export and facilitating the growth of this sector. The Indian Institute of Millet Research (IIMR) in Hyderabad, for instance, submitted a “White Paper on Millets” to Nitiyoag, highlighting various interventions and the role of stakeholders in millet export from India.

Here are some key interventions and their expected outcomes supported by these organizations:

Sl. No.	Intervention	Description	Expected Outcomes	Stakeholders
1	Standards and Grades	Establishing the Standards and Grades for small millets, and also for the degree of polishing for transparent marketing	-Consumer safety -Increased processing units	FSSAI ICAR-IIMR CSIR-CFTRI IIT -Kharagpur
2	HS Codes	Establishing HS Codes for small millets for exporting	Increased Exports	APEDA ICAR-IIMR
3	Export demand Mapping	Identifying Export market trends and potential for various millet value-added products	Clear positioning strategies	ICAR-IIMR APEDA
4	Positioning Strategies	Framing the USPs for various product segments of domestic and international markets	Better penetration of products	ICAR-IIMR
5	Export Promotion Forum	Creation of Millet Export Promotion Forum with all concerned stakeholders for integrated export promotion nationally	-Strong sourcing linkages -Increased export traders, start-ups	ICAR-IIMR DAC and FW APEDA

Table 1.4: Key interventions and outcomes

In addition to the efforts of organizations like IIMR, the Agricultural and Processed Food Products Export Development Authority (APEDA) plays a significant role in millet export from India. APEDA's primary objective is to promote the export of agricultural products, aiming to position India as a consistent supplier of quality and competitively priced products.

APEDA has implemented various promotional schemes to support millet export, including:

- Export Infrastructure Development Schemes.
- Quality Development Schemes.
- Market Development Schemes.

These initiatives by APEDA aim to enhance the export ecosystem for millets and other agricultural commodities, fostering growth and competitiveness in the global market. The following table provides an overview of the initiatives taken by APEDA in millet export promotion:

Initiative	Description
Export Infrastructure Development Schemes	Schemes aimed at developing export-related infrastructure.
Quality Development Schemes	Schemes focused on improving product quality and standards.
Market Development Schemes	Schemes designed to facilitate market expansion and demand generation.

Table 1.5: Initiatives taken by APEDA

By leveraging the support of organizations like IIMR and APEDA, the millet export sector in India is poised for growth, ensuring the country's position as a reliable and competitive player in the global market.

For entrepreneurs looking to venture into millet export from India, there are certain basic requirements and key advice to keep in mind to tap into the immense potential of millet value-added products in the global market.

Basic Requirements for Millet Export from India:

1. **Ability to Export the Required Quantity:** Entrepreneurs should ensure that they have the capacity to meet the quantity demands of potential buyers and maintain a consistent supply of millet products.
2. **Consistent Supply:** It is crucial to establish a reliable supply chain to ensure a steady flow of millet products to meet market demand. Consistency in supply builds trust and reliability among buyers.
3. **Quality Product:** Maintaining high-quality standards is essential to compete in the international market. Entrepreneurs should focus on producing millet products that adhere to strict quality control measures and meet the expectations of consumers and importing countries.
4. **Price Competitiveness:** To remain competitive, entrepreneurs should strive to offer millet products at a competitive price point without compromising on quality. This requires efficient production processes, cost optimization, and understanding market dynamics.
5. **Meeting Importing Countries' Standards and Grades:** Entrepreneurs must ensure that their millet products meet the specific standards and grades set by the importing countries. Adhering to these norms is essential to gain market access and comply with international trade regulations.

1.4.4 Advice to Entrepreneurs for Millet Export from India

1. **Develop Innovative Millet Products:** Entrepreneurs should focus on developing innovative millet-based products that cater to changing consumer preferences and trends. This can include introducing millet-based snacks, breakfast cereals, beverages, and gluten-free alternatives.
2. **Tailor Products to Consumer Preferences and Tastes:** Understanding the preferences and tastes of the target consumer market is vital. Entrepreneurs should conduct market research to identify consumer needs and develop millet products that align with their preferences.
3. **Technology Development for Superior Quality Products:** Invest in research and development to leverage technology for producing superior quality millet products. This can include advanced processing techniques, preservation methods, and packaging solutions that enhance the shelf life and appeal of the products.
4. **Focus on Gluten-Free Products:** With the increasing trend of gluten-free diets in western countries, entrepreneurs can capitalize on this market by developing gluten-free millet products. This can open up new opportunities and attract health-conscious consumers.
5. **Analyze Millet Products in Other Countries and Consumer Preferences:** Study the millet product landscape in other countries and analyze consumer preferences to gain insights into potential market opportunities. This information can guide entrepreneurs in developing targeted product offerings.

India has become a major player in the millet export market, thanks to its large production capacity and favourable market conditions. To capitalise on the growing global demand for healthy and sustainable food options, millet exporters must meet quality standards, ensure consistent supply, and focus on product innovation. With its nutritional benefits and increasing consumer awareness, millet export from India presents lucrative opportunities for entrepreneurs and contributes to the country's agricultural and economic growth.



Fig 1.11 Business opportunities

Unit 1.5 Millet Based Business Opportunities and Government Initiatives

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the available business opportunities in millet sector.
2. Discuss the various government initiatives and schemes to support millet startups in India.

1.5.1 Business Opportunities

Millet Business Plan – Introduction: Millets are taking their position on the plate and becoming part of the diet of health-conscious people, not by force but by choice. The demand for millets-based products is increasing in the urban areas and thus creating ample opportunities for new market entrants entrepreneurs.

The uniqueness of Millets:

- Millets are a superfood and are the powerhouse of rich nutrients packed with energy. It got its reward and is now called as Nutri-Cereals.
- Millets are gluten-free and the trend of the gluten-free market is increasing at a faster rate.
- It contains a good profile of micronutrients.
- It does not contain trans fat.
- It is rich in dietary fiber and resistant starch which works as pre-biotics.
- It is alkaline in nature and contains non-acid-forming properties.
- Millets contain a balanced amino profile. The digestibility of millets can be increased by proper processing and malting.
- Millets are good for farmers as it is suitable for dryland farming and requires less agricultural inputs and can sustain drought
- It is good for the planet as it is a climate-resilient crop.
- It is used in the pharmaceutical industry.

Millet Business Plan – Millet Primary Processing Unit:

There are nine types of millets grown in India. It is categorized into 2 depending on the presence of the husk layer. Sorghum, Pearl Millet, and Finger Millet does not contain husks and they are called naked grains. The rest 6 millets (Little Millet, Foxtail Millet, Barnyard Millet, Proso Millet, Kodo Millet, and Browntop Millet) requires the removal of the husk to make it suitable for human consumption. It starts with cleaning, grading, and finally removing the husk layer.

For establishing a millet processing unit we require space as per the machines to be installed. To start with we require at least three machines.

Grader-cum-Aspirator

Destoner-cum-Aspirator

Dehuller-cum-Aspirator (Single and Double Stage dehuller)

The cost of establishing this unit varies from 3-5 lakhs to 60-70 lakhs depending upon the capacity of the machines.

If you want to start with a small dehuller, it will cost about Rs.75,000/-. This is the first tabletop dehuller in India developed by DHAN Foundation.

Before Starting this primary processing unit, we need to keep in mind some valuable points:

- Need to do the survey to know the market potential and the availability of raw materials.
- The performance of machines and their efficiency to be checked before purchasing the machines.
- Entrepreneurs must be familiar with the operating of machines or a trained machine operator is required.
- Understanding the millet grains' shape and sizes.

Millet Value Addition:

Value-Addition is the process of taking a raw commodity and changing its form to produce a high-quality end product.

Why Value Addition of Millets is required?

To meet the taste/preferences of the consumers.

- 1) Reducing post-harvest losses.
- 2) Nutrient enhancement.
- 3) Ready to eat (RTE), ready to Cook (RTC) – Reduces the cooking time.
- 4) Enhance shelf life and make the product available for a long time.
- 5) Diversified Millet products can solve our food needs as climate changes.
- 6) Improving the consumption of millet products can help to overcome malnutrition.
- 7) Millet farmers will have more post-harvest technologies thus enhancing the economic value of millet as well as improving the status of farmers.

1.5.2 Government Schemes for millet based start-ups

In recent years, the world has witnessed a significant shift towards healthier and more sustainable food choices. As a result, ancient grains like millets have been thrust into the spotlight due to their numerous nutritional benefits and environmental advantages. These small but mighty grains have become the focus of attention for entrepreneurs and innovators looking to capitalize on the growing demand for nutritious snack options.

Recognizing the potential of millet-based startups, governments around the globe have stepped up to support these ventures through various schemes and initiatives. These government programs aim to provide financial assistance, technical know-how, and market access to budding entrepreneurs in the millet snack industry. By doing so, they foster innovation, create employment opportunities, and promote the consumption of healthier and more sustainable snacks.

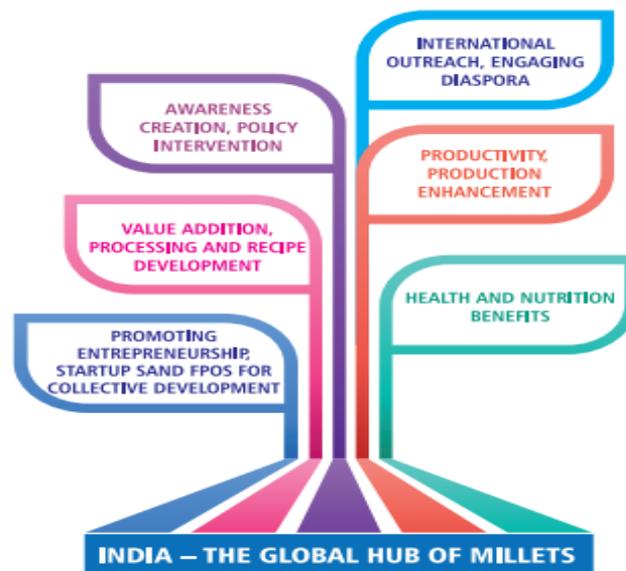


Fig 1.12 Global opportunities for millets

In this chapter, we delve into various schemes for millet startups, exploring the different avenues available to entrepreneurs looking to enter the millet snack market. We will examine the initiatives taken by governments in different countries and regions, showcasing the support mechanisms put in place to nurture the growth of millet-based businesses. From grants and subsidies to mentorship programs and research collaborations, these schemes play a crucial role in empowering entrepreneurs to turn their millet snack dreams into reality.

The Production Linked Incentive Scheme for Food Processing Industry (PLISFPI) and the Production Linked Incentive Scheme for Millet Based Products (PLISMBP)

The Production Linked Incentive Scheme for Food Processing Industry (PLISFPI) and the Production Linked Incentive Scheme for Millet Based Products (PLISMBP) are visionary initiatives recently announced by the Ministry of Food Processing Industries. These schemes are designed to propel the Indian food processing industry into the global spotlight while simultaneously empowering millet-based startups. The overarching objective is to create global food manufacturing champions and promote Indian brands of food products. By incentivizing the manufacturing of key food segments such as ready-to-cook/ready-to-eat (RTC/RTE) foods, processed fruits and vegetables, marine products, and Mozzarella Cheese, these schemes offer a unique opportunity for millet entrepreneurs to showcase their innovative and nutritious snack alternatives. Moreover, the support for branding and marketing abroad aims to foster the emergence of strong Indian brands that can capture the attention of international consumers. The schemes also play a pivotal role in uplifting farmers by ensuring remunerative prices for their produce and generating higher income. With an emphasis on sustainability and job creation, the PLISFPI and PLISMBP schemes are paving the way for a brighter future for millet startups, transforming the snack industry and driving positive change in the global food system.

The Pradhan Mantri Formalization of Micro Food Processing Enterprises (PMFME) scheme

The Pradhan Mantri Formalization of Micro Food Processing Enterprises (PMFME) scheme, launched as part of the Atmanirbhar Bharat Abhiyan, has emerged as a transformative force in the unorganized segment of the food processing industry in India. With its implementation spanning across 35 states and Union Territories, this scheme aims to enhance the competitiveness of existing individual micro-enterprises while promoting the formalization of the sector.

A key objective of the PMFME scheme is to provide support to Farmer Producer Organizations (FPOs), Self Help Groups (SHGs), and Producers Cooperatives along the entire value chain. It seeks to empower these entities by offering increased access to common services such as processing facilities, laboratories, storage, packaging, marketing, and incubation services. By integrating with an organized supply chain, the scheme aims to strengthen branding and marketing efforts, facilitating the transition of approximately 200,000 existing enterprises into a formal framework.



Fig 1.13

In line with the One District One Product (ODOP) approach, the PMFME scheme leverages the advantages of scale by focusing on procurement, common services, and product marketing within specific districts. Each district is identified for a specific food product, with an emphasis on perishables. Millets have found their place within the ODOP scheme, with districts like Malkangiri and Nuapada in Odisha, Tirap in Arunachal Pradesh, Komaram Bheem and Mahabubnagar in Telangana, Dharmapuri and Virudhunagar in Tamil Nadu, Nandurbar, Solapur, and Thane in Maharashtra, Davanagere in Karnataka, Poonch in Jammu and Kashmir, and Dang in Gujarat. Additionally, Sukma in Chattisgarh has also embraced millets under the PMFME scheme.

The PMFME scheme stands as a catalyst for change, empowering micro food processing enterprises and promoting their formalization. By providing crucial support and access to common services, the scheme fosters a favorable environment for growth and development within the food processing industry. As millets become an integral part of the ODOP approach, these initiatives open doors for entrepreneurs and create opportunities for the widespread adoption of millet-based products in the Indian market.

Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP):

Imagine a world where the goodness of millets is not only celebrated but also becomes a part of our daily lives, ensuring nutritional security for all. That's precisely what the Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP) aims to achieve. This innovative scheme takes a comprehensive approach, showcasing improved production and post-harvest technologies that make a visible impact on millet cultivation, consumption, and promotion.

Under the INSIMP scheme, financial assistance is provided to farmers, farmer producer organizations, and other stakeholders who play a crucial role in promoting millet cultivation, processing, and marketing. By offering this support, the scheme encourages farmers to embrace millet cultivation and empowers them to explore the vast potential of this nutrient-rich grain. Moreover, INSIMP recognizes the importance of consumer awareness and endeavors to educate people about the incredible nutritional benefits that millets offer.



Fig 1.14

Rashtriya Krishi Vikas Yojana (RKVY):

In the pursuit of transforming the landscape of millet production in India, the Rashtriya Krishi Vikas Yojana (RKVY) emerged as a comprehensive and empowering initiative. This scheme acts as a driving force, providing financial assistance to farmers, farmer producer organizations, and other stakeholders involved in promoting millet cultivation, processing, and marketing.

With over 500 startups actively working in the millet value chain, the impact of RKVY is undeniable. The Indian Institute on Millet Research has incubated 250 startups under RKVY-RAFTAAR, nurturing their growth and propelling them towards success. To further support these ambitious entrepreneurs, over Rs. 6.2 crores has been disbursed to more than 66 startups, creating a dynamic ecosystem of innovation and growth within the millet sector.

Haryana Millet Promotion Plan:

In the picturesque state of Haryana, millets have found a special place in the hearts and plates of its residents. The Haryana Millet Promotion Plan sets the stage for a year-round celebration of these tiny powerhouses of nutrition. With a meticulously crafted month-wise plan, activities such as farmers' training, awareness campaigns, and market promotions are carried out to foster millet cultivation, processing, and marketing in the state.

To encourage farmers to adopt improved production technologies and enhance millet productivity, financial assistance is provided under this scheme. By investing in the growth and development of millet cultivation, Haryana aims to create a sustainable ecosystem that not only benefits farmers but also brings the goodness of millets to every household in the state.

Through these engaging schemes, INSIMP, RKVY, and the Haryana Millet Promotion Plan, the stage is set for a millet revolution. With the combined efforts of farmers, entrepreneurs, and consumers, we can unlock the immense potential of millets, ensuring food security, promoting health and nutrition, and sowing the seeds of a brighter future for generations to come.

Apart from this, There are several organizations in India that can provide support in terms of technologies and finance to millet-based startups. Here are some of them:

Nutrihub:

Nestled within the vibrant campus of the Indian Institute of Millets Research (IIMR) in Hyderabad, Nutrihub shines as a beacon of support for agri-business startups. As a dedicated Technology Business Incubator, Nutrihub offers a nurturing environment where startups in the millet ecosystem can thrive. The incubator provides a comprehensive range of resources, including mentoring, networking opportunities, and crucial access to funding, empowering entrepreneurs to bring their millet-based innovations to life.



Fig 1.15

One of the greatest advantages of Nutrihub is its affiliation with IIMR, which opens doors to invaluable research facilities and technical expertise. Startups gain access to cutting-edge resources, enabling them to develop and refine their millet-centric products with the utmost precision and excellence. The Indian Institute of Millets Research not only provides technical support but also offers training programs that equip entrepreneurs with the knowledge and skills needed to succeed in the competitive market.

National Institute of Food Technology, Entrepreneurship, and Management (NIFTEM):

In the pursuit of nurturing millet entrepreneurship, the National Institute of Food Technology, Entrepreneurship, and Management (NIFTEM) stands as a formidable ally. With campuses in Thanjavur and Kundli, NIFTEM plays a pivotal role in supporting millet entrepreneurs through technology transfer

and the development of innovative millet products. By harnessing the power of research and knowledge, NIFTEM empowers entrepreneurs to transform their ideas into tangible, market-ready solutions.

Council of Scientific and Industrial Research (CSIR)-Central Food Technological Research Institute (CFTRI):

At the forefront of technological advancements in the millet sector, the Council of Scientific and Industrial Research (CSIR)-Central Food Technological Research Institute (CFTRI) in Mysuru holds immense significance. The institute has successfully developed numerous technologies centered around millets, which have been effectively transferred to small and medium enterprises. By bridging the gap between scientific innovation and entrepreneurial endeavors, CSIR-CFTRI contributes to the growth and prosperity of millet-based startups, driving positive change within the industry.

DRDO-Defence Food Research Laboratory (DFRL)

DRDO-Defence Food Research Laboratory (DFRL), located in Mysore, has made significant strides in the development of innovative technologies centred around millets. The laboratory's remarkable achievements go beyond scientific breakthroughs as it actively transfers these technologies to various companies, fostering growth and prosperity within the millet industry. By bridging the gap between scientific expertise and entrepreneurial endeavors, DFRL plays a pivotal role in driving positive change and transformation. Through collaboration and knowledge sharing, the laboratory empowers startups to harness the potential of millets, paving the way for a future where these nutritious grains play a crucial role in our diet and well-being.

Centre for Innovation and Agripreneurship (CIA):

Nestled within the esteemed National Institute of Agricultural Extension Management (MANAGE), the Centre for Innovation and Agripreneurship (CIA) emerges as a dynamic force in fostering successful ventures within the agricultural and allied sectors. The CIA serves as a comprehensive solution provider, guiding aspiring enthusiasts and entrepreneurs towards realizing their agricultural dreams. With a unique methodology that covers the entire journey from ideation to full-scale commercialization, the CIA creates a robust ecosystem that nurtures high-value propositions within a sustainable environment.

The center's primary focus lies in promoting the development of innovative products for startups, addressing disruptive challenges within the agricultural sector. By facilitating employment opportunities and wealth creation, the CIA contributes to the inclusive growth of the country's GDP. Through impactful capacity-building programs, the CIA has already trained an impressive number of professionals, with

many of them successfully establishing their own enterprises. Now, the center strives to take these agripreneurs to the next level by providing incubation support and fostering high-impact ventures that will shape the future of agriculture.

Agriculture and processed food production export Development Authority (APEDA)

It is an apex body that promotes export trade of agricultural products in India. Setup by the ministry of Commerce and Industry, Government of India. APEDA is responsible for export promotion of Fresh Fruits & Vegetables, Processed Food products, Livestock products and Cereals. It provides the crucial interface between farmers, storehouses, packers, exporters, surface transport, ports, Railways, Airways, all others engaged in export trade and finally to the international market. Directly or indirectly, it offers services that support farmers and exporters from different states in the country. It bridges the gap between agricultural and processed food producers to reach to the exporters in international markets.



Fig 1.16

The Federation of Indian Export Organisations (FIEO)

The Federation of Indian Export Organisations (FIEO) is a renowned apex body representing the entrepreneurial spirit of Indian exporters in the global market. Established in 1965 through a collaboration between the Ministry of Commerce, Government of India, and private trade and industry, FIEO serves as a crucial partner of the Indian government in promoting the country's exports. As a leading export promotion organisation, FIEO plays a vital role in supporting and facilitating India's export activities on the global stage.

Exercise **1. Fill in the blanks with the correct option.**

- a. Food_____ is the method used to convert raw materials into food products.
- | | |
|-----------------|----------------|
| i. proofing | ii. dispersing |
| iii. processing | iv. Picking |
- b. Journey of food from harvest ultimately reaches the_____
- | | |
|---------------|-------------|
| i. consumers | ii. bankers |
| iii. builders | iv. Packers |
- c. _____ is the backbone of the Indian economy.
- | | |
|----------------|----------------------|
| i. Agriculture | ii. Fishing |
| iii. Mining | iv. Meat and Poultry |

2. Answer the following questions:

- a. Describe the authentic tools for Millet Export from India.

- b. Name any 2 government initiatives that supports the millet base startups in india.



2. Prepare for Production

Unit 2.1 – Basic Calculations

Unit 2.2 – Selection of Raw Material

Unit 2.3 – Production Planning Process

Unit 2.4 - Cleaning and maintenance of the workplace



Key Learning Outcomes



At the end of this unit, you will be able to:

1. Use basic mathematics for various calculations in day-to-day processes
2. List the various raw materials used in the milling process
3. Name the various products obtained from raw materials that are milled
4. Select raw materials based on quality parameters
5. Plan the production schedule as per organisational standards and instructions
6. Plan and organise for raw material, manpower, equipment, and machineries for the scheduled production

UNIT 2.1: Basic Calculations

Unit Objectives

At the end of this unit, you will be able to:

1. Use basic mathematics for various calculations in day-to-day processes

2.1.1 Units of Measurement

In the food processing industry, raw materials, ingredients and chemicals are used in a specified quantity. They are measured in metric units. Some common units of measurements used are:

Particulars	Unit of measurement
Fruits and vegetables	Kilogram(kg) or gram(g)
Chemicals	Volume(oz.), Litre(L) or millilitre (ml)
Temperature	Degree Celsius (°C) or Fahrenheit (°F)
Duration	Time (minutes, hours, seconds)

The requirement of knowledge of basic mathematics in a Grain Mill is significant. The basic principles of mathematics include:

- Addition
- Subtraction
- Multiplication
- Division
- Percentage calculation
- Error judgement

These are required by a Millets Products Processor so as to calculate the predicted yield and the actual yield. Also, he/she would have to find the difference in the predicted outcome to the actual one. The amount of wasted grains and raw materials also has to be taken into account, therefore, it is necessary to have these mathematics skills.

The following example illustrates the need of mathematics in a milling plant.

The supervisor/manager has got 100 tonnes of grains which he provides to the mill operator. He expects a yield of 98 tonnes flour out of it (without considering wastage). The Millets Products Processor starts the milling and process and finds out that around 1 ton of raw material is wasted. Now, he needs to report this back to his supervisor/manager. The manager asks him to tell him the percentage loss for the targeted yield. The Millets Products Processor shall use this formula:

(Loss in tonnes x 100)/98 tonnes

This will give the percentage loss to the Millets Products Processor. Any sort of loss is to be immediately reported to the supervisor/manager who in turn has to enter the details in the ERP software.

A Millets Products Processor also needs to make sure that all the machines are being used to their optimum level. A machine which is being run must be run to its full capacity, else it will be a waste of energy.

Also, the amount of raw material to be used should be in sync with the target yield. A Millets Products Processor must know the calculations to acquire the exact amount of raw material which will give the required outcome. For example, if it is known that 2% of the raw material has to get wasted each time a milling process is conducted, then to achieve a 100 tonne output, one has to use a little over 102 tonnes of raw material. The following equation may be used to calculate this:

Required raw material (in tonnes) = Required yield + Loss% of Required yield

The above given formula can only be used if the Millets Products Processor knows about the quantity of raw material required for different grains. Every grain must be used

UNIT 2.2: Selection of Raw Material

Unit Objectives

At the end of this unit, you will be able to:

1. List the various raw materials used in the milling process
2. Name the various products obtained from raw materials that are milled
3. Select raw materials based on quality parameters

2.2.1 Raw Materials and Produce

The following table lists the various raw materials used in the milling process and the products obtained from them.

Raw materials	Produce
Wheat	Wheat flour
Durum wheat	Durum wheat flour, semolina
Paddy	Rice
Corn	Corn flour
Barley	Flour (either alone or mixed with wheat flour)
Sorghum/jowar	Jowar flour
Bajra	Bajra flour
Ragi	Ragi flour

2.2.2 Quality of Raw Materials

Quality is putting the best possible product together, and doing it consistently. Quality assurance is also an important aspect of your company's marketing activities. Future sales are directly and significantly affected by the level of quality and consistency of your product. Consumers won't want to deal with other companies once you have built a solid reputation for the quality and dependability of your product.

Usually, there is a completely different department for Quality Control and Quality Assurance. This being given, the internal and external audits have to be cleared by this department itself. These audits hold a lot of value in the quality certification of an organisation.

A quality product begins with quality ingredients. You need to work closely with your suppliers to ensure that they all meet your tight standards. These should be created for ordering raw materials, packaging materials and other supplies. There are standard parameters which are involved in selecting grains. The same has been discussed below.

Quality in a product includes:

- Consistency
- Physical appearance
- Nutrition
- Food safety
- Value
- Shelf life

There are several ways to check the quality of raw materials through physical parameters like:

- Weight
- Particle size
- Homogeneity checks
- Presence of foreign objects
- Colour analysis
- Viscosity measures
- Water activity

Sample Testing

Before sample testing, the Millets Products Processor must ensure that:

- the sample avoids contamination from other sources;
- the sample is representative of the entire batch;
- the sample doesn't lose the characteristic properties during its collection, handling, transport and storage before testing; and
- the sampling utensils and container remain free of extraneous materials.

In general, the sample should confirm the process of quality check. Then, the sample is sent into the laboratories for quality analysis without damaging the sample.

Methods to Select the required Grains

Each grain in a grain mill has different testing techniques. The following is a list of minimum working sample weights:

Grains	Sample weights
Maize (small grain)	200g
Maize (large grain)	250g
Sorghum	25g
Black eyes cowpeas	150g
Wheat	25g
Bulrush millet	10g
Paddy	15g

The number of bags of raw material to be tested are also selected in a standard way.

Number of bags in consignment	Number of bags to be sampled
Up to 10	Every bag
11 to 100	10, drawn at random
More than 100	Square root of total number of bags

UNIT 2.3: Production Planning Process

Unit Objectives

At the end of this unit, you will be able to:

1. Plan the production schedule as per organisational standards and instructions
2. Plan and organise for raw material, manpower, equipment, and machineries for the scheduled production

2.3.1 Production Plan

The following chart provides an overview of the production planning process:

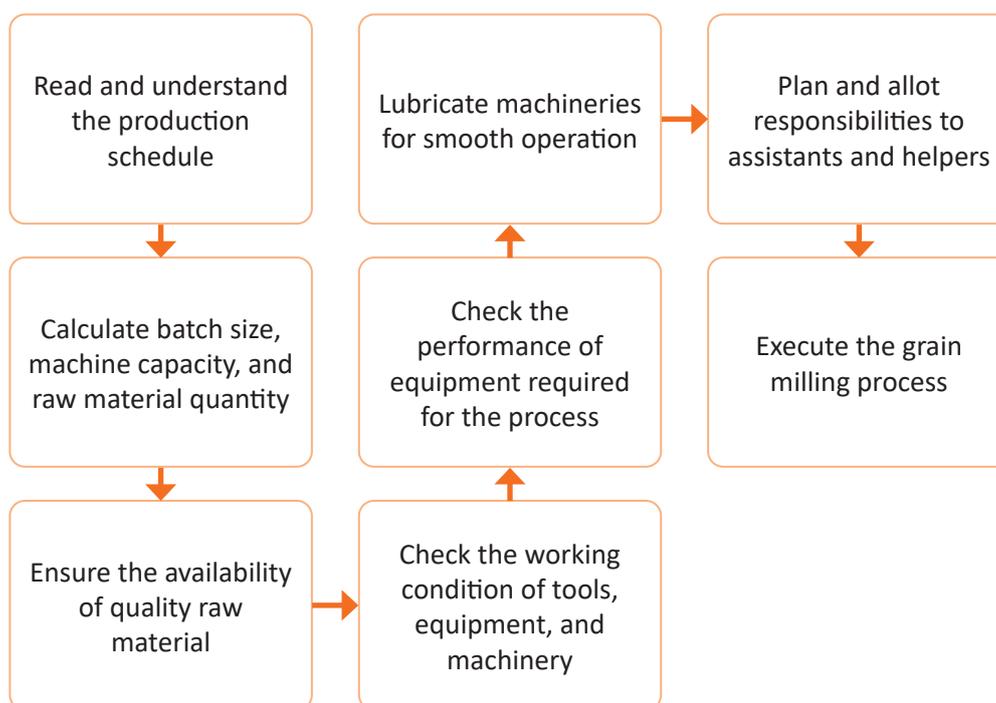


Fig. 2.1 Production plan

Unit 2.4 - Cleaning and maintenance of the workplace

Unit Objectives



At the end of this unit, you will be able to:

1. Maintain and clean the work area as per organizational procedures
2. Maintain and clean the machines and tools and sanitize them as per the organization's specifications and standards
3. Identify ways to dispose of the waste material at the designated place safely

2.4.1 Cleaning and Sanitization Procedures

Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.



Fig. 2.2 Cleaning and sanitization

The Purpose

The ultimate goal of cleaning and sanitizing equipment are as follows :

- Physically remove dirt and particles from the equipment (you want your equipment to look spotless to the naked eye)
- Remove residues from the equipment you may not be able to see, but can smell
- Destroy bacteria and microorganisms, including COVID-19

A sanitation plan is important in any food service preparation area. It ensures that all surfaces are cleaned regularly and reduces the risks of transferring bacteria or other pathogens from an unclean surface to clean equipment such as cutting boards or tools. A sanitation plan has two components:

- A list of cleaning and sanitizing agents or supplies with instructions on their safe use and storage
- A cleaning schedule, outlining how each item needs to be cleaned, who is responsible, and how frequently it happens

2.4.1.1 Types of Cleaning

- **Manual Cleaning:** As the name suggests, this is the most time-intensive type of cleaning where your employees will use rags, brushes, mops and other tools to clean machinery that isn't waterproof or needs to be dismantled.
- **Foam Cleaning:** This is the most common way to apply a detergent on most food processing equipment, and can be used on large areas like floors, walls, and production equipment.



Fig 2.3 Types of cleaning

- **Fogging:** Aerial fogging is used alongside other cleaning methods to release a mist of disinfectant into the air to kill airborne particles and reduce bacteria on equipment.

2.4.1.2 Steps to Cleaning and Sanitizing Equipment

Remove product residue from your food processing equipment: This means scraping off the residue or using water or compressed air if your equipment surface doesn't tolerate scraping.

- Pre-rinse with water to get rid of loose soil and deposits: This type of soil can include fats, oils, greases, proteins, algae, or fungi
- Clean with industrial-grade detergent to remove chemicals and residue not visible to the naked eye: Detergents can contain up to 15 components and the type of detergent you use depends on a lot of different factors, including soil type, equipment surface, temperature, and water hardness.
- Use a disinfectant to kill off any other dangerous microorganisms: Detergent works to remove soils and residue, but dangerous microorganisms that can lead to food contamination are oftentimes left behind. Disinfection picks up where the detergent is left off to remove these microorganisms.

When considering how best to clean your manufacturing equipment, keep in mind sanitisers that serve as both a detergent and disinfectant. With the added concern over COVID-19, it's important to work with your team, talk with suppliers, and check out product reviews to determine if a sanitiser or the two-step approach with a separate detergent and disinfectant is best for your food processing equipment.

2.4.2 Sanitary and Hygienic requirements for Food Manufacturer/ Processor/ Handler

The place where food is manufactured, processed or handled shall comply with the following requirements:

The food business premises should be clean, adequately lighted, and ventilated and have sufficient free space to maintain an overall hygienic environment.

- Floors, Ceilings and walls must be maintained in a sound condition.
- The floor and skirted walls shall be washed as per the requirement with an effective disinfectant the premises shall be kept free from all insects.

- Continuous supply of potable water shall be ensured on the premises.
- Any container or other equipment which is likely to cause metallic contamination injurious to health shall not be employed in the preparation, packing, or storage of food.
- All equipment shall be kept clean, washed, dried, and stacked at the close of business to ensure freedom from the growth of mould/ fungi and infestation.
- There should be an efficient drainage system and there shall be adequate provisions for the disposal of refuse.
- The workers working in processing and preparation shall use clean aprons, hand gloves and head wears.
- Persons suffering from infectious diseases shall not be permitted to work.
- All food handlers shall keep their fingernails trimmed, and clean, and wash their hands with soap and water before commencing work and every time after using the toilet.
- Eating, chewing, smoking, spitting and nose-blowing shall be prohibited within the premises, especially while handling food.
- All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.
- The vehicles used to transport food must be maintained in good repair and kept clean.
- Foods while in transport in packaged form or containers shall maintain the required temperature.

2.4.3 Personal Hygiene

It is imperative for safe food-handling outcomes for all workers to be familiar with standard sanitation and hygiene practices. The figure below shows the cycles of transmission of micro-organisms. One of the basic principles is to break the cycle by avoiding cross-contamination, which can be achieved by ensuring personal hygiene practices are followed.

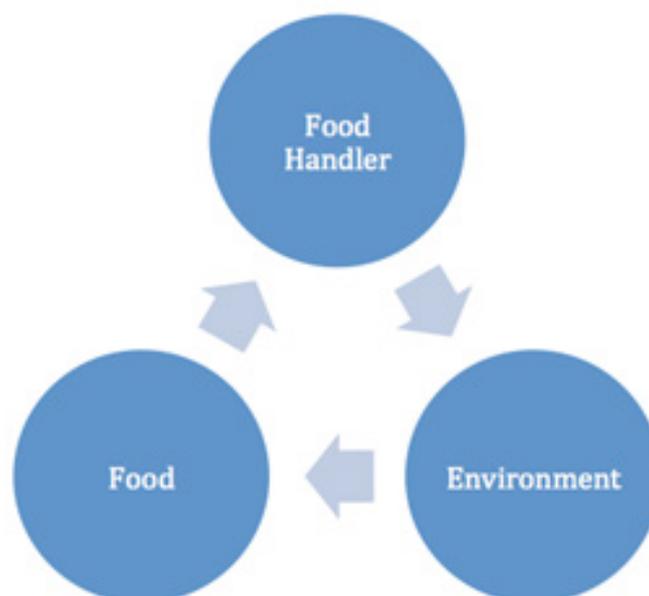


Fig. 2.4 The cycle of bacterial transmission

Proper personal hygiene is critical in any food service premise. Personal hygiene includes:

- Showering and bathing regularly
- Keeping hair clean and covered or tied back
- Keeping clean clothing and footwear that is used only at work
- Handwashing regularly
- Using clean utensils for tasting food
- Using separate cloths for cleaning and wiping plates

2.4.3.1 Handwashing

Proper and regular handwashing is a critical part of any food safety system. You must always wash your hands after:

- Sneezing, coughing, or touching your mouth or nose
- Using the bathroom
- Smoking or using toothpicks
- Handling raw foods
- Cleaning and wiping tables, food preparation surfaces, or equipment
- Handling soiled objects, garbage, or money

The steps for proper handwashing are as follows:

- Wet hands with warm water.
- Apply liquid soap and lather for at least 20 to 30 seconds.
- Scrub the backs of hands, wrists, all fingers, and under nails.
- Rinse under running water, pointing down toward the drain.
- Dry with a paper towel.
- Turn off the taps and open the bathroom door using the paper towel.

2.4.4 Equipment Maintenance

1. Routine Equipment Maintenance

Most processing equipment is intended to be disassembled for cleaning. Refer to the manufacturer's instructions and training provided by your employer or instructor on how to do this safely. Some equipment is intended to be cleaned in place. This should be identified in the sanitation plan and cleaning schedule.

All equipment must be routinely cleaned and inspected. Older equipment may have nooks and crannies where dirt and bacteria can hide, which can be difficult to clean effectively. Proper cleaning procedures must be established and followed at all times with regular review to ensure that procedures are working. If equipment is replaced or cleaning materials change, the process may have to be adjusted. If you notice any safety concerns with the equipment while cleaning it, such as a frayed cord, missing guard or loose parts, let the supervisor know immediately.

2. Periodic Equipment Maintenance

It refers to checking and resolving any fault in the machinery at scheduled intervals. These could be every day, week, month, and/or year.

3. Breakdown Equipment Maintenance

It refers to checking and resolving any fault in the machinery if they break down.

4. KAIZEN

Kaizen is an approach to creating continuous improvement based on the idea that small, ongoing positive changes can reap significant improvements.

2.4.5 Waste Management

The food processing industry around the world is making serious efforts to minimize by-products, compost organic waste, recycle processing and packaging materials, and save energy and water. The three R's of waste management – Reduce, Reuse and Recycle – can help food manufacturers in reducing the amount of waste sent to landfills and reusing waste.

Food Recovery Hierarchy

Food Recovery Hierarchy is an excellent resource to follow for food processors and beverage producers as it guides them to start a program that will provide the most benefits for the environment, society and the food manufacturer.

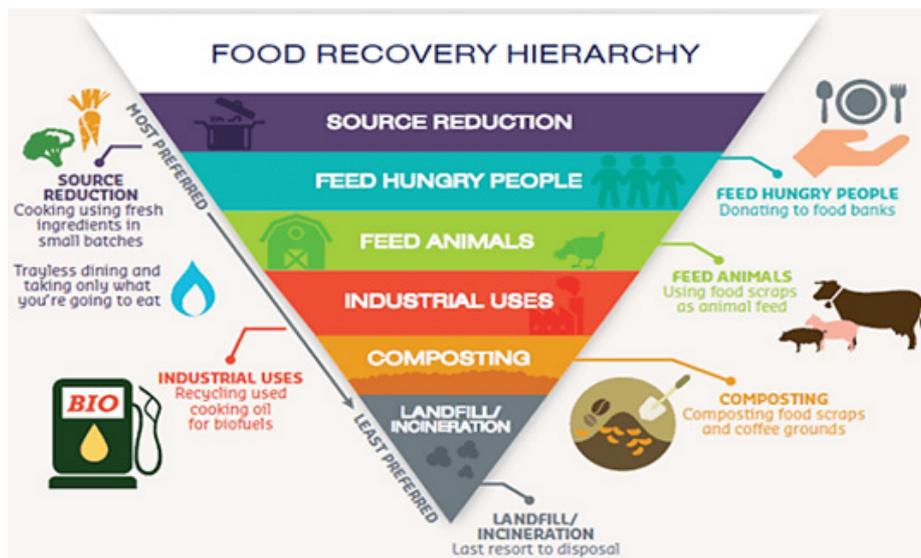


Fig. 2.5 Waste Management

Notably, landfill is the least favoured disposal option for waste generated by food and beverage producers worldwide. There are sustainable, effective and profitable waste management options including:

- making animal feed,
- composting to create nutrient-rich fertilizers,
- anaerobic digestion to produce energy-rich biogas,
- recycling/reusing waste for utilization by other industries,
- feeding surplus food to needy people

2.4.5.1 Waste Management Options

Food manufacturers have a unique problem – excess product usually has a relatively short shelf life while most of the waste is organic. Food waste created during the production process can be turned into animal feed and sold to goat farms, chicken farms etc. As far as WWTP sludge is concerned, top food manufacturers are recycling/reusing it through land application, anaerobic digestion and composting alternatives.

Organic waste at any food processing plant can be composted in a modern in-vessel composting and the resultant fertilizer can be used for in-house landscaping or sold as organic fertilizer at attractive prices.

Another plausible way of managing organic waste at the food manufacturing plant is to biologically degrade it in an anaerobic digester leading to the formation of energy-rich biogas and digestate. Biogas can be used as a heating fuel in the plant itself or converted into electricity by using a CHP unit while digestate can be used as a soil conditioner. Biogas can also be converted into biomethane or bio-CNG for its use as vehicle fuel.

Items such as cardboard, clean plastic, metal and paper are all commodities that can be sold to recyclers. Lots of cardboard boxes are used by food manufacturers for supplies which can be broken down into flat pieces and sold to recyclers.

Cardboard boxes can also be reused to temporarily store chip packages before putting them into retail distribution boxes. Packaging can be separated in-house and recovered using “jet shredder” waste technologies which separate film, cartons and foodstuffs, all of which can then be recycled separately.

2.4.5.2 Categories of Waste

1. Wet Waste

Wet Waste is biodegradable waste and includes Cooked and uncooked food, fruits, vegetable peels, flower waste, and other organically decomposable waste. This waste is collected daily and can be handed over in a green bin. We have classified the following streams as wet waste:

- Vegetable/fruit peels
- Cooked food/Leftovers
- Eggshells
- Rotten fruits/vegetables
- Tissue paper soiled with food
- Tea bags/Coffee grinds

2. Dry Waste

Dry Waste is typically defined as any waste which will not rot or disintegrate over time and has little or no moisture content. Dry waste can also be described as inorganic or non-biodegradable waste given its lack of food products. Most dry waste is recyclable and below is a list of common dry waste items:

- Metal
- Glass
- Plastic
- Wood/Wooden Objects
- Paper & Cardboard
- Fabric/Textiles
- Aluminium Foil

3. Hazardous Waste

Hazardous Waste is waste with properties that make it dangerous or potentially harmful to human health or the environment.

- Chicken/fish bones
- Chemicals
- Flavours
- Untreated water

2.4.5.3 Waste Segregation

Garbage bins are categorised into different colours- green and blue, to differentiate the type of waste put into them. It is essential to separate them from other types of waste, to be safely processed.

Several different colours indicate different types of waste. These colours also define the level of caution that needs to be taken when handling such materials.

Wet Waste	Dry Waste
Fruit & Vegetable Peels and pieces	Plastics bags, bottles, packing item
Leftover food	Food packets, milk sachets
Used tea leaves/ Coffee Powder	Tickets, Newspapers
Match Sticks	Computer printouts
Used/ Soiled tissue papers	Disposable Crockery, Pamphlets
Shredded newspapers	Glass bottles and jars,
Flowers, Plant leaves, Compostable ma-terials	Tetra pack, Aluminium cans, etc.
Meat and Poultry waste	Thermocol

2.4.5.4 Techniques of Waste Disposal

Between the range and variety of items that are in the store and the growing amounts of trash dumped in landfills each year, effective waste disposal is a necessity. Being aware of all the possible methods will make the task of disposing of waste much easier.

1. 3 R's

The principle of reducing waste, reusing and recycling resources and products is often called the "3Rs."

- **Reducing** means choosing to use items with care to reduce the amount of waste generated.
- **Reusing** involves the repeated use of items or parts of items that still have usable aspects.
- **Recycling** means the use of waste itself as a resource.

Waste minimization can be achieved efficiently by focusing primarily on the first of the 3Rs, "reduce," followed by "reuse" and then "recycle." The waste hierarchy refers to the "3Rs" i.e., reduce, reuse and recycle, which classify waste management strategies according to their desirability. The 3Rs are meant to be a hierarchy, in order of importance. The waste hierarchy aims to extract the maximum practical benefits from products and generate the minimum amount of waste.



Fig. 2.6 Waste Hierarchy

2. Some other techniques

- i. **Composting:** Composting involves the breakdown of organic waste in the presence of microorganisms, heat and moisture. Three types of microorganisms are involved in the process of composting—bacteria, fungi and actinomycetes that act upon the waste to convert it into sugars, starch, and organic acids. These, in turn, are acted upon by high-temperature bacteria, which prevail in the compost heap and help to promote the stabilized compost.

Composting has the following advantages:

- Recycling of waste by the generation of useful manure, which is organic.
 - Reduction in volume of waste to be disposed of on land.
 - No requirement for any high-end technical expertise.
- ii. **Vermicomposting:** This is a process, in which food material and kitchen waste including vegetables and fruit peelings, papers, etc., can be converted into compost through the natural action of worms. An aerobic condition is created by exposure to organic waste in the air.

3. Ensuring Food Safety and Personal Hygiene



Unit 3.1 - Introduction to Food Safety

Unit 3.2 - Schedule IV requirements of FSSAI

Unit 3.3 - Personal Hygiene

Unit 3.4 - Health Safety



Key Learning Outcomes

By the end of this module, the participants will be able to:

1. Identify the hazards, types of hazards (Physical, chemical, biological and Allergenic) and risks at workplace
2. HACCP , TACCP, VACCP , Control measures , CCP, Critical limit
3. Explain the preventions of product contamination
4. Discuss the factors affecting food spoilage and food storage techniques
5. Describe Schedule IV requirements of FSSAI
6. Discuss cleaning and sanitization process, needs and importance and storage of sanitizing materials
7. Discuss health and safety policies and procedures
8. Discuss Employee health do's and don'ts, Food borne illness and preventive health checkups

UNIT3 .1: Introduction to Food Safety

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify types of hazards and risks at work place

3.1.1 Food Safety

Food safety refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.

3.1.2 Food Safety Hazard and Risk

Hazard is a factor or agent which may lead to undesirable effects like illness or injury in the absence of its control, whereas, risk refers to the probability that the effect will occur.

Hazard is that part of food which somehow entered in the food and which is non-consumable.

Types of hazards and risks at work place

There are two types of hazards: one is food safety hazard and second is health safety hazards.

Food Safety Hazard

There are four major hazards that may be introduced into the food supply any time during harvesting, processing, transporting, preparing, storing and serving food. These hazards may be microbiological, chemical, physical and allergens.

Microbiological hazards

When harmful microorganisms are found or grown on food it is called microbiological hazards. Food which contains harmful or pathogenic bacteria when eaten can make people ill.

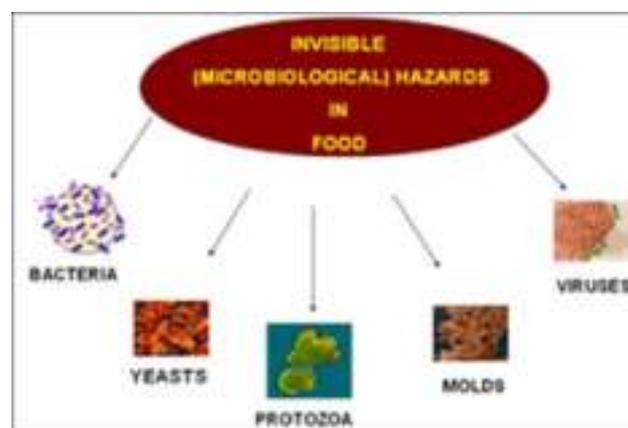


Fig. 3.1: Microbiological Hazards

Food spoilage and deterioration is no accident. It is a naturally occurring process. To understand how to maintain the quality of food and prevent spoilage, we need to know what can cause it.

Food spoilage: The microorganisms that can cause food-borne illness are called pathogenic microorganisms. These microorganisms grow best at room temperatures (25-30°C), but most do not grow well at refrigerator or freezer temperatures. Pathogenic microorganisms may grow in foods without any noticeable change in odor, appearance or taste. Spoilage microorganisms, including some kinds of bacteria, yeasts and molds, can grow well at temperatures as low as 4°C. When spoilage microorganisms are present, the food usually looks and/or smells awful.



Fig. 3.2: Food Spoilage

FAT TOM- This is a term used commonly in food industry to describe the six favorable conditions required for the growth of the food borne pathogens/micro-organisms.

FAT TOM - FOOD SAFETY

F **Food:** Microorganisms need a constant source of nutrients to survive, especially protein. Moist, protein-rich food (raw meat or seafood, cooked rice or pasta, eggs, and dairy products) are potentially hazardous.

A **Acidity:** Bacteria grow best in an environment that is slightly acidic or neutral (pH level of 4.6-7.5) and they flourish in a pH range between 6.6 and 7.5.

T **Time:** Food should not remain in the temperature danger zone (40°F - 140°F) for more than 2 hours, and either be cooled or heated.

T **Temperature:** Bacteria grow best at a temperature range of 40°F to 140°F - which is referred to as the "temperature danger zone".

O **Oxygen:** Almost all foodborne pathogens are aerobic, that is, requiring oxygen to survive and grow.

M **Moisture:** Water is essential to bacterial growth. Microorganisms grow faster in food with high water content (meats, produce, and soft cheeses).

FAT TOM is a mnemonic device used in the food service industry to describe the six aspects that contribute to the growth of foodborne pathogens. With the proper control of these aspects, the chance of food illness is reduced.

Fig. 3.3: FATTOM Food Safety

Physical Hazards

These include any foreign material, which you would not expect to find in your food. Hair, finger nails, pieces of wood, metal, plastic, glass and insect debris are examples of what can find their way into food as foreign matters.



Fig. 3.4: Physical Hazards

Chemical Hazards

Chemical hazards include, food contact materials, cleaning agents, pest control substances, contaminants (environmental, agricultural and process e.g. acrylamide), pesticides, biocides and food additives. They are naturally occurring, intentionally added or unintentionally added.

- Preservatives
- Colours and dyes
- Flavour enhancers
- Water additives
- Packaging materials
- Processing aids

Allergen

An allergen is any protein that is capable of producing an abnormal immune response in sensitive segments of the population.

A known component of food which causes physiological reactions due to an immunological response (e.g.- nuts, gluten, egg, ,milk etc, identified in legislation relevant to country of production or sale)



Fig. 3.5: Allergens

It is important to be aware of food allergens in food industry as this is the risk associated with the unintended presence of allergen due to cross contamination and should take this a matter of serious concern. Food allergies can cause serious and even deadly reactions.

What Are the Most Common Food Allergens?

There appears to be eight common allergens accounting for most food allergic reactions. They stand to be- milk, eggs, peanuts, soya, wheat, tree nuts (like walnuts and cashews), fish and shellfish (such as shrimp).

What Are the Signs & Symptoms of a Food Allergy?

The common sign and symptoms are: trouble breathing; coughing; hoarseness; throat tightness' belly pain' vomiting' diarrhe' itchy, wateru, or swollen eyes; red spots; swelling, a dropi in blood pressure and is capable of happening because a person can't digest a substance, such as lactose.

Handling of Allergenic Foods:

The common sign and symptoms are: trouble breathing; coughing; hoarseness; throat tightness' belly pain' vomiting' diarrhe' itchy, wateru, or swollen eyes; red spots; swelling, a dropi in blood pressure and is capable of happening because a person can't digest a substance, such as lactose.

3.1.3 Contamination, Cross Contamination and Prevention

Contamination: The presence of unwanted materials such as dust and particles during the manufacturing and transportation time is called contamination. The term contaminants include any unwanted matter that is found in the product. These contaminants affect the quality of the product or the process.

The most common types of contaminant include:

- Physical contaminant Examples: fiber material, particles, chips from your pill press tooling.
- Chemical contaminant. Examples: vapor, pesticides, grease. detergents, and so on.
- Biological contaminant Examples: fungus, bacteria, virus.

Cross contamination is possible when the unwanted matter is introduced or brought from one process to the next during manufacturing.

A leak in the holding containment would contaminate the product inside it; this would be an example of physical contamination.

Certain metals standing to be more advantageous to health, like iron, appearing to be globally added to some foods, involving infant formulas as well as breakfast cereals, to highlight their dietary advantages.

For biological contamination, bacteria may thrive if the container is not properly cleaned and dried. The contaminated container will then affect the product and microbes may thus be introduced to the batch.

Prevention of Contamination:

- Determine the cause of the contamination
- Anticipate the effect
- Eliminate the source material

- To remove the contaminant carrier:
 - Reduce human involvement
 - Regulate the use of the equipment
 - Regulate the use of air
 - Regulate the use of water
- To reduce human carrier risk:
 - Ensure that proper attire is worn when coming and going from the production area
 - People frequently touch their eyes, nose, and mouth without even realizing it. Germs can get into the food through their contaminated unwashed hands.
- To reduce water as carrier:
 - As water is the number one source for cross contamination, it is important to reduce and prevent water contamination
 - Water borne contaminants: particulates (such as minerals) and pathogens (e. coli, salmonella, etc.)
 - Use of preventive measure such as filtration devices, distillation or reverse osmosis, UV treatments
- To reduce air as carrier:
 - Control air flow through AHUs (Air Handling Unit)
 - Use of air locks
 - Installation of HEPA (High Efficiency Particulate Absorbing Filters) filters
 - Ultra-Low Particulate Air

3.1.4 Storage (Importance of Storing Food at Specified Temperature)

Storage temperature is one of the most important factors in the preservation of food because microorganisms have been found to grow in almost all temperature.

Food storage is a major issue when keeping food safe. Food which is not correctly stored can spoil or become contaminated, which can make people sick. There are very specific rules regarding the temperatures that food must be stored at, cooked to and reheated to and if not followed, the risk of becoming ill as a result of contamination increases.

Room Temperature Food Storage

Keep dry storage areas clean with good ventilation to control humidity and prevent the growth of mold and bacteria. 21°C is adequate for dry storage of most products. One of the first things to check regarding food which has been stored in the 'use-by' or 'best-before' dates printed on the packaging.

These dates will give you the most accurate indication of a food's shelf life, however, when a packet or can is opened, the expiry date almost always changes.

Refrigerating and Freezing Food

To reduce the risk of bacterial contamination, many foods must be stored in the refrigerator and thus kept below 5°C. These foods are often classified as 'high-risk foods' and include – meat, poultry, dairy,

seafood, eggs, small goods and cooked rice and pasta. This also refers to ready-to-eat foods that have high-risk foods as ingredients and include – casseroles, quiche, pasta salad, pizza, sandwiches and many cakes.

By keeping these high-risk foods under 5°C it stops them from entering the 'danger-zone' – temperatures between 5°C and 60°C. The danger-zone is the temperature zone which provides bacteria with the perfect environment to rapidly grow and multiply to numbers that cause food poisoning.

By freezing food its longevity is increased because the water content of the food freezes – this prevents bacteria from multiplying and food spoiling. Food should be kept frozen at –18°C; when thawing, it should be stored in a refrigerator that reaches no more than 5°C until it is ready to be prepared.

3.1.5 Transportation

Selling fresh and high-quality produce is essential in groceries and retail food businesses. That's why the transport and storage of foods is so important, and refrigerated transport is essential to achieve this.

Refrigerated Transportation

Refrigerated transportation is a shipping cargo with advanced temperature adjustment features. It is built and designed mainly for climate-sensitive goods such as vegetables, fruits, meat, all-prep meals, bread, etc. in which the freight is loaded with ice and salt to maintain the food's quality at a particular temperature.



Fig. 3.6: Refrigerated Transportation

Ambient Temperature for Shipping

When it comes to cold chain logistics, maintaining ambient temperature tends to mean maintaining a temperature between 15°C to 25°C or 59°F to 77°F. These temperatures fall in the range of comfortable room temperature instead of being on one extreme end of temperature ranges.

3.1.6 HACCP, TACCP, VACCP, control measures, critical control point, critical limit

HACCP (Hazard Analysis Critical control point): It is a systematic approach in identification, evaluation and control of food safety hazards and it's written documented plan based on HACCP principles known as HACCP Plan. It has 12 steps and 7 principles as:-

- Assembly of HACCP Team
- Describe Product
- Identify indent use
- Draw Flowchart / Diagram
- Verify Flowchart/ Diagram
- Conduct a hazard analysis (Principle 1)
- Determine critical control points (CCPs) (Principle 2)
- Establish critical limits (Principle 3)
- Establish monitoring procedures (Principle 4)
- Establish corrective actions (Principle 5)
- Establish verification procedures (Principle 6)
- Establish record-keeping and documentation procedures (Principle 7)

VACCP (Vulnerability Analysis Critical control points):

It focuses on food fraud as well, and widens the scope to include systematic prevention of any potential adulteration of food, whether intentional or not, by identifying the vulnerable points in a supply chain. It is especially concerned with economically motivated adulteration (EMA). Examples include product substitutions, unapproved product enhancements, counterfeiting, stolen goods and others.

TACCP (Threat Analysis Critical control points): generally requires a wider range of employee involvement than HACCP, as it covers issues such as manufacturing plant and transportation security, IT security, and employee background checks. Some points will overlap with HACCP, such as tamper-proof seals and various quality control checks.

Reduce the likelihood (chance) and consequence (impact) of a deliberate attack;

Protect organizational reputation;

Reassure customers and the public that proportionate steps are in place to protect food;

Demonstrate that reasonable precautions are taken and due diligence is exercised in protecting food.

Control: It is means to prevent, eliminate, or reduce hazard.

Control measures: It is means of any action or activity that is used to prevent, reduce to acceptable levels, or eliminate a hazard.

Critical limit: it is means a point, step, or procedure in a food process at which a control measure can be applied and at which control is essential to prevent, reduce to an acceptable level, or eliminate an identified food hazard.

UNIT 3.2: Schedule IV requirements of FSSAI

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify requirements in Schedule IV in FSSAI

3.2.1 Schedule IV Requirements of FSSAI

To provide assurance of food safety, Food businesses must implement an effective Food Safety Management System (FSMS) based on Hazard Analysis and Critical Control Point (HACCP) and suitable pre-requisite programmes by actively controlling hazards throughout the food chain starting from food production till final consumption.

As per the condition of license under FSS (Licensing & Registration of Food Businesses) Regulations 2011, every food business operator (FBO) applying for licensing must have a documented FSMS plan and comply with schedule 4 of this regulation. Schedule 4 introduces the concept of FSMS based on implementation of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) by food businesses and is divided into five parts as under:

Schedule 4	General Requirements
Part 1	General hygienic and sanitary practices to be followed by food business operators applying for registration - Petty food operators and Street food vendors
Part 2	General hygienic and sanitary practices to be followed by food business operators applying for license- Manufacturing/ processing/ packaging/storage/distribution
Part 3	General hygienic and sanitary practices to be followed by food business operators applying for license- Milk and milk products
Part 4	General hygienic and sanitary practices to be followed by food business operators applying for license- Slaughter house and meat processing
Part 5	General hygienic and sanitary practices to be followed by food business operators applying for license- Catering

Table 3.1: Five Parts of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP)

Part II: General hygienic and sanitary practices to be followed by food business operators applying for license- Manufacturing/ processing/ packaging/storage/distribution

- **Location and Surroundings**
- Location shall be:
 - away from environmentally polluted areas
 - away from industrial activities which produce:
 - Disagreeable or obnoxious odor,
 - Fumes
 - Excessive Soot
 - Dust



Well Guarded Entrance of the Plant



Demarcation of the area

Fig. 3.7: Location and Surrounding factors

- Smoke
- Chemical or biological emissions
- Pollutants
- Layout and Design of Food Establishment Premises

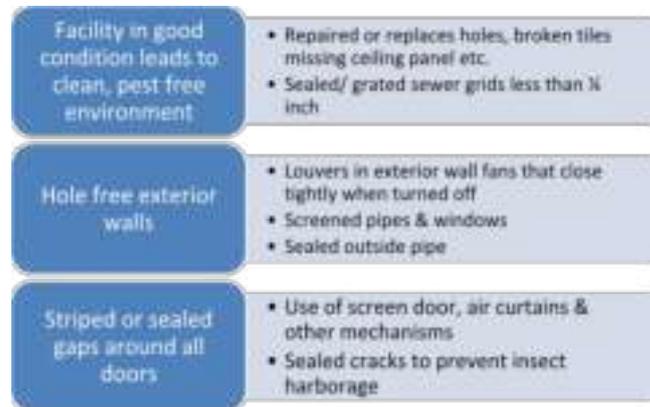


Fig. 3.8: Layout and Design factors

- **Equipment and Containers**
 - made up of non-corrosive / rust free material
 - smooth, free from any grooves
 - easy to clean and maintain
 - non-toxic and non-reactive
 - of food grade quality



Fig. 3.9: Equipment and Container factors

- **Facilities**
 - **Water supply**
 - Only potable water meeting BIS (Bureau of Indian Standards) standards
 - Appropriate facilities for storage and distribution of water
 - Periodic cleaning of storage tanks and its record
 - Non-potable water, if used, only for cooling of equipment, steam production, fire fighting
 - Distinguished non-potable water pipes



Colour coding of water pipes to avoid contamination

Fig. 3.10: Water Supply

- Drainage and waste disposal

- Disposal of sewage and effluent in conformance with the requirements of Factory
- Designed and constructed to reduce risk of contamination to food and potable water
- Separate waste storage area
- Covered containers for waste storage
- No accumulated waste in food handling, food storage or other working areas
- Periodic disposal of waste/refuse
- Pedal operated adequate size bins for waste collection
- Waste bins emptied and washed daily with a disinfectant and dried before next use



Sr. No.	Material	Dustbin Colour	SWMS
1	Oily Contam Waste	Red	1
2	Paper	Green	2
3	Plastic Jars, Sampling Bottles	Purple	3
4	Plastic Bags	Yellow	4
5	Polish Filter	Grey	5
6	Food Waste	Orange	6
7	Glass Bottles	Black	7

Fig. 3.11: Waste Disposal



Fig. 3.12: Drainage System

- Personnel facilities and toilets

- Facilities for washing and drying hands
- Supply of hot and cold water
- Separate lavatories of appropriate hygiene design for males and females separately
- Suitably located Changing facilities for personnel
- No direct opening of such facilities in food processing, service or storage area

- **Ventilation and Lighting**

- Air quality and ventilation:

- Natural / mechanical ventilation system including air filters, exhaust fans
- Designed and constructed as such air does not flow from contaminated areas to clean areas

- Lighting

- Adequate Natural /artificial lighting
- Protected lightings to avoid contamination by breakages



Fig. 3.13: Personal facilities



Fig. 3.14: Ventilation and Lighting

- **Food Operations And Controls**

- **Procurement of raw materials**

- Quality raw materials (free of parasites, micro-organisms, pesticides etc.)
 - Raw material conforming to the regulations under the act
 - Records of raw material as source of procurement



Fig. 3.15: Procurement of raw materials

- **Storage of raw materials and food**

- Adequate food storage facilities to protect food from contamination
 - Cold storage facilities according to requirement
 - Segregation of storage area for raw and processed food, recalled materials, packaging materials, stationary, cleaning materials/ chemicals
 - Separate cold storage of raw food like meat/poultry/seafood product away from the area of WIP (Work in Progress), processed, cooked and packaged products.
 - Monitoring of temperature and humidity
 - FIFO First received (In) materials must move out first
 - Non –toxic containers for food storage
 - Stored on racks or pallets well above the floor and away from the wall



Fig. 3.16: Storage of raw materials and food

Review Of Product Label /Packaging Usage And Control

Labels should be reviewed allergens are mentioned don it prior to their receipt for their accuracy. Line Personnel should be trained to ensure labelling is changing when a changeover takes place.

Food Processing / Preparation, Packaging and Distribution / Service

- **Storing at appropriate temperature:** The Food Business shall develop and maintain the systems to ensure that time and temperatures are controlled effectively where it is critical to the safety and suitability of food. Such control shall include time and temperature of receiving, processing, cooking, cooling, storage, packaging, distribution and food service till it reaches the consumer, as applicable.
- **Food Packaging:** Packaging materials shall provide protection for all food products to prevent contamination, damage and shall accommodate required labelling as laid down under the FSS Act & the Regulations there under.
- **Transportation:** All critical links in the supply chain need to be identified and provided for to minimize food spoilage during transportation. Processed / packaged and / or ready-to-eat food shall be protected as per the required storage conditions during transportation and / or service.
- **Management and Supervision**
 - Provision of resources to implement & maintain Food Safety
 - Developing SOPs for processing, packing, dispatch & storage of food
 - Competent Technical Managers & Supervisors:
 - having skills on food hygiene principles & practice
 - taking appropriate preventive & corrective action
 - ensure effective monitoring and supervision.
- **Maintaining Process related records (e.g. production records)**
- **Sanitation And Maintenance of Establishment Premises**
 - Facilities should permit effective cleaning.
- **Cleaning Program**
 - areas to be cleaned,
 - cleaning frequency,
 - procedure,
 - equipment,
 - cleaning material and method

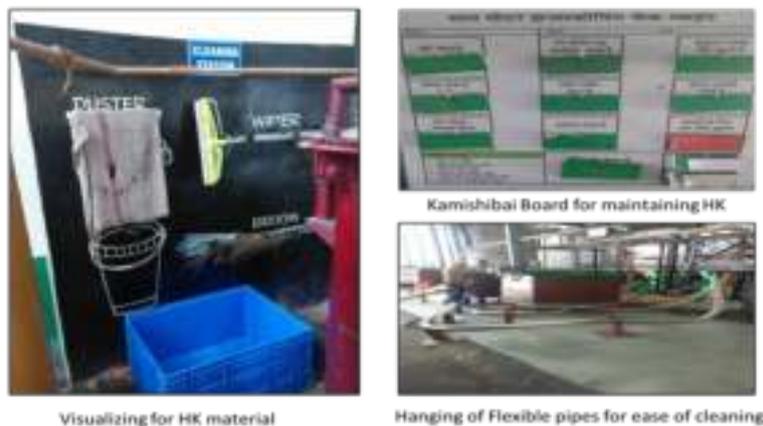


Fig. 3.17: Cleaning Program

- **Maintenance**

- Preventive and Corrective Maintenance
- Lubricants and heat transfer fluids shall be food compatible Procedure for releasing maintained equipment back to production
- Maintenance personnel shall be trained in the product hazards associated with their activities



Fig. 3.18: Maintenance

- **Pest Control Systems**

- Report pest infestations immediately.
- Do not use pesticides/insecticides in food processing area.



Fig. 3.19: Fly Catcher and Rodent Traps

- **Personal Hygiene**

- Health Status
 - Personnel suffering from disease or illness shall not be allowed to enter in food handling area
 - System to report illness or symptoms of illness to management
 - Medical examination of food handlers/ employees once in a year
 - Records of medical examination
 - Factory shall be compulsorily inoculated against the entire group of diseases and recorded
 - In case of epidemic, all workers to be vaccinated irrespective of the yearly vaccination.

- **Personal Cleanliness**

- High degree of personal cleanliness by food handlers
- Food business shall provide to all food handlers;
 - Protective clothing
 - Head covering
 - Face mask
 - Gloves
 - Foot wear



Fig. 3.20: Personal Cleanliness

- **Visitors Generally**
 - Generally visitors should be discouraged to go inside the food handling areas
 - The food business shall ensure visitors to its food manufacturing/ handling areas shall;
 - Wear protective clothing
 - Footwear
 - Adhere to personal hygiene provisions envisaged in the respective section
- **Product Information And Consumer Awareness**
 - Batch Identification
 - Identifies producer
 - Product recall
 - Effective stock rotation - FIFO
 - Product Information
 - Adequate information & enables other person in food chain to handle, display, store, prepare & use the product safely & correctly
 - Labeling
 - Should confirm to Legal Requirements
- **Consumer Education**
- **Training**
 - Awareness & responsibilities
 - Training Programmes
 - Nature of food
 - Control Spoilage
 - Handling of food
 - Storage
 - Training Records
 - Instruction & supervision
 - Periodic assessment of training & effectiveness
 - Refresher training
- **Good Manufacturing Practices For Whole Premise**

Good Manufacturing Practices* (GMPs) are the basic operational and environmental conditions required to produce safe foods. They ensure that ingredients, products and packaging materials are handled safely and that food products are processed in a suitable environment.

GMPs address the hazards associated with personnel and environment during food production. They provide a foundation for any food safety system. Once GMPs are in place, processors can implement a Hazard Analysis Critical Control Point (HACCP) system to control hazards that may affect the ingredients and packaging material during food processing.

GMPs Address:

- **Environmental control (premises):** Location, design and construction of the building and its interior, equipment, water supply.
- **Personnel practices:** Personal hygiene, hand washing, clothing/footwear/headwear, injuries and wounds, evidence of illness, access and traffic patterns, chemical use.
- **Shipping, receiving, handling, storage:** Inspection procedures for transport vehicles; loading, unloading and storage practices; inspection procedures for incoming products; shipping conditions; returned and defective products; allergen control; chemical storage; waste management.
- **Pest control:** Monitoring procedures for the exterior and interior of the building (ex: surveillance, fumigation) and the use of pesticides.
- **Sanitation:** Cleaning and sanitizing procedures and pre-operational assessment.
- **Equipment maintenance:** Procedures describing preventive maintenance and calibration of all the equipment and instruments that can affect food safety (ex: thermometers, thermocouples, metal detectors, scales, pH meters)
- **Recall and traceability:** Procedures that ensure final products are coded and labeled properly; incoming materials; in-process and outgoing materials are traceable; recall system is in place and tested for effectiveness (ex: procedures for mock recalls).
- **Water safety:** Water safety monitoring procedures for water, ice and steam, and water treatment procedures that ensure it is potable for use in food processing



Fig. 3.21: GMPs Address



Fig. 3.22: Storage of sanitizing materials

Where and How to Store Your Cleaning Supplies

- **Clean, Cool, Dry:** Store your cleaning supplies in an area that is clean and free of debris. Make sure that there aren't any temperature extremes in the area where your cleaning supplies are stored. Another thing to make sure of is that the area is dry.
- **Original Containers:** Keep cleaning supplies in their original containers. If you mix your own cleaners, make sure you use new clean bottles and label them to avoid a mixup.
- **Safe Storage:** Be sure to keep your cleaning supplies stored in places where your children and/or pets will not be able to get to them. Consider higher storage or locked storage options to protect small children and pets.

Cleaning and Sanitization Process, Need and Importance

Workplace Sanitation: Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.

Cleaning Procedures and Schedules: Cleaning with soap and other detergents is just one step of the cleaning procedure. It is also necessary to sanitize. Cleaning will remove any dirt or grease, but will not necessarily kill any bacteria or other pathogens. Only a sanitizer will kill bacteria and ensure the area is safe for food preparation. Leading sanitizers used in the food service industry are chlorine solutions (bleach), quaternary solutions (quarts), and iodine. Use these materials according to the manufacturer's instructions that accompany the product and that are found on the material safety data sheet (MSDS) using the appropriate personal protective equipment.

A sanitation plan is important in any food service preparation area. It ensures that all surfaces are cleaned on a regular basis and reduces the risks of transferring bacteria or other pathogens from an unclean surface to clean equipment such as cutting boards or tools. A sanitation plan has two components:

- A list of cleaning and sanitizing agents or supplies with instructions on their safe use and storage
- A cleaning schedule, outlining how each item needs to be cleaned, who is responsible, and how frequently it happens

Routine Equipment Maintenance

Refer to the manufacturer's instructions and training provided by your employer or instructor on how to do this safely. Some equipment is intended to be cleaned in place. This should be identified in your sanitation plan and cleaning schedule.

All equipment must be routinely cleaned and inspected. Older equipment may have nooks and crannies where dirt and bacteria can hide, which can be difficult to clean effectively. Proper cleaning procedures must be established and followed at all times with regular review to ensure that procedures are working. If equipment is replaced or cleaning materials change, the process may have to be adjusted. If you notice any safety concerns with the equipment while cleaning it, such as a frayed cord, missing guard or loose parts, let your supervisor know immediately.

- **Good Food Hygiene Practices**
 - Cleaning
 - Food areas and equipment between different tasks, especially after handling raw food shall be cleaned.
 - The surface shall be thoroughly cleaned in case if somebody spills food / water / drink.
 - Raw materials
 - Raw materials shall be purchased from reliable and known dealers and checked for visible deterioration & off-odour, physical hazards and foreign body contamination.



Fig. 3.23: 8 Principles based on eight quality management principles

- Cooking
 - The preparation/ processing/ cooking should be adequate to eliminate and reduce hazards to an acceptable level which might have been introduced at the raw food level.
 - The preparation/ processing/ cooking methods should ensure that the foods are not re-contaminated.
 - The preparation/ processing/ cooking of veg. & non-veg. products should be segregated.
 - Whenever cooking or reheating of food is done, it should be hot all the way through, it is especially important to make sure that food is cooked thoroughly.
 - Re-use of cooking oil should be avoided.
 - In case of reheating of oil use maximum three times to avoid the formation of Trans fat. It is ideal to use once if possible.
- Chilling
 - Semi cooked or cooked dishes and other ready-to-eat foods such as prepared salads and desserts having short shelf life should not be left standing at room temperature.
 - Chilled food intended for consumption should be cold enough.
 - Food items that need to be chilled should be put straight away into the fridge.
 - Cooked food should be cooled as quickly as possible and then put it in the fridge.
 - Chilled food should be processed in the shortest time possible.
 - Fridge and display units should be cold enough and as per requirement. In practice, fridge should be set at 5°C to make sure that food is kept in chilled condition. Also, fridge and display units should be maintained in good working condition to avoid food spoilage and contamination.
- Cross-contamination

Following should be done to avoid cross-contamination.

 - Separation of each crop/species and also processed and unprocessed foods.
 - Hands should be thoroughly washed after touching.
 - Work surfaces, chopping boards and equipment should be thoroughly cleaned before the preparing of food starts and after it has been used.
- Personal Hygiene
 - High standards of personal hygiene should be maintained.
 - All employees handling food should wash their hands properly:
 - before preparing food
 - after touching raw food or materials, specially meat/poultry or eggs
 - after breaks
 - after using the toilet after cleaning the raw materials or utensils / equipments
 - Street shoes inside the food preparation area should not be worn while handling & preparing food.
 - Food handlers should ensure careful food handling & protect food from environmental exposure.
- Transportation and Handling Of Food
 - Food shall be adequately covered during transportation to assure food safety.
 - Transportation vehicles
 - Vehicle inspection
 - Shall not contaminate foods & packaging
 - Should be easy to clean and maintain

- Provide effective protection from dust & dirt
- If required maintain temperature, humidity, atmosphere
- If required allow monitoring of temperature, humidity, etc.
- Should be used only for carrying food.
- Regular maintenance of vehicles is required.
- Appropriate supply chain to minimize food spoilage
- Non-toxic, clean, well maintained food containers during transportation
- Temperature and humidity control during transportation
- Dedicated vehicles for food transportation
- Effective cleaning and sanitation of vehicles between loads carrying high risk foods as fish, meat poultry to avoid cross contamination



Fig. 3.24: Transportation and handling of food

- Storage
 - It is very important to store food properly for the purpose of food safety. Following things must be ensured:
 - Raw meat/poultry should be stored separately from other foods
 - Storage temperature of frozen food should be -18°C or below.
 - Storage instructions over food packaging should be followed.
 - Dried foods (such as grains and pulses) should be stored off the floor, ideally in sealable containers, to allow proper cleaning and protection from pests.
 - Store commercial ice cream at temperatures below 0°F .
 - Store biscuit, brownie, and muffin mixes at room temperature.

Stock rotation

The rule for stock rotation is FIFO (first in, first out) to make sure that older food is used first. This will help to prevent wastage. Older product will have nearer shelf life expiry, so older product should be moved out first, but new products will have time to move out since expiry is so far. That's why a rule of FEFO does also exist which means First Expiry First Out. It is called Good Distribution Practice.

UNIT 3.3: Personal Hygiene

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify types of health and safety policies and procedures

3.3.1 Personal Hygiene

The expression “food hygiene” is often associated to personal hygiene. The concept of food hygiene really refers to the general cleanliness state of the food handlers’ body and clothes. Microorganisms can easily pass to food and reach the consumer if the handler comes into contact with any pathogenic microorganism by their clothes, hands, hair, nails, rings and then sets out to prepare food. As so, the personal hygiene of whoever contacts with food, as well as behaviors they assume during its processing, constitute an important preoccupation in the food business. The set of rules, conditions and practices that assure adequate personal hygiene make up the good practices for personal hygiene.

3.3.2 Importance of Personal Hygiene

It is imperative for safe food-handling outcomes for all workers to be familiar with standard sanitation and hygiene practices. Fig. 1.3.1 shows the cycles of transmission of micro-organisms. One of the basic principles is to break the cycle by avoiding cross-contamination, which can be achieved by ensuring personal hygiene practices are followed.

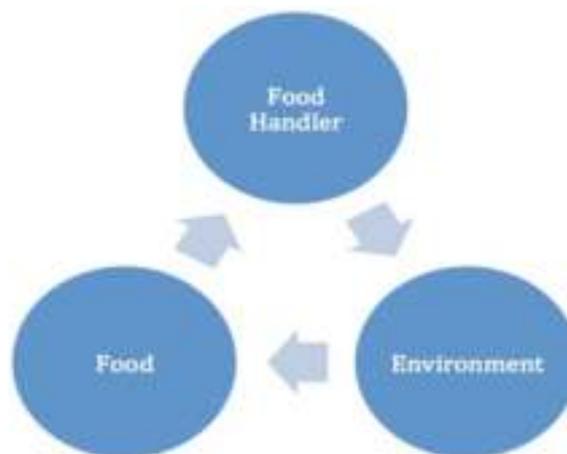


Fig. 3.25: Importance of Personal Hygiene

Proper personal hygiene is critical in any food service premise. Personal hygiene includes:

- Showering and bathing regularly
- Keeping hair clean hair and covered or tied back
- Keeping clean clothing and footwear that is used only at work
- Hand washing regularly



Fig. 3.26: Personal hygiene

3.3.3 Hand Washing

Proper and regular hand washing is a critical part of any food safety system.



Fig. 3.27: Methods of washing hand

How to Use Sanitizer?

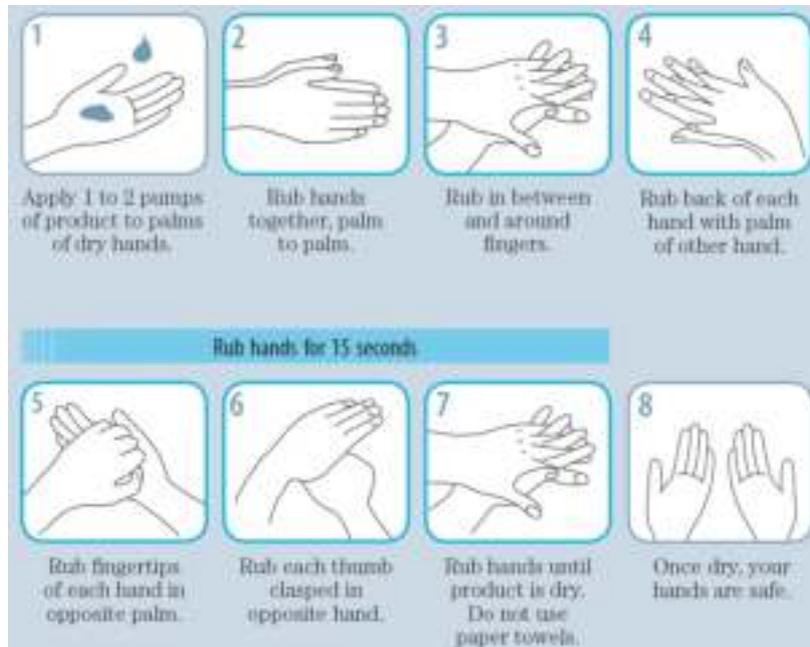


Fig. 3.28: Usage of Sanitizer

When to Wash and Sanitize Hand?



Fig. 3.29: Times to wash and sanitize hand

We need to stop the spread of COVID-19 in food industry by washing hands regularly with soap and water for 20 seconds – especially after going to the bathroom, before eating, and after coughing, sneezing, or blowing our nose.

3.3.4 Good personal hygiene can prevent food poisoning

Bacteria that cause food poisoning can be on everyone – even healthy people. You can spread bacteria from yourself to the food if you touch your nose, mouth, hair or your clothes, and then food.

Good personal hygiene also makes good business sense. Customers like to see food-handling staff who take hygiene seriously and practice safe food handling.

- Personal hygiene is important to prevent food poisoning.
- When handling food, wash your hands thoroughly and often.
- If you are sick, do not go to work, because you can contaminate food more easily.
- Food handlers should be properly trained in safe food handling.

Food handling businesses ensure the following factors are considered to ensure personal hygiene:

- **Hand Washing** — ensure effective hand washing techniques are followed at appropriate times
- **Minimise hand contact with food** — try to minimise direct hand contact with raw food by using appropriate utensils and safe use of disposable gloves
- **Personal cleanliness** — cover hair; do not sneeze or cough over food; cover cuts and sores; and do not wear jewellery
- **Wear protective clothing** — wear suitable clean protective clothing and handle appropriately to prevent cross contamination
- **Exclude ill staff** — staff must report illnesses; exclude staff with vomiting or diarrhoea

UNIT 3 .4: Health Safety

Unit Objectives

By the end of this unit, the participants will be able to:

1. Illustrate the concept of health safety
2. Understand the hazards of health safety
3. Explain the health and safety policies and procedures
4. Describe the personal protective equipment
5. Discuss the types of personal protective equipment

3.4.1 Health Safety

The term Health and Safety is generally used to describe Occupational Health and Safety, and relates to the prevention of accidents and ill health to employees and those who may be affected by their work.

3.4.2 Health Safety Hazards

Safety hazards exist in every workplace, but how do you know which ones have the most potential to harm workers? By identifying hazards at your workplace, you will be better prepared to control or eliminate them and prevent accidents, injuries, property damage, and downtime.

First of all, a key step in any safety protocol is to conduct a thorough safety hazard assessment of all work environments and equipment

In a safety hazard assessment, it is important to be as thorough as possible because after all, you can't protect your workers against hazards you are unaware of and unprepared for. Avoid blind spots in your workplace safety procedures by taking into consideration these 3 types of workplace hazards:

- **Safety hazards**

Safety hazards are number one on the list of 3 types of workplace hazards. These hazards play an effect on employees who work directly with machinery or in construction sites. Safety hazards are unsafe working conditions that that can cause injury, illness, or death.

Safety hazards are the most common workplace risks. They include:

- Anything that can cause spills or trips such as cords running across the floor or ice
- Anything that can cause falls such as working from heights, including ladders, scaffolds, roofs, or any elevated work area.
- Unguarded and moving machinery parts that a worker can accidentally touch.
- Electrical hazards like frayed cords, missing ground pins and improper wiring
- Confined spaces



Fig. 3.30: Safety hazards

- **Ergonomic hazards**

Ergonomic safety hazards occur when the type of work, body positions, and working conditions put a strain on your body.

Ergonomic Hazards include:

- Improperly adjusted workstations and chairs
- Frequent lifting
- Poor posture
- Awkward movements, especially if they are repetitive
- Having to use too much force, especially if you have to do it frequently
- Excessive vibration



Fig. 3.31: *Ergonomic Hazards*

- **Work organization hazards**

Safety hazards or stressors that cause stress (short-term effects) and strain (long-term effects). These are hazards associated with workplace issues such as workload, lack of control and/or respect, etc.

Examples include:

- Workload demands
- Workplace violence
- High intensity and/or pace
- Respect (or lack thereof)
- Flexibility
- Control or say about things
- Social support or relations
- Sexual harassment

3.4.3 Health and Safety Policies and Procedures

Overview

The law says that every business must have a policy for managing health and safety.

A health and safety policy sets out your general approach to health and safety. It explains how you, as an employer, will manage health and safety in your business. It should clearly say who does what, when and how.

3.4.4 What is Personal Protective Equipment?

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

3.4.5 Types of PPE

Head protection

Examples of head protection equipment:

- Helmets;
- Hard hats;
- Hair nets

Hand protection

Examples of hand protection equipment:

- Work gloves and gauntlets;
- Wrist cuff arm nets.

Eye and face protection

- Safety glasses and goggles;
- Eye and face shields;



Fig. 3.32: Eye and face protection

Respiratory Protection

This type of PPE must be present when being in contact with large amounts of gases, powders, dust and vapors.



Fig. 3.33: Types of Respirators

Hearing protection

Examples of hearing protection equipment:

- Earplugs and defenders;
- Noise meters;
- Communications sets;
- Acoustic foam.

Foot protection

As examples of foot protection equipment can be pointed out the following ones:

- Safety boots and shoes;
- Anti-static and conductive footwear.

Height and access protection

As examples of height and access protection equipment can be mentioned in the following ones:

- Fall-arrest systems;
- Body harnesses;
- Lowering harnesses;
- Rescue lifting;
- Energy absorbers and others

First aid kit

The kit should be kept in an accessible location and /or close to areas where there is a higher risk of injury or illness. The first aid kit should provide basic equipment for administering first aid.

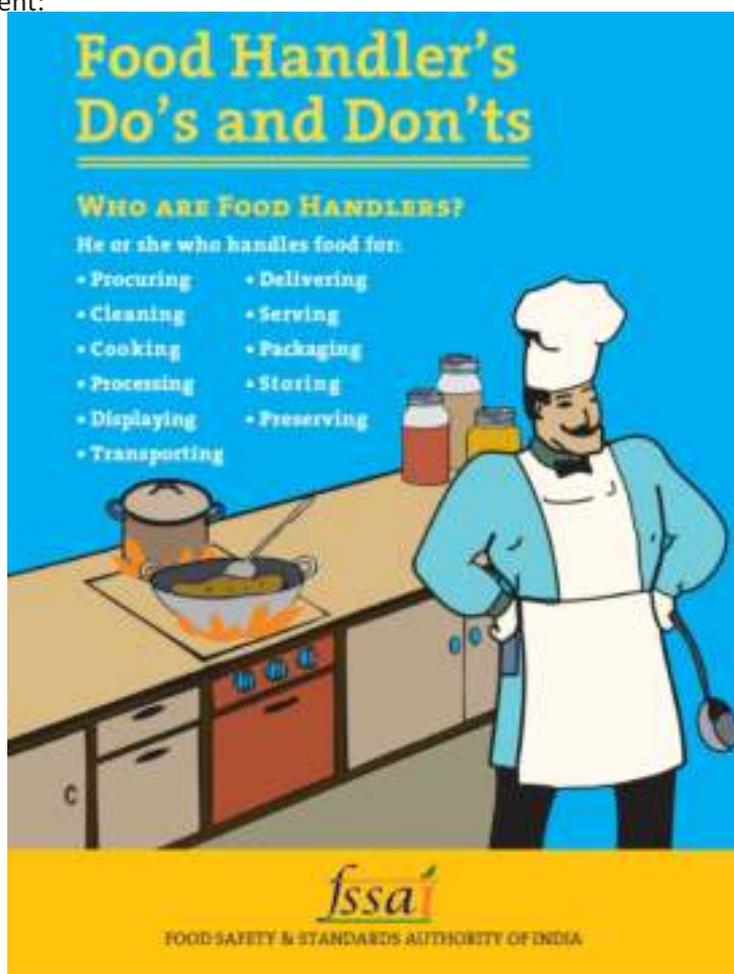


Fig. 3.34: FSSAI dos and don'ts for food handlers

Pictograms

Not only is preparing your workshop for accidents a smart thing to do, it is even smarter to organize your workshop in such a way that no serious accidents can take place. A simple way to make your workshop safer is to use pictograms: indicating flammable materials, the necessary use of hearing protection, indicating emergency exits.

Health and Safety Policy

FBO is committed to the goal of providing and maintaining a healthy and safe working environment, with a view to continuous improvement. This goal is only achievable by adherence to established objectives striving to exceed all obligations under applicable legislation, and by fostering an enthusiastic commitment to health, safety and the environment.

In particular:

Management, working in cooperation with the Joint Health and Safety Committee, will strive to take all reasonable steps to reduce workplace hazards to as low as reasonably achievable.

Supervisors and managers are held accountable for the health and safety of all employees under their supervision. This includes responsibility for applicable training and instruction, appropriate followup on reported health and safety concerns, and implementation of recommended corrective action.

FBO is committed to providing all necessary training and instruction to ensure that appropriate work practices are followed on the job, and to promote their use off the job.

Health, safety, the environment and loss control in the workplace are everyone's responsibility. Company expects that everyone will join in our efforts to provide a healthy and safe working environment on a continuous day to day basis.

Importance of Preventive Health Checkups

No matter what age group you are a part of, regular preventive health tests are essential for each one of us.

Whether one is feeling fit from within or is still in his early years of life, a preventive health checkup is an important practice that one must inculcate in his or her daily life.

- It can detect developing disease and prevent them
- Increase better chances for treatment and cure
- Can identify health issues early and prevent them
- It helps to improve lifestyle and increase productivity at work.

FSSAI Format for health check up

PERFORMA FOR MEDICAL FITNESS CERTIFICATE FOR FOOD HANDLERS
(FOR THE YEAR

(See Para No. 10.1.2, Part- II, Schedule - 4 of FSS Regulation, 2011)

It is certified that Shri/Smt./Miss.....
employed with M/s....., coming in direct
contact with food items has been carefully examined* by me on date
Based on the medical examination conducted, he/she is found free from any
infectious or communicable diseases and the person is fit to work in the above
mentioned food establishment.

Name and Signature with Seal
of Registered Medical Practitioner /
Civil Surgeon

***Medical Examination to be conducted:**

1. Physical Examination
2. Eye Test
3. Skin Examination
4. Compliance with schedule of Vaccine to be inoculated against enteric group of diseases
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination.

Fig. 3.35: Format for health check up

Medical examination to be concluded –

1. Physical examination
2. Eye Test
3. Skin examination
4. *Compliance with schedule of vaccine to be inoculated against enteric group of diseases
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination

* Vaccine to be inoculated against enteric group of diseases shall be decided by the medical practitioners in accord to remove the ping to the list as declared by the municipal corporation of that area.

Summary

- Food safety refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.
- It is important to be aware of food allergens in food industry as this is the risk associated with the unintended presence of allergen due to cross contamination and should take this a matter of serious concern. Food allergies can cause serious and even deadly reactions.
- The presence of unwanted materials such as dust and particles during the manufacturing and transportation time is called contamination. The term contaminants include any unwanted matter that is found in the product. These contaminants affect the quality of the product or the process.
- Refrigerated transportation is a shipping cargo with advanced temperature adjustment features. It is built and designed mainly for climate-sensitive goods such as vegetables, fruits, meat, all-prep meals, bread, etc. in which the freight is loaded with ice and salt to maintain the food's quality at a particular temperature.
- The retail food industry plays a significant role in assuring a safe food supply for its consumers. At the retail level, activities to control food safety risks can be divided into four key areas: the supplier and source of foods and food ingredients; in-store practices and procedures; education and training of employees and food handlers; and consumer engagement.
- Good Manufacturing Practices (GMPs) are the basic operational and environmental conditions required to produce safe foods. They ensure that ingredients, products and packaging materials are handled safely and that food products are processed in a suitable environment.
- Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.
- The rule for stock rotation is FIFO (first in, first out) to make sure that older food is used first. This will help to prevent wastage. Older product will have nearer shelf life expiry, so older product should be moved out first, but new products will have time to move out since expiry is so far. That's why a rule of FEFO does also exist which means First Expiry First Out. It is called Good Distribution Practice.
- The expression "food hygiene" is often associated to personal hygiene, being many times limited to the care of washing hands. The concept of food hygiene really refers to the general cleanliness state of the food handlers' body and clothes.
- Health and Safety is a term that generally covers the legal requirements that fall under the Health and Safety at Work Act etc. 1974. The term Health and Safety is generally used to describe Occupational Health and Safety, and relates to the prevention of accidents and ill health to employees and those who may be affected by their work.

Exercise

A. Answer the following questions briefly.

1. _____ refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption.
 - a. Food Safety
 - b. Fire Safety
2. _____ is a factor or agent which may lead to undesirable effects like illness or injury in the absence of its control, whereas, risk refers to the probability that the effect will occur.
 - a. Threat
 - b. Hazard
3. The presence of _____ materials such as dust and particles during the manufacturing and transportation time is called contamination.
 - a. wanted
 - b. unwanted
4. _____ is one of the most important factors in the preservation of food because microorganisms have been found to grow in almost all temperature.
 - a. Storage temperature
 - b. Hazard temperature
5. Selling fresh and _____ produce is essential in groceries and retail food businesses.
 - a. low-quality
 - b. high- quality

B. Answer the following questions by choosing the correct option:

1. What are the most common types of contaminant?
2. Outline the layout and design of food establishment premises.
3. Explain VACCP
4. What are the facilities provided by water supply?
5. What are the two components of the sanitation plan?

Scan the QR codes or click on the link to watch the related videos



https://www.youtube.com/watch?v=6WXc6cH_gil&t=1s

Personal Hygiene



<https://www.youtube.com/watch?v=d5kn5ns0zWM>

General Requirement on Hygiene and sanitation



<https://www.youtube.com/watch?v=KBvU4Bmu500>

Food Safety

4. Produce Millet Base Composite Flour



Unit 4.1 -Introduction to millet flours

Unit 4.2- Processing of millet based composite flours

Unit 4.3 Equipment used in processing of millet composite flours



Key Learning Outcomes

At the end of this module, the participants will be able to:

1. Explain the health benefits of millet flours.
2. Discuss the processing for production of millet base composite flours.
3. Describe about the equipment used in processing of flours.
4. Describe the raw material requirements for millet base composite flour.

Unit 4.1 Introduction of Millet flour

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the benefits of millets flours over traditional ones.
2. Discuss the health benefits of millet flours.
3. Discuss the uses of millet flours.

4.1.1 Introduction

Millet has been grown all around the world, it has been a staple food from centuries and especially in the region of Asia and Africa. There are many varieties of Millets such as Finger millet (ragi), Peral Millet (bajra), foxtail millet etc. Millets are naturally Gluten free making them an excellent alternative for people suffering from Gluten intolerance or anyone seeking alternatives to traditional wheat flour.

Derived from various millet grains, this gluten free flour offers a range of health benefits and adds unique flavours and texture to a variety of culinary creations. Millet flour is an excellent choice for people who want to start their dieting or simply want to incorporate healthier options in their food.

Millet flour has many advantages over traditional wheat flour but one of the key advantages of Millet flour is its exceptional nutritional value. It is rich in dietary fibre, which aids in digestion, promotes a healthy gut and helps regulate blood sugar levels. It is also a good source of essential minerals like iron, magnesium, and phosphorus as well as vitamin B-complex and antioxidants.

Millets when ground turn into Millet flour which is slightly sweet & nutty in flavour which makes it a suitable raw material for bakery products like, cookies, breads etc. It can also be combined with other gluten free flour to make a composite flour or even mixed with traditional wheat flour for healthier options.

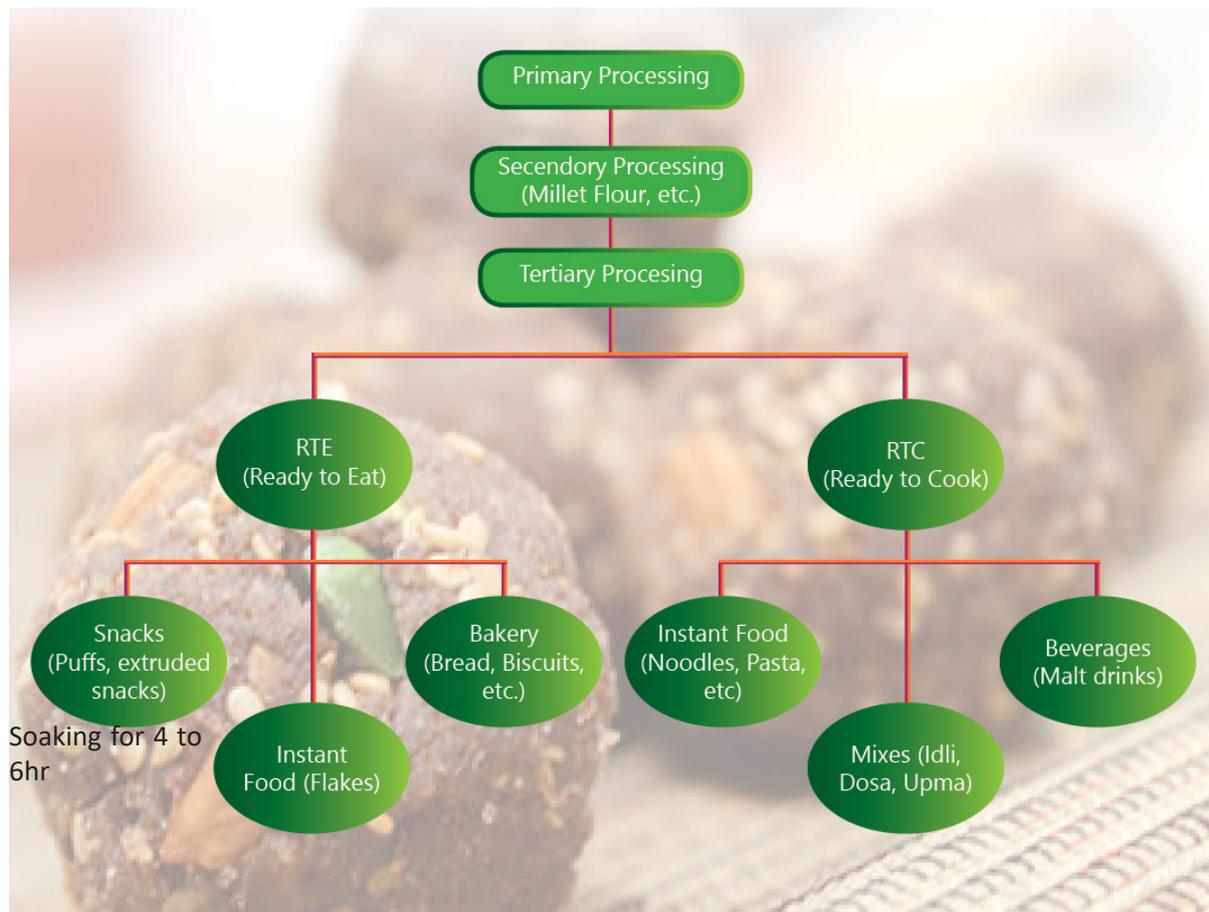


Fig 4.1 Processing of Millets

4.1.2 Millet Flours

Millet flour, like many alternatives to wheat-based flour, has grown in popularity in the past few years. With so many of us trying to eat more whole foods, exploration of less conventional grains has boomed.

Millet is considered an ancient grain which means it has remained unchanged for centuries and is still packed full of nutrients and vitamins, unlike the overly refined grains of the modern world. The high levels of both macro and micronutrients in the flour made from millet grains make it a popular choice for those wanting to live a healthier life.

With all of these qualities, you may already want to head over to our flour section and browse the millet flours we have on offer. If we've not convinced you yet, read on and find out what exactly millet flour is and how it can benefit you and your family.



Fig 4.2 Millet uses in flours

4.1.3 Millet flour health benefits

Now you know what millet flour actually is, we've rounded up a few of the amazing health benefits that come with consuming this fantastic wholegrain. Read on to find out more.

Good source of antioxidants

Millet flour is a fantastic source of compounds with antioxidant properties, such as catechins and ferulic acid. These compounds protect the body from oxidative stress which has been linked to cancer and other chronic illnesses.

Ferulic acid works to protect the skin, heal wounds and has anti-inflammatory properties, whereas catechins can protect the body from heavy metals.

Darker millet varieties tend to contain more antioxidants. These varieties include finger and foxtail millet. You can find these varieties in flour form, as both mixed and single grain flours like finger millet flour. Australia is home to a booming millet flour industry and so finding these varieties shouldn't be too difficult.

Could help regulate blood sugar levels

Being rich in fibre and non-starchy polysaccharides, both indigestible carbs, means millet can control blood sugar levels. This is particularly good for people who have type 2 diabetes as the grain can help them to regulate their blood sugar.

The grain also has a low glycaemic index and can help to reduce insulin resistance, which can be a marker of type 2 diabetes.

Improves digestive health

As mentioned, millet contains high levels of fibre which can contribute to good digestive function. Containing both soluble and insoluble fibre means there are a number of ways millet flour can support the digestive system.

The insoluble fibre in millet is 'prebiotic' meaning it contributes to good gut health by supporting bacteria in the digestive system. The soluble fibre in the grain aids in trapping and removing cholesterol from the body.

4.1.4 Millet flour uses

Millet flour has a variety of uses in baked goods and is favoured for its light texture and nutty flavour. Take a look at some of the uses and find answers to questions like is millet flour gluten-free? And what can I bake with millet flour?

Is millet flour gluten-free?

Millet is a completely gluten-free grain, making it a safe choice for those who suffer from coeliac disease, or with gluten intolerances. Millet flour is used, in combination with other gluten-free flour, in lots of gluten-free baked goods and products.

Though the grain itself is gluten-free, it is always best to check the label and ensure that the millet product you choose is labelled as such. This is because many grains can suffer cross-contamination with gluten-containing grains, making them unsuitable for consumption for those with sensitivities to gluten.



Fig 4.3 Gluten free millets

Baking with millet flour

Millet flour can be used in a variety of flour containing recipes. Millet flour has a similar protein structure to flour containing gluten which makes it a good substitution, however, it is recommended that millet flour is used in combination with other flours when substituting wheat flour.



Fig 4.4 Millet flours in bakery

Millet flour adds more flavour to the recipes it is used in and is favoured for adding corn-like, nutty flavours to bread, pancakes, and muffins.

Other millet uses

Millet is an incredibly versatile grain and when not flour, it can be used in a variety of other ways. Millet can be used to make beer, particularly for those sensitive to gluten. It can also be used in cereals and porridges, and as a crunchy, wholegrain snack.

Millet flour is a fantastic alternative to wheat-based flour and can be used in place of gluten-containing flours in baked goods. It contains high levels of antioxidants, fibre, and protein, as well as some vital nutrients.

Millet flour can help to reduce cholesterol levels and regulate blood sugar. It can also contribute to good heart health. Millet flour should be consumed in moderation as part of a healthy and balanced diet.

Unit 4.2- Processing of millet based composite flours

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the raw material requirements for processing of millet base flours.
2. Discuss the processing steps for production of millet.
3. Discuss the packaging requirements for the millet base flours.
4. uses of millet flours.

4.2.1 Processing of Millet Flour

Describe the raw material requirements for processing of millet base flours.

Quality Raw Material-

Quality is putting the best possible product together and doing it consistently. Quality assurance is also an important aspect of your company's marketing activities. Future sales are directly and significantly affected by the level of quality and consistency of your product. Consumers won't want to deal with other companies once you have built a solid reputation for the quality and dependability of your product.

Usually, there is a completely different department for Quality Control and Quality Assurance. This being given, the internal and external audits have to be cleared by this department itself. These audits hold a lot of value in the quality certification of an organisation.

A quality product begins with quality ingredients. You need to work closely with your suppliers to ensure that they all meet your tight standards. These should be created for ordering raw materials, packaging materials and other supplies. There are standard parameters which are involved in selecting grains.

Processing

To process Millet based composite flour you need to have all the raw material beforehand. Percentage of each raw material used should be calculated beforehand to avoid any confusion. You can adjust the ratio of any millet depending on the characteristics of final product.

Here we are taking a combination of Finger Millet, Sorghum, Pearl Millet and Wheat.

The ratio of these grains are- Wheat-40%, Peral Millet- 30%, Sorghum-20% and Ragi-10%.

Process flow for Millet flour is given below-

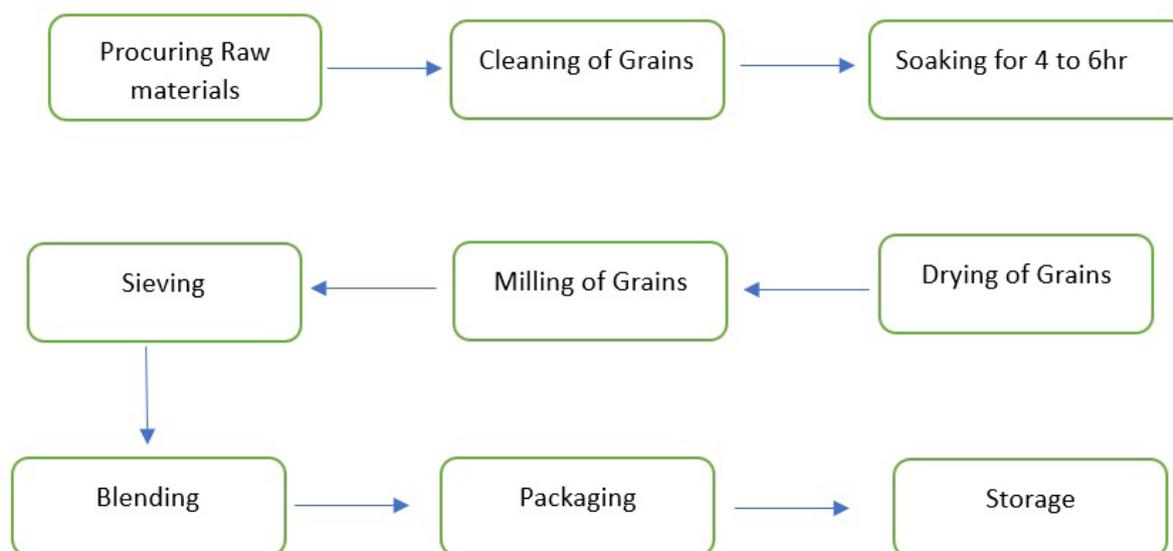


Fig 4.5 Process flow of Millet Flour

Lets discuss all the steps of Millet flour in detail.

1. **Cleaning-** The grains which is to be grained is to be cleaned first. This cleaning is done in various ways. Cleaning step itself consist of many steps to get the best quality flour. First grains are put in destoner to remove stones & any other heavy particles, after this grains are then fed through magnetic separator which removes any metal pieces present in the grains. Then the grains are passed through disc separator which eliminates any foreign grains present in the millets. Then these grains are fed into impact entoleter where improper grains, insects or their eggs get break. For the final cleaning step these grains are pass through Aspirator where damaged grains and other light weight particles gets eliminated from the grains.
2. **Soaking-** After cleaning grains are soaked in normal water for few hours. This step is done for easy bran removal & to get the uniform moisture content throughout. Soaking also helps in the removal of Phytic acid.
3. **Drying-** Grains are the dried under sun or in a dryer for easy milling.
4. **Milling-** With the help of elevator, grains are then uniformly fed into the Pulveriser or Hammer mill where grains are break down into finer particles. You can adjust the speed of the blades depending on your desired end results.
5. **Sieving-** Grains are sieved to get a smoother texture. During sieving process all the coarse particles are removed and we get flour of a uniform mesh size. It also helps in the removal of finer foreign matter like hair, threads etc.
6. **Blending-** flour is blended to get the uniform colour. Blending helps in achieving consistency in the flour. After blending flour go through few quality checks like magnets and metal detector to get rid of any metal pieces. After quality checks flour is then packed in desirable packaging material.

These Processing steps may vary depending on the recipe formulation.

4.2.2 COMPOSITE MILLET-BASED FLOUR

Ratio of different types of millets and varieties of millets that can give quality flour:

Composite Millet Flour can be made with all types of millets and there are different combinations. As per research, based on appearance, colour, flavor, taste, texture and overall acceptability the following ratio is taken for making composite millet flour.

Best Millet Composite Flour	
Ingredients	Qty in gm
Wheat	50
Foxtail Millet	10
Little Millet	20
Finger Millet	10
Soybean	10
Fenugreek Seed	1

Table: Millet composite flour quantity

All the ingredients are cleaned and the soybean is defatted by roasting. The blends are prepared by mixing wheat with foxtail, little and finger millet with fenugreek seeds and defatted soy bean.

There are different combinations of millets available in the Indian Market:





In this, 25% Millets is taken mixing Ragi, Bajra and Jowar & Whole Wheat (74%). In addition to that Soybean and Fenugreek seeds are added.



This Multi Millet Roti mix has a great combination of Foxtail Rice, Little Rice, Brown top Rice, Barnyard Rice, Kodo Rice, Ehwat, Sorghum, Peral Millet



This Highly Nutritious Organic flour with all the goodness of 9 Millets: Sorghum (Jowar), Pearl Millet (Bajra), Finger Millet (Ragi), Amaranth (Rajgira), Foxtail Millet (Kangni), Barnyard Millet (Samvat), Kodo Millet (Kodra), Little Millet (Kutki), Proso Millet (Chena).



This Millet Protein Flour has Peral Millet, Whole Wheat,Gluten,Pysillium Husk



Sudhana Multi Millet flour has Whole wheat (70%), millets 25% (jowar, bajra, Ragi & foxtail), Urad dal, Soya, Fenugreek.



Mixed Millet flour is prepared by cold milling unpolished foxtail millet, pearl millet, Kodo Millet and Barnyard Millet. Millets have been cultivated since pre-historic times and is one of the world, earliest food plants used by humans. It is naturally gluten free and is non-acid forming.

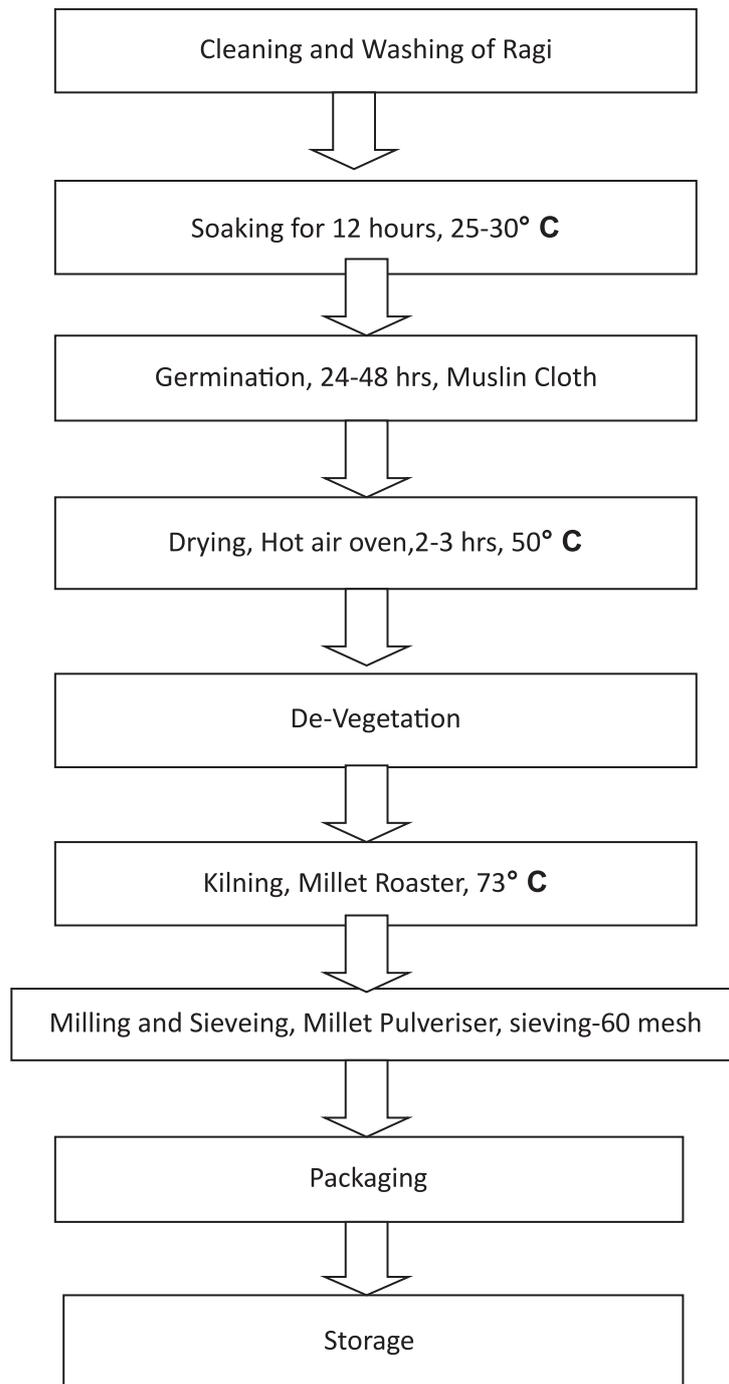


Fig 4.6 Millet Malt Process

4.2.3 Packaging of the flour

Food packaging plays a critical role in the modern food industry, ensuring the safety, preservation, and presentation of various food products. It serves as a protective barrier between the food and the external environment, safeguarding it from contamination, spoilage, and damage during transportation and storage. Additionally, food packaging is a means of conveying important information to consumers, such as nutritional content, ingredients, and expiration dates. This introduction provides an overview of the key aspects of food packaging.

1. Purpose of Food Packaging:

Protection: Packaging safeguards food from physical, chemical, and biological factors, including moisture, oxygen, light, and microorganisms.

Preservation: It extends the shelf life of food by maintaining freshness and preventing spoilage, thereby reducing food waste.

Identification: Packaging helps consumers identify the product, brand, and essential information like ingredients and nutritional values.

Convenience: Packaging designs can enhance the convenience of handling, storing, and consuming food products.

2. Types of Food Packaging:

Primary Packaging: The immediate layer of packaging in direct contact with the food, such as cans, bottles, and pouches.

Secondary Packaging: The outer layer that contains primary packages, used for grouping and transportation, like cardboard boxes.

Tertiary Packaging: Larger containers, typically used for shipping multiple secondary packages on pallets.

3. Materials Used in Food Packaging:

Plastics: Common for their versatility, lightweight nature, and barrier properties.

Paper and Cardboard: Eco-friendly and often used for secondary and tertiary packaging.

Metal: Used for cans and containers, offering excellent preservation properties.

Glass: Used for products like bottled beverages and preserves, ensuring product visibility.

Flexible Packaging: Includes materials like foil, films, and laminates, offering various advantages in terms of flexibility and preservation.

Material use in Flour Packaging

Paper Bags: Traditional packaging for flour, often made from kraft paper. They are durable and can be sealed to keep flour fresh. Some paper bags have a plastic or wax lining for added protection.

Plastic Bags: Polyethylene bags are commonly used due to their moisture resistance and cost-effectiveness. They come in various sizes and can have resealable closures.

Paper/Plastic Composite Bags: A combination of paper and plastic provides the best of both worlds: the strength of paper and the moisture resistance of plastic.

Bulk Packaging: Flour is sometimes packaged in bulk, either in large paper sacks or plastic containers, for commercial use.

Bag Size and Design:

Flour is typically packaged in a range of sizes, from small 5Kg bags for home use to larger 20- 25Kg bags as well as 50kg bags for commercial or industrial use.

Bags may feature a gusset design for stability when standing on store shelves or storage.

The packaging of flour is crucial to ensure its quality, shelf life, and safe consumption. Flour packaging serves several purposes, including protection from contaminants, preservation of freshness, ease of handling, and clear communication of essential information to consumers. Here's an overview of common practices in the packaging of flour:



Fig 4.7 Packed Millet Flour

Paper Bags: Traditional packaging for flour, often made from kraft paper. They are durable and can be sealed to keep flour fresh. Some paper bags have a plastic or wax lining for added protection.

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FSSAI Mandatory Labelling Requirements

Flour packaging must include important information for consumers, such as:

Brand name and logo

Product name (e.g., all-purpose flour, whole wheat flour)

Net weight

Nutritional information (e.g., calories, protein, and carbohydrate content)

Ingredients list

- Allergen warnings
- Usage instructions
- Barcode for scanning at the checkout
- Best before or use-by date
- Storage recommendations



Fig 4.8 Labelling specifications

Unit 4.3 Equipment used in processing of composite flours

Unit Objectives

At the end of this unit, you will be able to:

- Describe about the various equipment's used in for processing of millet base flours.
- Discuss the quality analysis parameters for the final products.

4.3.1 Processing Equipment requirements

To produce Millet based flour or composite flour, various types of equipment are needed. Some of the equipment's are mentioned below-

Name of the Equipment	Use and Operations
Destoner	This machine is used for cleaning a wide variety of products such as wheat, maize, rice, nuts, and pulses. The machine not only gives a de-stoning separation, but also separates heavy and light product streams.
Impact entoleter	Impact Entoleter is used to destroy and remove any insects present in the grains.
Closed Circuit Aspirator	The closed-circuit aspirator provides for efficient and controlled separation of light impurities from cereals. Three inlet options enable a stand-alone application as well as compatibility with a milling separator or a scouring machine. The closed-circuit aspirator is either installed at the grain intake point or integrated into the cereal cleaning system.
Pulveriser Mill	Pulveriser is used to grind and mill grains into fine powder.
Blender	Blenders are used to mix and blend flour to achieve consistent color.
Sifter	Sifters are used to Sift and sort grist and floury products in different categories.

Table 4.1: Equipments used in processing.

WW Equipment Supplier List

1. Perfura Technologies Pvt. Ltd.
2. AV, Engineering Industries
3. Victor Agro Sales
4. Agromech engineering
5. KMS Industries
6. Borne Technologies Pvt. Ltd.
7. DHAN Foundation



Fig 4.9 Millet Dehuller
Capacity- 100kg/hr
Approx Costing- 30k to 80k Approx
Costing- 50k to 90k



Fig 4.10 Destoner cum Grader cum
aspirator Flour Blender
Capacity-100kg/hr
Approx Costing- 80k to 2lac Approx
Costing- 50k to 1lac



Fig 4.11 Destoner cum Grader cum aspirator
Capacity-100kg/hr
Approx Costing- 80k to 2lac



Flour Blender
Capacity-100kg/hr
Approx Costing- 50k to 1lac



Fig 4.12 Pulverizer
Capacity-100kg/hour
Approx Costing- 50k to 1lac

Capacity of all the machinery mentioned above is around 100kg/hour.

2 QUALITY ANALYSIS

Analysing Final Product Quality is very important, as it ensures that the product we are processing is good for human consumption. There are several parameters of flour that need to be checked before transporting it for the market.

Some of the Important Quality parameters are-

1. Moisture Content-
2. Ash
3. Particle Size
4. Color Analysis-
5. Protein Content-
6. Fat Content-
7. Microbiological test-
8. Sensory evaluation

S. No.	Parameters	Limits
1.	Moisture, % by mass, Not more than	11.0
2.	Acid Insoluble Ash on dry basis, % by mass, Not more than	0.15
3.	Protein (N x 6.25), % by mass (on dry basis), Not less than	8.0
4.	Alcoholic acidity, % by mass (on dry basis), Not more than	0.18
5.	Total Dietary fiber, % by mass (on dry basis), Not less than	12.0
6.	Particle size, Not less than	98% should pass through 40 mesh
7.	Uric acid, mg/kg, Not more than	100

Table: Millet parameters and its limits

Exercise

Answer the following questions:

1. Which type of millet is commonly used in the processing of millet composite flours?

2. Describe any 2 health benefits of using millet base flour over traditional flours.

3. Write the application of sifter and pulverizer in millet flour processing.

5. Produce Millet Based Baked Products



Unit 5.1- Introduction to millet base bakery products

Unit 5.2- Market trends and opportunities in millet base bakery products

Unit 5.3- Recipe Formulation for Millet-Based Bakery Products

Unit 5.4- Recipe Formulation for Millet-Based Bakery Products

Unit 5.5 Machinery requirements and vendor selection



Key Learning Outcomes

At the end of this module, the participants will be able to:

- Explain about the different millets base bakery products.
- Discuss role of different ingredients in preparing millet based baked products.
- Explain different Baking techniques for millet base product preparation.
- Types of equipment's used in baking process for millet base bakery products.
- Different packaging materials and packaging techniques for millet base baked products.
- Discuss the vendor selection and management process.

Unit 5.1- Introduction to millet base bakery products

Unit Objectives

At the end of this unit, you will be able to:

1. Describe Nutritional Comparison of Common Millet Varieties.
2. Explain the various components of millet bakery products.
3. Discuss the various types of millets used in millet base bakery products.
4. Discuss about variety of Millet based bakery Products.

5.1.1 Introduction

1.1. The rise of millet bakery products

Millet cultivation and consumption in India date back thousands of years, tracing their roots to ancient civilizations. In regions with diverse agro-climatic conditions, millets were valued for their resilience and ability to thrive in challenging environments. Historically, these grains played a pivotal role in Indian diets, contributing to the cultural and nutritional fabric of the country.



Fig. 5.1: Ancient Millet Farming in a Farm

Millet grains are nutrition powerhouses, rich in fiber, protein, vitamins, and minerals. Comparatively, they offer higher levels of certain nutrients than conventional grains like rice and wheat. With rising health consciousness, consumers are increasingly drawn to millet-based bakery products for their potential to provide sustained energy, aid digestion, and manage weight.

Nutrient (per 100g)	Finger Millet	Pearl Millet	Foxtail Millet
Protein	7.3g	10.6g	12.3g
Fiber	3.6g	1.3g	8.0g
Iron	3.9mg	16.9mg	2.8mg
Calcium	344mg	42mg	31mg
Magnesium	137mg	114mg	24mg

Table 5.1: Nutritional Comparison of Common Millet Varieties

The bakery industry in India has undergone a transformative shift due to changing consumer preferences. Health-conscious individuals seeking alternatives to refined wheat products have paved the way for millet-based bakery items. The market has responded with innovation, offering millet bread, cookies, cakes, and more.

Baking with millet presents unique challenges, including issues with texture, binding, and flavor. Overcoming these challenges required innovative baking techniques and the development of specialized millet flour blends. Food technologists and chefs collaborated to create products that not only deliver health benefits but also meet taste expectations.



Fig. 5.2: Variety of Millet based bakery Products

The revival of millet cultivation for bakery products is not only nutritionally beneficial but also economically and ecologically sound. Millets require less water and fewer inputs than other grains, contributing to sustainable agriculture. This resurgence supports local farmers, promotes biodiversity, and reduces the carbon footprint associated with agriculture.

Facts

- Millets use approximately 70% less water than rice production.
- The millet cultivation area in India has increased by 60% in the last decade.
- Millet-based bakery products are predicted to contribute 40% to the Indian bakery market by 2027.



Fig. 5.3: Innovative Baking Techniques for Millets Based Bakery Products

5.1.2 Millets in Bakery Products - Health and Sustainability Benefits

In recent years, there has been a growing trend towards seeking healthier and more sustainable food options. Millets, a group of ancient grains, have gained considerable attention due to their remarkable health and sustainability benefits. This chapter explores why millets are being increasingly incorporated into bakery products, elucidating their positive impact on both human health and the environment.

Millet as a Nutrition Powerhouse

- Millets, which include varieties such as finger millet (ragi), pearl millet (bajra), foxtail millet, and sorghum, boast an impressive nutritional profile.
- They are rich sources of complex carbohydrates, dietary fiber, and essential micronutrients, making them ideal candidates for enhancing the nutritional content of bakery products.
- Millets are gluten-free, making them suitable for individuals with gluten sensitivities or celiac disease. Moreover, they are packed with vital vitamins and minerals, such as magnesium, phosphorus, iron, and B-vitamins.

Nutrient Content per 100g	Finger Millet	Pearl Millet	Foxtail Millet	Wheat	Rice
Macronutrients					
Carbohydrates (g)	72.8	65.4	73.5	71.2	77.7
Protein (g)	7.3	10.6	12.3	11.8	7
Fat (g)	1.5	5.5	3.3	1.2	0.6
Dietary Fiber					
Fiber (g)	3.6	1.3	8.5	12.2	1
Vitamins					
Vitamin A (IU)	5	5	17	9	0
Vitamin C (mg)	1.7	1.7	2.3	0.5	0
Vitamin E (mg)	0.1	0.1	0.1	0.1	0.1
Minerals					
Calcium (mg)	344	42	31	34	28
Iron (mg)	3.9	4.7	2.8	2.5	0.8
Magnesium (mg)	137	114	24	44	25
Antioxidants					
Phenolic Compounds (mg)	15	14	22	10	5
Flavonoids (mg)	3	2	1	1	0.1

Table 5.2: *The nutritional content of different millet varieties

The high dietary fiber content in millets aids digestion, promotes satiety, and helps regulate blood sugar levels, reducing the risk of type 2 diabetes. Additionally, millets contain antioxidants that contribute to reducing inflammation and lowering the risk of chronic diseases, including heart disease and certain types of cancer. The incorporation of millets into bakery products can thus elevate their nutritional value, transforming traditional indulgences into healthful treats.

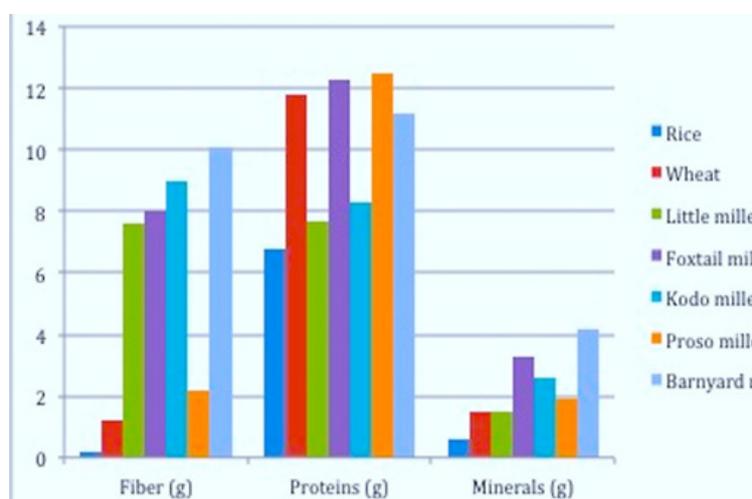


Fig. 5.4: Comparison Nutritional Values of Cereals and Various Millets

Sustainability Metrics	Millet Varieties	Wheat	Rice
Water Usage			
Water Requirement (L/kg)	Low	High	Very High
Land Requirements			
Land Requirement (m ² /kg)	Low	Moderate	High
Pesticide/Fertilizer Use			
Pesticide Use (kg/ha)	Low	High	High
Fertilizer Use (kg/ha)	Low	High	High
Carbon Footprint			
Carbon Footprint (kg CO ₂ e/kg)	Low	Moderate	High

Table 5.3: Comprehensive data on Various Sustainability benefits for millet cultivation

Furthermore, millets are typically grown using traditional farming practices, which often involve fewer synthetic inputs like pesticides and fertilizers. This translates to lower greenhouse gas emissions and a reduced carbon footprint. By integrating millets into bakery products, the food industry can actively support sustainable agriculture and contribute to the conservation of biodiversity.

5.1.4 Millets in Bakery: A Winning Combination

Incorporating millets into bakery products not only enhances the nutritional value but also imparts unique flavors and textures. Millet flours can be blended with conventional flours to create versatile mixes suitable for a range of bakery items, from bread and muffins to cookies and cakes. The nutty and earthy flavors of millets can add a delightful twist to familiar recipes, enticing consumers to opt for healthier alternatives without compromising on taste.



Fig. 5.5: Types of Millets

Gluten-free millet flours can replace or complement wheat flour in gluten-free bakery products, meeting the needs of individuals with gluten sensitivities. Moreover, the vibrant colours of certain millets, such as ragi, can lend appealing aesthetics to baked goods.

5.1.5 Overcoming Challenges and Promoting Adoption

While the benefits of millet inclusion in bakery products are significant, there are challenges to overcome. Developing standardized processing techniques, recipes, and awareness campaigns are crucial steps toward mainstreaming millets in bakery. Collaborative efforts between researchers, chefs, bakers, and policymakers are essential to ensure the successful integration of millets into the bakery sector.

Education plays a pivotal role in fostering consumer acceptance. Informative labeling and marketing campaigns can highlight the health and sustainability benefits of millet-based bakery products, encouraging consumers to make conscious choices.

The incorporation of millets into bakery products presents a win-win situation for both human health and the environment. These ancient grains bring to the table an array of essential nutrients, dietary fiber, and antioxidants that can revolutionize the nutritional quality of baked goods. As the food industry continues to evolve, embracing millets in bakery products stands as a testament to innovation, health consciousness, and sustainability awareness.

Unit 5.2-Market trends and opportunities in millet base bakery products

Unit Objectives

At the end of this unit, you will be able to:

1. Explain the market trends and opportunities in millet base bakery products.
2. Discuss the consumer preferences and demand in the Millet Bakery Market.
3. Explain the key demand determinants for millet base bakery products.

5.2.1 Market Trends and Opportunities

The food industry in India has witnessed a significant shift in recent years, with consumers becoming more health-conscious and environmentally aware. As a result, there has been a growing interest in traditional and nutritious alternatives to conventional grains. Millets, often referred to as "nutri-cereals," have gained traction due to their nutritional value and climate-resilient nature. This chapter delves into the market trends and opportunities surrounding millet bakery products in India.



Fig. 5.6: Opportunities and Challenges

5.2.2 Rise in Nutritional Awareness

- India's population is becoming increasingly conscious of their dietary choices, seeking healthier options that provide essential nutrients. Millets are rich in dietary fiber, vitamins, and minerals, making them a suitable choice for health-conscious consumers. The gluten-free nature of millets also appeals to those with gluten sensitivities or celiac disease.
- Millet consumption is deeply ingrained in Indian culture and history. These grains have been consumed for generations, particularly in rural communities. The resurgence of interest in traditional foods has created a unique market opportunity for millet-based bakery products that celebrate both cultural heritage and health.
- The environmental impact of agriculture is a pressing concern globally. Millets are well-suited for sustainable farming due to their minimal water requirements and ability to grow in diverse climatic conditions. As consumers become more conscious of their ecological footprint, millet bakery products align with their values of sustainability.

Trend	Statistics and Facts
Growth in Millet Production	Millet production in India increased by 40% over the last five years, reaching X million metric tons in the last year.
Rise in Millet Consumption	Millet consumption has risen by 35% among urban populations due to increased health awareness.
Market Share of Millet Bakery Products	Millet-based bakery products now account for 30% of the overall bakery market in India.
Investment in Millet R&D	Over 500 Startups are working in Millet value chain while the Indian Institute on Millet Research, has incubated 250 Startups under RKVY-RAFTAAR. More than Rs.6.2 crores have been disbursed to over 66 Startups while about 25 Startups have been approved for further funding

Table 5.4: Recent Market Trends: A Statistical Overview for the promotion of Millets

5.2.3 Opportunities in the Millet Bakery Sector

The millet bakery industry in India is riding the wave of changing consumer preferences, health consciousness, and environmental awareness. The convergence of tradition and innovation provides a unique platform for growth. By capitalizing on the current market trends and strategically addressing the identified opportunities, businesses can position themselves at the forefront of this emerging sector while contributing to the betterment of both public health and the planet. There is huge rise in the opportunities in Millets processed products especially in bakery sector are as following:

- **Product Diversification:** The millet bakery sector offers ample opportunities for product diversification. Breads, muffins, cookies, and even pastries can be infused with millet flour to enhance nutritional value. Experimenting with different millet varieties can lead to a wide range of flavors and textures, catering to diverse consumer preferences.
- **Collaborations with Farmers:** Collaborating with local farmers for a steady supply of high-quality millets not only ensures consistent production but also contributes to the economic upliftment of rural communities. Such collaborations can also be leveraged as a unique selling proposition, highlighting the origin and authenticity of the ingredients.
- **Health-Centric Marketing:** The health benefits of millets provide a strong foundation for marketing strategies. Emphasizing attributes like low glycaemic index, high fibre content, and essential nutrients can attract health-conscious consumers. Packaging and promotional materials should educate consumers about the nutritional advantages of millet-based bakery products.
- **Penetrating Untapped Markets:** Rural and semi-urban markets remain relatively untapped for millet bakery products. These regions often have a stronger connection to traditional foods and may readily accept millet-based offerings. Developing cost-effective distribution networks and product sizes suitable for these markets could yield significant growth.
- **Food Processing:** Millets can be processed into various food products, including flour, flakes, porridge, and snacks. There is a rising trend of using millet-based products as a substitute for wheat and rice due to their nutritional benefits. Entrepreneurs can set up millet processing units to manufacture these value-added products and cater to the increasing demand.
- **Export Potential:** Millet bakery products hold export potential to markets with growing demand for healthy and gluten-free options. International consumers seeking alternatives to wheat-based products present a viable opportunity for Indian millet-based bakery exports.

5.2.4 Consumer Preferences and Demand in the Millet Bakery Market

Consumer preferences and demand play a crucial role in shaping the dynamics of markets, influencing the products offered and the strategies adopted by businesses. In recent years, there has been a growing interest in alternative and healthier food options, leading to the rise of niche markets such as the millet bakery market in India. This chapter aims to explore consumer preferences and demand in the context of the millet bakery market, examining the factors that influence purchasing decisions and the implications for businesses operating in this sector.

Understanding Consumer Preferences

Consumer preferences refer to the subjective choices individuals make when faced with various options. These choices are often influenced by factors such as taste, health considerations, cultural norms, and personal values. In the context of the millet bakery market, understanding consumer preferences involves examining the reasons behind the shift towards millet-based products, particularly in bakery items.

Health Benefits: The health benefits of millets, such as being gluten-free and having a low glycaemic index, have garnered significant attention among health-conscious consumers. As shown in Table 5.1, a survey conducted in major Indian cities revealed that 68% of respondents cited health benefits as a key factor influencing their preference for millet bakery products.

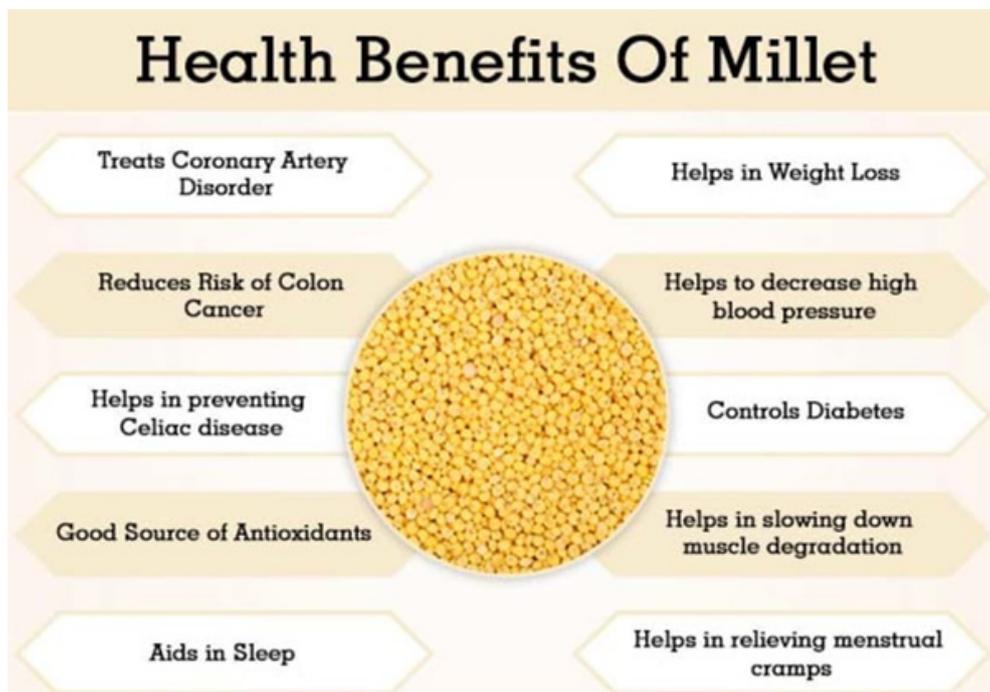


Fig. 5.7: Health benefits of Millets

Factors	Percentage of Respondents*
Health Benefits	68%
Taste and Flavor	24%
Dietary Restrictions	8%

Table 5.5: Factors Influencing Consumer Preferences in the Millet Bakery Market

Taste and Flavor: While health considerations are important, taste and flavor remain critical factors in consumer choices. Millets, once considered bland, have undergone innovation in the bakery industry, leading to the development of palatable and appealing products. Approximately 24% of survey respondents indicated that taste and flavor played a vital role in their preference for millet-based bakery items.

Dietary Restrictions: For individuals with dietary restrictions, such as those following gluten-free diets, millet bakery products offer a convenient and tasty alternative. About 8% of respondents mentioned dietary restrictions as a factor guiding their choices in the millet bakery market.

Price Change	Quantity Demanded Change
10% Increase	-5%
10% Decrease	6%

Table 5.6: Price Elasticity of Demand for Millet Bakery Products

Price Sensitivity: Price elasticity of demand measures the responsiveness of quantity demanded to change in price. As depicted in Table 6, millet bakery products exhibit slightly elastic demand, meaning that consumers are sensitive to price changes but not highly responsive.

Consumer income: Income also play a significant role in shaping demand. As disposable income rises, consumers are more likely to explore premium and healthier food options, such as millet bakery products. This relationship is particularly relevant in urban areas where higher-income individuals are more prevalent.

Market trends and effective advertising: It can significantly impact consumer demand. Growing awareness of the health benefits of millets, coupled with strategic marketing campaigns promoting the taste and variety of millet bakery items, can drive consumer interest and boost demand.

Unit 5.3- Recipe Formulation for Millet-Based Bakery Products

Unit Objectives

At the end of this unit, you will be able to:

- Discuss the recipe formulation for various millet base bakery products.
- Discuss the basic principles of baking with Millets.
- Role of different ingredients in preparing millet based baked products.
- Explain the importance of recipe standardization and scaling.

5.3.1 Recipe Formulation for Millet-Based Bakery Products

4.1 Basic Baking Principles with Millets

Baking is an age-old culinary technique that has evolved over centuries, transforming simple ingredients into delectable treats that satisfy our taste buds. With the growing emphasis on healthy eating, there's a rising interest in incorporating nutritious ingredients into traditional recipes. Millets, a group of small-seeded grasses, have gained attention for their exceptional nutritional value and versatility in cooking. In this article, we'll delve into the world of basic baking principles with millets, exploring their benefits and providing step-by-step guidance to create delicious baked goods.

The Nutritional Value of Millets

Before diving into the baking process, let's explore the nutritional benefits that millets bring to the table:

- **Rich in Nutrients:** Millets are packed with essential nutrients such as dietary fibre, vitamins (especially B-complex vitamins), and minerals like iron, magnesium, and phosphorus.
- **Gluten-Free Alternative:** Millets are naturally gluten-free, making them an excellent option for individuals with gluten sensitivity or celiac disease.
- **Low Glycaemic Index:** Millets have a low glycaemic index, which means they cause a slower and steadier rise in blood sugar levels compared to refined grains.
- **Diverse Varieties:** There are several types of millets available, including pearl millet (bajra), finger millet (ragi), foxtail millet, and more, each offering unique flavors and health benefits.

Here are the basic 9 principles of baking with Millets

1. Choosing the Right Millet

Selecting Variety: Choose a millet variety suitable for baking, such as foxtail millet or pearl millet flour. These flours are readily available in health stores or can be prepared at home by grinding millet grains to a fine consistency.

2. Substituting Millet Flour

Flour Combination: When using millet flour in baking, it's advisable to combine it with other flours like rice flour or almond flour. This helps improve the texture and binding properties of the baked goods.



3. Adjusting Liquid Content

Liquid Absorption: Millet flours tend to absorb more liquid than regular wheat flour. To maintain the right consistency, gradually add liquids (water, milk, yogurt, etc.) to your batter while mixing.

4. Binding Agents

Egg or Egg Replacers: Eggs provide structure and moisture in baking. For vegan options or egg allergies, use substitutes like flax eggs (ground flaxseed mixed with water) or applesauce.

5. Leavening Agents

Rising Agents: Millet-based batters' benefit from leavening agents like baking powder or baking soda, which help the goods rise and become airy.

6. Sweeteners and Flavor Enhancers

Natural Sweeteners: opt for natural sweeteners like honey, maple syrup, or coconut sugar to enhance the taste. Adjust quantities to achieve your desired level of sweetness.

Flavor Additions: Incorporate flavors like vanilla extract, cocoa powder, or spices to complement the nutty undertones of millet.

7. Mixing and Kneading

Gentle Mixing: When combining dry and wet ingredients, avoid overmixing, as millet flours lack gluten and can become tough if overworked.

8. Baking Time and Temperature

Temperature Adjustment: Millet-based baked goods may require slightly lower baking temperatures compared to recipes using wheat flour. Keep a close eye on your goods to prevent over-browning.

9. Cooling and Storage

Cooling Period: Allow your baked items to cool on a wire rack to prevent moisture buildup, which could lead to sogginess.

Storage: Store millet-based baked goods in airtight containers to maintain freshness. Refrigeration can extend shelf life



5.2.5 Demand Determinants

Demand for millet bakery products: It is influenced by a range of factors, including price, income levels, consumer preferences, and market trends. Analysing these determinants can provide insights into market dynamics and help businesses formulate effective strategies.

Price Change	Quantity Demanded Change
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10% Decrease	6%

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Fig. 5.8: Choosing the Right Millet

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Storage: Store millet-based baked goods in airtight containers to maintain freshness. Refrigeration can extend shelf life



5.4.2 Adapting Traditional Recipes with Millets

Incorporating millet flours into your baking endeavours can lead to a world of nutritious and flavourful delights. By understanding the principles of millet-based baking and experimenting with different recipes, you can create a range of baked goods that are not only delicious but also contribute to your overall well-being. So, gather your millet flours, roll up your sleeves, and embark with the below sample recipes:

1. Millet Muffins

Ingredients:

- 1 cup millet flour
- 1/2 cup almond flour
- 1/4 cup honey
- 1/2 cup milk (or non-dairy milk)
- 2 flax eggs (2 tbsp ground flaxseed + 6 tbsp water)
- 1 tsp baking powder
- 1/2 tsp vanilla extract
- Pinch of salt



Fig. 5.9: Millet Muffins

Instructions:

1. Preheat the oven to 350°F (175°C) and line a muffin tin with liners.
2. In a bowl, prepare the flax eggs and let them sit for 5 minutes.
3. In a separate bowl, whisk together the millet flour, almond flour, baking powder, and salt.
4. Add the honey, milk, vanilla extract, and prepared flax eggs to the dry ingredients. Mix gently until just combined.
5. Divide the batter evenly among the muffin cups.
6. Bake for 20-25 minutes, or until a toothpick inserted into a muffin comes out clean.
7. Allow the muffins to cool in the tin for a few minutes, then transfer them to a wire rack to cool completely.

2. Ragi Chocolate Chip Cookies

Ingredients:

- 1 cup ragi (finger millet) flour
- 1/4 cup butter, softened
- 1/2 cup coconut sugar
- 1 flax egg (1 tbsp ground flaxseed + 3 tbsp water)
- 1/2 tsp baking soda
- 1/2 tsp vanilla extract
- 1/4 cup dark chocolate chips



Fig. 5.10: Millet cookies

Instructions:

1. Preheat the oven to 375°F (190°C) and line a baking sheet with parchment paper.
2. Prepare the flax egg and set it aside.
3. In a bowl, cream together the softened butter and coconut sugar until smooth.
4. Add the flax egg and vanilla extract and mix well.
5. In another bowl, combine the ragi flour and baking soda.
6. Gradually add the dry ingredients to the wet ingredients and mix until a dough forms.
7. Fold in the dark chocolate chips.
8. Take spoonful of dough and roll them into balls. Place them on the prepared baking sheet and flatten slightly.
9. Bake for 10-12 minutes, or until the edges are golden.
10. Allow the cookies to cool on the baking sheet for a few minutes before transferring them to a wire rack to cool completely.

5.4.3 Developing Unique Millet-Centric Recipes

Millet grains are naturally rich in a variety of nutrients. They are a good source of dietary fiber, which aids digestion and helps maintain a healthy gut. Millets are also gluten-free, making them an excellent option for individuals with gluten sensitivities or celiac disease. These grains are packed with essential minerals like magnesium, phosphorus, and iron, which play vital roles in bone health, energy production, and oxygen transport.

Additionally, millets offer an impressive array of antioxidants, vitamins, and phytonutrients. For instance, pearl millet is known for its high levels of B vitamins, particularly niacin and thiamin. Finger millet, on the other hand, stands out for its remarkable calcium content, making it an attractive choice for those looking to bolster their bone strength.

The most common millet used in producing millet bakery products is Ragi Millet (Finger Millet). Finger Millet is commonly known as Ragi. It has become a part of the diet in most households in India due to its impressive nutritional value. Its value can't be understood until you take it regularly. It was always considered poor man's food but now it is accepted by people living in urban areas. Infact, millet value addition technologies have contributed a lot in bringing back all kind of millets to our plate. It has gained popularity among farmers because it is easy to grow and process as compared to other millets.

5.4.4 Nutritional Value of Finger Millet

Finger millet is well recognized because it is rich in calcium, protein, magnesium, iron, phosphorous, vitamins, dietary fibre, and zinc. The seed coat is also a rich source of phenolic compounds, minerals, and dietary fibre.

Nutrient	Amount per 100g
Calcium	364 mg
Protein	7.2 g
Magnesium	146 mg
Iron	4.6 mg
Zinc	2.5 mg
Dietary Fiber	11.2 g

Table 5.8: Nutritional value

4.3.1.1 Advantages of Using Finger Millet as a Base Ingredient for Bakery Products

Incorporating Finger Millet into our diets can lead to a multitude of benefits, ranging from improved bone health and weight management to diabetes control and skin vitality. As we embrace the nutritional marvel that is Finger Millet, we take a step towards healthier, more fulfilling lives.

- **Calcium-Rich Champion:** Finger Millet boasts an extraordinary calcium content of approximately 364mg per 100 grams, surpassing even milk by threefold. Calcium is vital for maintaining robust bones and teeth. This exceptional calcium concentration is particularly beneficial for growing children and older individuals who may be susceptible to osteoporosis. By integrating Finger Millet into our diet, we fortify our skeletal structure and enhance overall bone health.
- **Aiding Weight Management:** In an era marked by escalating obesity rates, particularly in urban settings, Finger Millet emerges as a valuable ally. With its naturally low-fat content (just 1.9g), Finger Millet becomes a suitable choice for weight loss journeys. Notably, Finger Millet contains Tryptophan, an amino acid that plays a pivotal role in weight management by curbing appetite. This amino acid contributes to protein synthesis and slows down digestion, preventing unnecessary calorie intake and promoting healthier weight maintenance.

- **Diabetes Management:** As diabetes assumes the status of a global emergency, dietary interventions become crucial. Finger Millet's low glycaemic index facilitates controlled blood sugar levels by supporting gradual digestion. This characteristic prevents abrupt spikes in blood sugar levels, making Finger Millet a valuable addition for individuals managing diabetes or aiming to reduce the risk of developing it.
- **Nurturing Pregnancy and Beyond:** Finger Millet extends its benefits to expectant mothers by aiding healthy pregnancies. Its mineral and nutrient-rich composition supports milk production, alleviates anxiety, and stress. With an abundance of calcium, iron, and amino acids, Finger Millet contributes to immunity enhancement, providing strength and vitality during pregnancy. Furthermore, it aids lactating mothers by fostering milk production, ensuring both maternal and infant nourishment.
- **Radiant Skin through Collagen Formation:** The secret to youthful and vibrant skin lies, in part, within Finger Millet. Essential amino acids like Methionine and Lysine, present in Finger Millet, play a pivotal role in collagen formation. Collagen is integral for maintaining skin elasticity, preventing wrinkle formation, and counteracting sagging. By incorporating Finger Millet into our diet, we can promote healthy, radiant skin.
- **Combating Anaemia and Iron Deficiency:** In India, the prevalence of iron deficiency and anaemia, particularly among children and adolescents, remains a concern. Finger Millet steps in as a natural source of iron, addressing this issue and positively influencing haemoglobin levels. Its iron content contributes to healthier blood production, mitigating the risks associated with anaemia.
- **Digestive Health and Bowel Regularity:** Adequate dietary fibre intake is essential for optimal digestive health and regular bowel movements. Finger Millet excels in this aspect, offering a rich source of dietary fibre. By enhancing digestion and preventing constipation, Finger Millet contributes to overall gut well-being.

5.4.5 Ragi Millet Recipes

Ingredients:

- 1 cup fine ragi flour or sprouted ragi flour
- 1 cup wheat flour (atta) or plain flour
- tablespoons cocoa powder
- 1 teaspoon baking powder
- ½ teaspoon baking soda
- 100 grams butter
- 1 cup sugar or jaggery powder
- ½ cup curd (yogurt), whisked
- 1 cup milk (180 ml)
- 1 tablespoon vanilla extract
- 1/8 teaspoon salt (optional)



Fig. 5.11: Ragi Cake

Preparation for Ragi Cake:

- 1 Begin by greasing a 7 or 8-inch cake pan and lining it with parchment paper to prevent sticking.
- 2 Preheat your oven to 180°C (350°F) for at least 15 minutes.
- 3 In a mixing bowl, sieve together the ragi flour, wheat flour, salt (if using), baking powder, baking soda, and cocoa powder. It's recommended to sieve these dry ingredients three times to ensure a smooth and uniform mixture.
- 4 To the same bowl, add in the sugar or jaggery powder, allowing it to blend seamlessly with the dry ingredients.
- 5 Incorporate the milk, vanilla extract, whisked curd, and softened butter into the bowl. Make sure to whisk the curd before adding it for a consistent texture.
- 6 Gently mix all the ingredients until just combined. Avoid over-mixing, as this can affect the cake's texture.
- 7 Transfer the cake mixture into the prepared greased tray.
- 8 Lightly tap the cake pan on the kitchen counter a few times to remove any trapped air bubbles and ensure a smooth batter distribution.
- 9 Baking the Ragi Cake: Place the cake pan in the preheated oven and bake for approximately 25 to 30 minutes at 180°C (350°F). Keep an eye on it—my cake was perfectly done at 30 minutes. You'll know it's ready when a skewer inserted into the cake comes out clean.
- 10 Once baked, allow the cake to cool in the pan for about 15 minutes before gently transferring it to a wire rack. Handle the cake with care, as it's delicate at this stage.
- 11 For the final touch, let the Ragi Cake cool completely before slicing and savoring each nutritious bite.

5.4.6 Ragi Protein Ladoo (Sugar & Oil free)

Ingredients for Ragi Ladoo:

- 1 cups ragi flour – sprouted or plain
- 1 cup roasted peanuts
- 1 cup resins
- 5 green cardamoms or elaichi
- 1 cup soft dates (remove the seeds & make to small pieces)
- Few cinnamons sticks (1 inch)



Fig. 5.12: Ragi Ladoo

Preparation for ragi ladoo:

- 1 Begin by gently roasting the ragi flour over low heat until its distinct aroma fills the air. Once you achieve this aromatic goodness, set the roasted ragi flour aside to cool.
- 2 Combine all your ingredients: the roasted peanuts, dates, and raisins. Don't forget to add the fragrant cardamom seeds and a dash of cinnamon to enhance the flavors.
- 3 With your mixer, give a quick 4 to 5 pulses to blend the ingredients coarsely. This step helps bring the ingredients together and creates a balanced texture.
- 4 Gradually introduce the cooled roasted ragi flour into the mixer. Pulse it twice to ensure proper integration while maintaining the desired texture.
- 5 Transfer this harmonious mixture into a bowl. With your skilled hands, knead the ingredients into a cohesive dough. Feel the natural goodness coming together.
- 6 As your dough takes shape, transform it into round Ragi Ladoos. Mold each ladoo with care, infusing them with the heartwarming essence of your culinary creation.
- 7 To preserve the freshness and flavor of your Ragi Ladoos, store them in an airtight jar. This ensures that every bite maintains its irresistible taste and nutritional value.

5.4.6 Ragi Cookies

Ingredients for ragi Cookies:

- ½ cup RAGI FLOUR or finger millet flour
- ½ cup wheat flour
- ½ cup jaggery powder
- ¾ tsp baking powder
- 3 tablespoon cocoa powder
- 6 to 8 tbsp ghee melted or ½ cup cold butter
- 2 tbsp milk if needed
- 1 teaspoon vanilla essence



Fig. 5.13: Ragi Cookies

Preparation for ragi biscuits:

- 1 **Begin with the Aroma:** Start by gently roasting the ragi flour over low heat until the rich aroma of ragi envelops your kitchen. Once you've achieved this delightful fragrance, set the roasted ragi flour aside to cool.
- 2 **Blend the Flours:** In a mixing bowl, combine the roasted ragi flour and wheat flour. Add the baking powder to the mix and ensure thorough integration by blending them together.
- 3 **Introduce the Ghee:** Melt the ghee and allow it to cool. Gradually pour 8 tablespoons of this aromatic ghee into the flour mixture.
- 4 **Creating the Dough:** Begin mixing the ingredients until they come together. If the dough appears slightly dry or doesn't form easily, consider adding 1 to 2 tablespoons of milk. Use milk judiciously, adding just enough to achieve the desired consistency.
- 5 **Chill the Dough:** Form the dough into a cohesive mass and cover it. Place the dough in the refrigerator for about 10 minutes. This brief chill helps in easy handling and shaping.
- 6 **Baking Ragi Cookies: Preheat and Prepare:** Preheat your oven to 180°C (350°F) for about 15 minutes. This ensures that your cookies bake evenly.
- 7 **Divide and Shape:** Divide the dough into 14 to 16 portions. Slightly flatten each portion and shape them into round cookies. A gentle touch works wonders.
- 8 **Arrangement Matters:** Lay the shaped cookies on a baking tray, ensuring they are approximately 1 inch apart from each other. Keep in mind that cookies tend to expand as they bake.
- 9 **Baking Brilliance:** Slide the baking tray into the preheated oven and bake the cookies for approximately 20 minutes. The precise baking time may vary based on your oven's characteristics and the thickness of the cookies. Watch for a lovely golden hue to appear.

5.4.7 Ragi Sandwich

Ingredients for ragi sandwich:

1. 2 Cup Idli Batter
2. 1 Cup Ragi flour
3. One grated onion
4. Few grated capsicum
5. Few grated carrot
6. 6-7 curry leaves
7. 2 green chillies
8. 2 tablespoon ghee
9. Salt (as per taste)

Preparation for ragi sandwich:

- Begin by mixing the idli batter and ragi flour in a bowl. This amalgamation of textures and flavors forms the base of your nutritious sandwich.
- Add the finely chopped onion, capsicum, grated carrot, aromatic curry leaves, and a hint of green chilli for that extra zing. Don't forget a sprinkle of salt to enhance the flavors.
- Give the mixture a good mix, ensuring that the ingredients are evenly distributed. This step lays the foundation for a balanced and flavourful sandwich filling.
- Prepare your grill sandwich toaster by generously greasing it with ghee. This ensures that your sandwich doesn't stick and imparts a subtle richness to the final product.
- Lay a portion of the mixture onto one side of the grill sandwich toaster. Close it and place it on a gas stove. Allow it to cook for approximately 8-9 minutes, making sure to flip it upside down as needed for even cooking.
- Once the Ragi Sandwich has cooked to perfection, transfer it to a plate. Serve it piping hot, allowing the nutritious goodness to tantalize your taste buds.

5.4.8 Ingredients for Ragi Bread

- 200 gm Wheat flour
- 100 gm Ragi flour
- 200 ml milk.
- Yeast - 10 gm.
- 20 gm butter/ 20 ml cooking oil.
- Sugar-10 gm (to activate the yeast)
- 1 teaspoon of salt
- 20 ml of warm water



Fig. 5.14: Ragi Bread

Process Flow to make Ragi Bread:

- 1 First of all, in a small bowl, put the sugar and warm water and mix it properly till the sugar dissolve and then put the yeast and keep aside for 15 minutes.
- 2 Take another big bowl and put the whole wheat flour and ragi flour. Add the activated yeast and give a quick mix and then add the butter/cooking oil, salt and slowly keep adding the milk till it becomes a good dough.
- 3 Keep kneading the dough for another 5 minutes. You can add a little wheat flour if required.
- 4 Ferment the dough with a moist cover for 15-20 minutes or till the volume becomes double.
- 5 After 15-20 minutes, roll the dough properly and give it the shape of a bread loaf. Seal it properly.
- 6 Put the dough into a greased bread mold and keep aside for proving in a humid condition and warm temperature for half an hour.
- 7 After 30 minutes sprinkle some water and dust some wheat flour and put it into the oven at 200 °C for 45 minutes.
- 8 After 45 minutes take out the bread and demount it and keep it on a rack for cooling.
- 9 After cooling you can slice it and taste the Ragi bread.

5.4.9 Sorghum Cookies

Ingredients Required for SORGHUM Cookies:

- Sorghum Flour – 3 kg
- Sugar Powder – 600 gm
- Hydrogenated Vegetable Fats – 1.2 kg
- Skimmed Powder – 70 gm
- Baking Powder – 40 gm
- Salt – 30 gm
- Vanilla Essence – 30 ml
- Water- 600 ml



Fig. 5.15: Sorghum Cookies

Flow Chart for Sorghum Cookies on Commercial Basis:

Step:1 – Creaming (Fat & Sugar Powder) – For 15 minutes

Step:2 – Addition of Skimmed Milk Powder, Baking Powder & Salt

Step:3 – After 10 minutes – Addition of Vanilla Essence

Step:4 – After 5 minutes – Water is added

Step:5 – Finally Fine Sorghum Flour is added

Step:6 – Dough is kneaded properly

Step:7 – Dough is put into the Hopper of the Cookies Cutting Machine

Step:8 – Command is given of the desired shape of the cookies

Step:9 – Cookies are cut on the baking trays

Step: 9 – Baking trays are put into the pre-heated rotary convection oven

Step :10 – Cookies are baked for 15 minutes at 180 degrees Celsius.

Step:11 – Cookies are cooled on the cooling racks

Step:12 – Finally Cookies are packed and labeled.

5.4.10 Kodo Millet Cookies

Ingredients Required for Kodo Millet Cookies

S. No.	Ingredients	Weight (Kg)
1	Kodo Millet Flour	100
2	Shortening (Hydrogenated Vegetable Oil)	13-17
3	Sugar Powder	32-38
4	Invert Syrup	6 -10
5	Skimmed Milk Powder	0.25 - 0.75
6	Salt	1.2-1.5
7	Sodium Bicarbonate	0.2 -0.9
8	Ammonium Bicarbonate	0.5 - 0.7
9	Vanilla Essence	0.1-0.2
10	Water	30-40

Table 5.9: Kodo millet cookies ingredients

Detailed Process Flow Chart:

- I. Scaling of Ingredients
- II. Creaming Shortening, sugar powder, invert syrup (5-8 min)
- III. Dissolving salt, ammonium bicarbonate, sodium bicarbonate, water
- IV. Add to the above mixture and mix (6-10 min.)
- V. Adding Kodo Millet Flour and mixing (7-9 min)
- VI. Sheeting dough (3.5 mm thickness)
- VII. Cutting into circular shapes (50 mm diameter)
- VIII. Baking (9-11 min. at 205 °C)
- IX. Cooling and Packing

5.4.11 Recipe Standardization and Scaling

In the world of baking, precision and consistency are key to creating delectable treats that satisfy the taste buds of eager customers. Whether you're a professional baker or an enthusiastic home cook, the importance of recipe standardization and scaling cannot be overstated. This holds particularly true when crafting bakery millet recipes, where the unique qualities of millet grains can greatly benefit from standardized techniques.

Millet, a versatile and nutritious grain, has been gaining popularity as a gluten-free alternative in baking due to its delicate nutty flavor and health benefits. It is rich in fiber, minerals, and antioxidants, making it an excellent choice for those seeking wholesome alternatives in their baked goods. When incorporating millet into bakery recipes, it's essential to strike a balance between its distinct texture and taste, and the desired outcome of the baked product.



The Importance of Recipe Standardization

Recipe standardization involves fine-tuning a recipe to ensure that every time it's prepared, the results are consistent in terms of taste, texture, and appearance. This is particularly crucial in commercial baking, where customers expect the same experience with every purchase. When it comes to bakery millet recipes, standardization helps achieve the following:

- **Consistency:** Standardized recipes ensure that the final product is consistent in taste, appearance, and texture. This consistency fosters customer loyalty and trust in the brand or bakery.
- **Efficiency:** With standardized recipes, bakers can work more efficiently, as they know the exact quantities and steps required. This reduces the margin of error and the time spent on experimentation.
- **Quality Control:** By maintaining a standardized approach, bakers can quickly identify any deviations in the production process and rectify them before the final product reaches the customer.
- **Scaling Possibilities:** A standardized bakery millet recipe serves as a solid foundation for scaling production up or down as needed. This flexibility is crucial in meeting changing demands while maintaining product integrity.

5.4.12 Scaling Up or Down: Adapting Millet Recipes

Recipe scaling involves adjusting ingredient quantities to produce different batch sizes while preserving the quality and characteristics of the final product. Whether you're baking for a small gathering or catering to a larger event, here's how to effectively scale bakery millet recipes:

Benefit	Description
Proportional Adjustments	When scaling, maintain proportional ingredient ratios for consistent outcomes.
Testing and Adjustment	Conduct trial runs to validate scaled recipes, adjusting based on actual baking performance.
Consistency in Technique	Replicate original techniques alongside ingredient quantity changes to maintain consistent results.
Equipment Consideration	Larger batches might need different equipment or longer baking times; adapt to ensure even baking and optimal results.

Table 5.10: Recipe scale up

Unit 5.5 Machinery requirements and vendor selection

Unit Objectives



At the end of this unit, you will be able to:

1. Explain about the various equipment's used for baking process.
2. Discuss selection of Vendors for Equipment and machinery.

5.5.1 Machinery and Equipment Requirements

Millet Cookies are ready to eat products consumed by different age groups. Millet Cookies can be prepared exclusively with millet flour without adding Maida to it. This makes millet cookies 100% gluten free and healthy too.

Equipments required for making Millet Cookies

So, to start a millet bakery unit, we require three machines. The three machines are-

1. Planetary Mixer
2. Cookies cutting machine
3. Rotary Convection Oven.

Planetary Mixer:

Planetary mixers are generally used for making cakes, biscuits, cookies, bread, buns, etc. This machine consists of a kettle, blades, and a kettle shifter. There are different blades for making cakes, biscuits, breads, and a scraper. In the food processing industry, it is suitable for mixing the solid and liquid ingredients.



Fig. 5.16: Millet Planetary Mixer

Before selecting a planetary mixer, it is always advisable to go with one which is designed to comply with hygiene and safety regulations. You can also look for a machine that has the facility to inject air while mixing which reduces the mixing time and enables the provision of aerated dough.

Apart from these features, it must have a speed adjuster and height adjuster for the blades.

The planetary mixer comes with different capacities starting from 8 kilograms to 175 kilograms and you can go as per your requirement.

Cookies cutting machine:

The cookie-cutting machine consists of a hopper in which sheeting rollers are inserted and beneath the rollers cutting die are fitted. The function of the sheeting rollers is to spread the dough into a biscuit shape. The machine is digitally controlled. As per the command and setting instructions, the dough is cut into the required shape. There are many models for making cookies like straight drop, twist drop, drag-drop, drag-twist drop, and wire cut.



Fig. 5.17: Millet Cookie-Cutting Machine

In this machine, there is a sensor that can sense the tray once it is placed and cut the dough into the given command.

Different shapes and adding flavor to the cookies will increase the number of product ranges and also consumers will be attracted to them.

Rotary Convection Oven:

If you have a convection oven at home, you would know that a rotary convection oven is better than a plain convection oven. The warm air in the convection oven is not dispersed evenly. Whereas in a rotary convection oven, the trays are rotated while a built-in fan circulates warm air around the food being cooked. As a result, a rotary oven cooks food more quickly and at a lower temperature than a convection oven. The components of the rotary oven are a cabin with racks, trays, an oven cavity, and a temperature indicator on the starter.

Apart from the 3 machines, we require the following equipments:

- a. Baking Trays
- b. Cooling Racks
- c. Packaging Equipments (Sealing Machine, Labelling machine)
- d. Packaging Materials
- e. Weighing Machine

Want to know more about machines and equipment used in a standard bakery? In the world of baking, the right equipment can make all the difference between a mediocre product and a delectable masterpiece. This chapter delves into the essential bakery equipment required to establish a successful millet-based bakery enterprise. From mixing and kneading to baking and packaging, understanding the roles and types of equipment is crucial for producing consistent, high-quality millet bakery products.

Mixing and Kneading Machinery

Stand Mixers: These versatile machines are the workhorses of any bakery. They come in various sizes and power levels, accommodating both small-scale and large-scale operations.



Fig. 5.18

A planetary mixing action ensures thorough blending of ingredients, essential for achieving a uniform dough consistency when working with millet-based flours.

Spiral Mixers: Particularly suitable for heavy dough, spiral mixers use a rotating spiral hook to knead and develop gluten. For millet-based dough, these mixers are beneficial as they provide better gluten development due to the unique characteristics of millet flours.



Fig. 5.19

Baking Ovens

Deck Ovens: Ideal for artisanal baking, deck ovens consist of several shelves or "decks" on which products are baked directly. This type of oven allows for even heat distribution and precise control over baking conditions, making it suitable for a wide range of millet-based bakery goods.



Fig. 5.20

Convection Ovens: Convection ovens circulate hot air using fans, ensuring uniform baking and browning. They are efficient for baking batches of cookies, muffins, and smaller-sized millet products.



Fig. 5.21

Rack Ovens: Rack ovens are designed for high-volume production. They accommodate racks of baked goods, making them suitable for bread, buns, and other larger-sized millet bakery items.

Cooling and Packaging Equipment

Cooling Racks: Once baked, millet products need proper cooling to prevent moisture retention that can compromise their texture and flavor. Cooling racks with ample ventilation facilitate rapid and uniform cooling.



Fig. 5.22

Packaging Machinery: Packaging millet bakery products requires careful consideration. Equipment like wrappers, sealers, and label applicators are essential for ensuring product safety, hygiene, and shelf appeal.

Specialty Equipment

Proofing Cabinets: These cabinets provide a controlled environment for dough fermentation, crucial for achieving the desired rise and texture in millet-based bread and other baked goods.



Fig. 5.23

Dough Dividers and Rounders: For bakeries producing larger quantities of products, these machines automate the process of dividing and shaping dough, ensuring consistent portion sizes.



Fig. 5.24

Slicers and Cutters: For products like bread and pastries, slicers and cutters ensure precise and uniform portions, enhancing product presentation and customer satisfaction.

Apart from this, Stainless steel is the material of choice for most bakery equipment due to its durability, ease of cleaning, and resistance to corrosion. Proper handwashing and sanitation are critical in any bakery. Installing hygiene stations equipped with sinks, sanitizers, and gloves promotes a clean working environment.

5.5.2 Selection of Vendors for Equipment and machinery

For aspiring entrepreneurs seeking to procure equipment or machinery from suppliers, it's customary to anticipate the receipt of comprehensive documents or emails directly from the vendors. These communications serve to provide you with a thorough understanding of the equipment being offered, presenting intricate details such as specifications, technical features, and potential applications.

Within these documents or emails, vendors typically furnish you with an itemized breakdown of the equipment portfolio you're interested in acquiring. Each equipment entry is accompanied by a meticulous description outlining its capabilities, functionalities, and any specialized attributes. Furthermore, vendors often include high-quality visuals, such as images or diagrams, to aid in visualizing the equipment.

Alongside the equipment specifics, the documents or emails also encompass the financial aspect of the transaction. This encompasses a transparent and detailed estimation of the associated costs for each individual equipment piece. These cost breakdowns are designed to provide you with a comprehensive view of the financial investment required for your intended purchase.

Overall, these documents or emails form an essential component of the procurement process, enabling you as an entrepreneur to make well-informed decisions based on a comprehensive understanding of the offered equipment, its features, and the associated financial implications.

Dear sir,

Based on discussion had with Mr.Subramanian,we submit our quotation for Bakery Machinerics.

S. No	DESCRIPTION	QTY	PRICE
1	CEPHAS C-100 PLANETARY MIXER Electronic Version driven by variable speed drive Set of 1 Agitator,1 Egg wisk,1 bread hook , 1Scraper, 1Bowl & 1Trolley, (Cap:100Ltrs/40 Kg batter) Dimension :(LBH): 1275x875x1640mm Power: 5 HP, 3 phase		4,33,000.00
2	FULLY PLC CONTROLLED - COOKIES MACHINE - PLC 450 With Rotating Head , Dropping and Wire Cut Fully Automatic.Tray Size:450X700mm.No.of.Nozzles:7 Dimension :(LBH):1650x1355x1400mm Power: 2.04HP		9,41,000.00
3	04AR / 70 90R - ARUN REGA DIESEL OPERATED ROTARY RACK OVEN With full Automation & Steaming facility. Capacity : Double Trolley of 45x70cm,cap: 336 Bread/Load Power: 3.75 HP Trays, Moulds on Customer Scope		9,75,000.00
			23,49,000.00
	PACKING CHARGES @2%		46,980.00
	INSURANCE @0.25%		5,873.00
			24,01,853.00
	GST @18%		4,32,334.00
			28,34,187.00

Fig. 5.25: Equipments specifications.

Exercise 

Answer the following questions:

1. Which type of millet is commonly used in bakery products.

2. Name any two types millet base bakery product.

3. Describe the basic Baking Principles with Millets.

4. Write the application of Planetary Mixer and Rotary Convection Oven in baking process.

6. Produce Millet Based Ready to Cook Products



Unit 6.1- Introduction to millet based packaged Food Industry

Unit 6.2- Opportunities for millet base ready to eat snacks industries

Unit 6.3- Development of recipes for millet base ready to cook snacks

Unit 6.4 Equipment requirements for ready to cook snacks



Key Learning Outcomes

At the end of this module, the participants will be able to:

- Explain about the different millets used in ready to cook food products.
- Discuss role of different ingredients in preparing millet based RTE products .
- Explain different recipes of preparing millet base ready to cook snacks.
- Discuss the types of equipment's used in processing of snack products.

Unit 6.1- Introduction to millet based packaged Food Industry

Unit Objectives

At the end of this unit, you will be able to:

1. Discuss the various types of millets used in ready to cook snacks products.
2. Discuss the specification of millets quantity to be used in various snacks.

6.1.1 Introduction to Millet based RTE/RTC Foods

Millets are good sources of compounds with protein composition, and antioxidant and antimicrobial properties. Millet based food is beneficial for patients suffering from chronic diseases such as type 2 diabetes, cancer, and cardiovascular diseases. Millet based functional food can help address the increasing burden on the health care system by promoting healthy lifestyle through prevention rather than treatment.

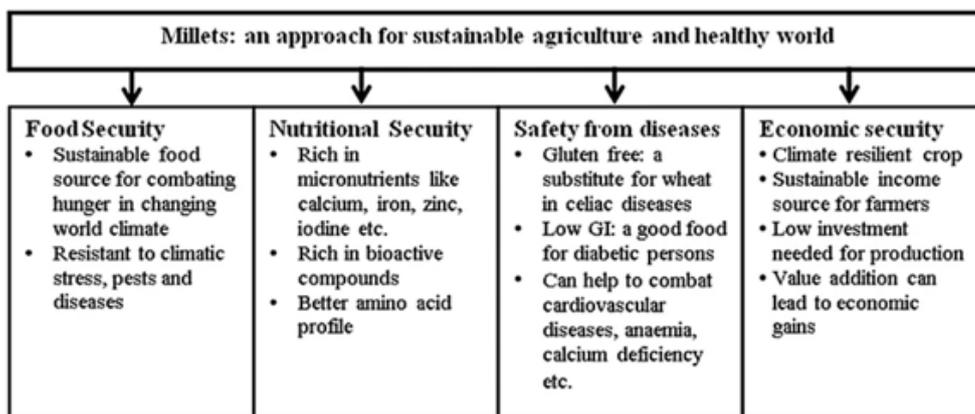


Fig 6.1 Millets :an approach for sustainable agriculture

Here are some unique points for which Millet-based products are set to gain increasing acceptance in the processed food market:

1. Powerhouse of rich nutrient
2. Gluten free
3. It Dietary fiber and resistant starch & micronutrients
4. Easy to crop and process it for the end-user
5. It is good for the planet as it is climate-resilient crops
6. It become a part of ready to cook & eat- reduces cooking time

A recent study showed that millets and legumes combined provide a complete protein, highly digestible, and power-packed nutrients.

Rise in consumer preference for millet-based products, which offer a unique experience based on taste and texture, is expected to drive the India millet based packaged food market. Millets are also healthy and highly nutritious. This is also anticipated to augment the millet based packaged food market.

6.1.2 Specifications of Millet content in the millet based Ready to Cook/Ready to Eat products

The Ministry of Food Processing Industries (MoFPI) has issued an order for specification of millet content in the millet-based ready to cook (RTC)/ ready to eat (RTE) products under the Production Linked Incentives Scheme for food processing industry.

According to the MoFPI order, the ready to cook, ready to eat millet food products (except flour/atta) having minimum millet percentages as prescribed by the ministry are eligible to be covered under the scheme.

“It has now been decided to specify the levels of millet in various RTC/RTE food products permissible under the scheme,” reads the order.

The order added that the food products were divided into three categories and percentage of millet incorporation in the product. The products include breakfast cereals having finger, pearl, foxtail, little, kodo, barnyard and sorghum millets, wherein the minimum incorporation level with individual millet is fixed at 25%, the second category includes pasta, noodles, spaghetti having finger, pearl, foxtail, little, kodo, and sorghum millet, wherein the minimum incorporation level with individual millets is fixed at 10% and other ready to cook/ eat products with 20% minimum incorporation level of individual millet.

As per the above discussed guidelines, Ready to Cook/ Ready to Eat (RTC/ RTE) Millet food products (except flour/atta), having minimum millet percentage as prescribed by the Ministry are eligible to be covered under the Scheme. It has now been decided to specify the following levels of millet in various RTC/ RTE food products permissible under the Scheme:

S. No.	Food Category	Types of Millet	Minimum incorporation level with individual Millet(%)
1	Pasta, Noodle, Spaghetti	Finger millet, Pearl millet, Foxtail millet, Little millet, Kodo millet, Sorghum	10%
2	Breakfast Cereals	Finger millet, Pearl millet, Foxtail millet, Little millet, Kodo millet, Barnyard millet, Sorghum	25%
3	Other · RTC RTE Products	---	20%

Table 6.1: Levels of millets used in RTE products

Unit 6.2- Opportunities for millet base ready to eat snacks industries

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the factors driving the demands for millet base packed foods.
2. Nutritional Comparison of Common Millet Varieties.
3. Discuss the important aspects of millet value addition.

6.2.1 Specifications of Millet content in the millet based Ready to Cook/Ready to Eat products

The food processing industry in India has been evolving at a rapid pace owing to the emergence of innovative product segments. This indicates a shift in customer preference toward processed foods. Additionally, food processing capacities have increased in many Indian states. The market is anticipated to further diversify in terms of product type. Production of packaged foods is rising significantly in India. This is driving the demand for value-added millet products. There exists substantial growth potential for millet based processed food in India primarily due to the increase in disposable income of the people.



Fig 6.2 Millet base Packaged foods

The government needs to provide incentives for processing and export of millet products to encourage key private corporations such as ITC, Britannia, Marico, Kellogg's, and MTR to aggressively include millets in their product portfolio. It is essential to strengthen small and medium-sized businesses to promote millet products in local markets and provide consistent supply to government R&D programs on millets.

In terms of demography, the adults segment held major share of 82.7% of the India millet based packaged food market in 2022. The segment is expected to grow at a value CAGR of 9.1% during the forecast period. Growth in awareness about the benefits of millet based processed food and significant rise in cultivation are factors driving the demand for millet based packaged food in India.

6.2.2 Outlook of India Millet Based Packaged Food Market

Indian Millet Production Scenario:

Millet is a type of grain that is popular in many parts of the world, especially in Africa and Asia. It is a staple food in many parts of the world, particularly in Africa and Asia. According to the World Food Programme, there are an estimated 1.2 billion people who consume millet as a part of their diet.

Millet production has remained relatively stable over the past few years, with an estimated production of 28 million metric tons in 2020. The majority of millet is produced in Africa, followed by Asia. India is the largest producer of millet, followed by Niger and China. Other major millet-producing countries include Burkina Faso, Mali, and Senegal. While millet is not a major food crop in the developed world, it plays a vital role in the diets of many people in developing countries. Millet is a drought-tolerant crop that can be grown in dry, arid climates where other crops would fail. It is also a nutritious grain that is high in fiber and essential minerals. For these reasons, millet will continue to be an important food crop in the years to come.

In India, millet production has been on the rise in recent years. India is one of the largest producers of millets & Indian farmers have been increasingly planting millet as a drought-resistant crop. The Indian government has also been promoting millet production as part of its National Food Security Mission. As a result of these factors, millet production in India is expected to continue to grow in the coming years. The graph below depicts the production trends of millets in India.

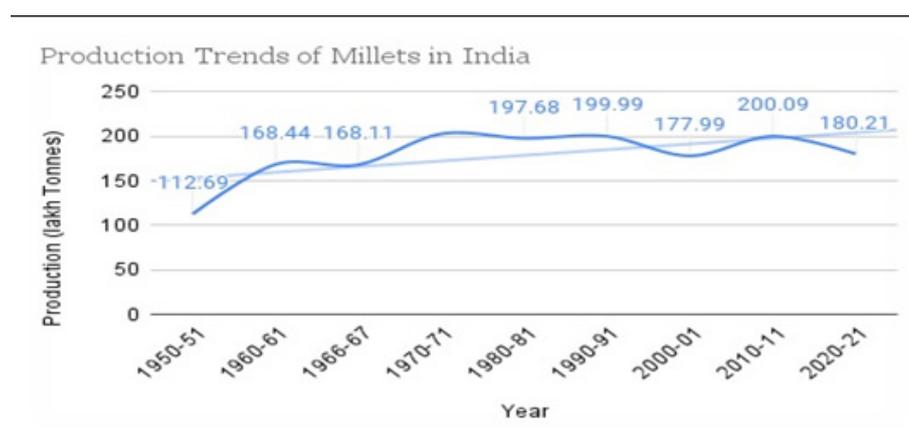


Fig 6.3 Production trends of millets in India

Regional Outlook of India Millet Based Packaged Food Market

India is one of the leading producers and suppliers of millet, and there are a number of millet sourcing points located throughout the country. The main millet-growing states in India are Rajasthan, Maharashtra, Karnataka, Andhra Pradesh, and Madhya Pradesh. These states have a large number of millet farmers who grow the grain for both domestic and international markets. In addition to the major millet producing states, there is also a number of smaller millet producing regions located throughout India. These regions include the states of Uttar Pradesh, Bihar, and Madhya Pradesh.

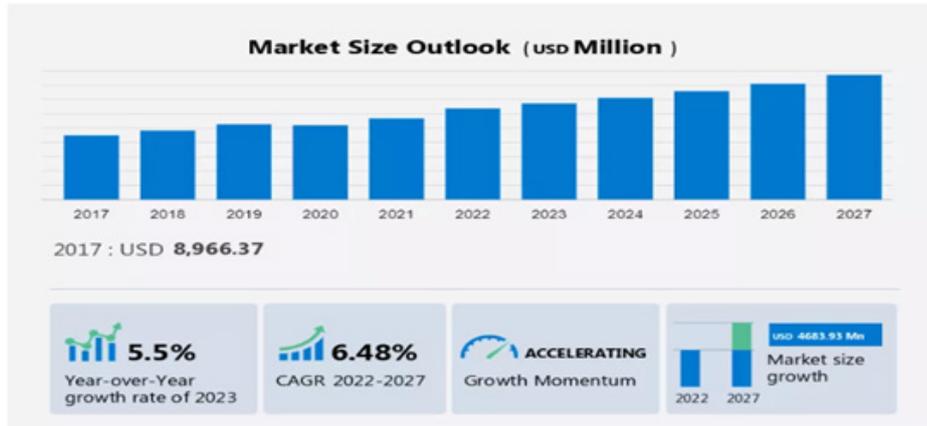


Fig 6.4 Millet industry growth outlook

South India held the largest value share of 44.0% of the India millet based packaged food market in 2022. Consumption of millet based packaged food is increasing in South India due to changes in consumer lifestyle, rise in concern about health and sustainability, high disposable income of the people, and presence of established research & development centers and manufacturing units throughout the region.

West India accounts for around 9.6% CAGR of the millet based packaged food market. Rise in service class population, changes in lifestyle, and high penetration of various sales channel are some of the major factors driving the demand for millet based packaged food in West India.

6.2.3 Millet value addition

Before Starting the primary processing unit, we need to keep in mind some valuable points:

- Need to do the survey to know the market potential and the availability of raw materials.
- The performance of machines and their efficiency to be checked before purchasing the machines.
- Entrepreneurs must be familiar with the operating of machines or a trained machine operator is required.
- Understanding the millet grains' shape and sizes.

Millet Value Addition:

Value-Addition is the process of taking a raw commodity and changing its form to produce a high-quality end product.

Why Value Addition of Millets is required?

To meet the taste/preferences of the consumers.

- 1) Reducing post-harvest losses.
- 2) Nutrient enhancement.
- 3) Ready to eat (RTE), ready to Cook (RTC) – Reduces the cooking time.
- 4) Enhance shelf life and make the product available for a long time.
- 5) Diversified Millet products can solve our food needs as climate changes.
- 6) Improving the consumption of millet products can help to overcome malnutrition.
- 7) Millet farmers will have more post-harvest technologies thus enhancing the economic value of millet as well as improving the status of farmers.



Fig 6.5 Millet value addition

Ready-to-eat millet products like Millet Vermicelli, Pasta, Flakes, and Puffs are emerging products and becoming more familiar in households today. I got an opportunity to visit the Indian Institute of Millet Research, Hyderabad, and witnessed the making of Millet Pasta. Let us see the video, how the millet pasta is made and what are machines required for making pasta. In the same machine, we can also make millet vermicelli by changing the dice.

Unit 6.3- Development of recipes for millet base ready to cook snacks

Unit Objectives



At the end of this unit, you will be able to:

1. Describe the various recipes for millet base ready to eat snacks products.
2. Explain the different raw material requirements for ready to cook snacks.
3. Discuss the processing steps in producing the ready to eat and cook snacks.

6.3.1 Recipes For Millet Based RTE/RTC Foods

6.1.1.1 MILLET RAVA/ SEMOLINA (Idli, Upma)TECHNOLOGY

Description of the recipe

Semolina are ready to cook foods. Millet grains (Pearl Millet, Finger Millet and Foxtail Millet) are processed by dry milling. The dry milling process starts with the cleaning of grains. The cleaned grain is milled by the hammer mills to separate the endosperm, germ and bran from each other to get semolina. Millets Semolina: (3 variants) Millet grain is pulverised to get

semolina; variants differ with particle size. According to the variant needed to process the mesh size in the mill is adjusted.

Advantages and Uniqueness of technology/Product

- Utility can be used to make upma, khichdi, rawa laddu, idli, dosa, kesari etc.
- They are rich in protein, fibre, iron, and zinc.
- All three rawa can be stored for a period of 4 months for pearl millet and finger millet.
- The rawa for foxtail millet can be stored for 3 months and shelf life analysis are still in progress



Fig 6.6 Millets Rava

Process of Making Millet Rava

The steps involved in making millet rava (semolina) can be summarized as follows:

1. Millet grains are fed into a hopper: The millet grains are loaded into a hopper, which serves as a container for the grains. The hopper ensures a continuous flow of grains for further processing.
2. Moving through a conveyor belt: The millet grains from the hopper are then transported through a conveyor belt. The conveyor belt moves the grains from one point to another, allowing for a controlled and systematic movement of the grains.
3. Grinding with a hammer crusher: As the millet grains move along the conveyor belt, they enter a hammer crusher. The hammer crusher is a machine equipped with rotating hammers that crush the grains into smaller particles. The rotating hammers repeatedly strike the millet grains, breaking them down into smaller pieces.
4. Sieving the crushed grains: After the millet grains are crushed by the hammer crusher, the resulting crushed particles are sieved to separate them based on their size. Sieving is performed using a sieve, which is a device with a meshed or perforated surface. The crushed millet grains are poured onto the sieve, and by shaking or sifting, the smaller particles (millet rava) pass through the sieve, while the larger particles are retained.
5. Sorting and packaging: Once the millet rava is obtained through the sieving process, it may undergo additional sorting to remove any impurities or unwanted particles. The final millet rava is then ready for packaging, where it is packed into suitable containers or bags for distribution and sale.

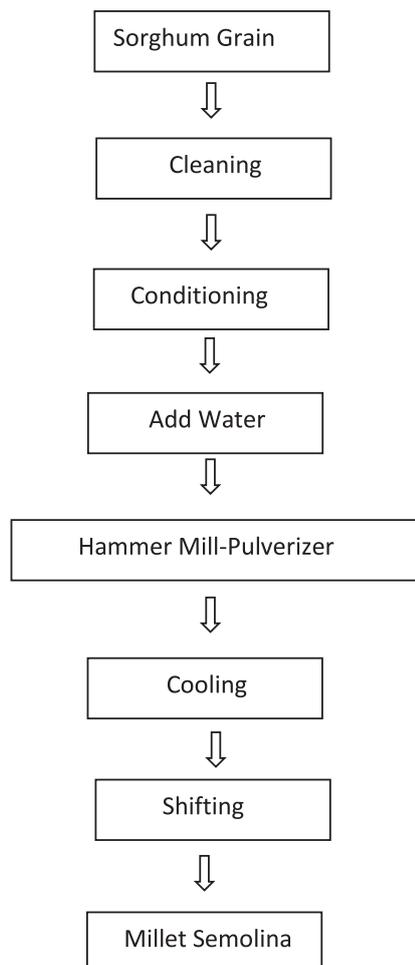


Fig 6.7 Process flow of making Millet Rava

6.3.1. 2 SORGHUM IDLI MIX

Description of the technology

Idli is an indigenous traditional breakfast food in mostly southern Indian cuisine, which is a steamed product made from rice semolina and ground pulses and typically served with a spiced vegetable filling or chutney. We have made an attempt to prepare instant sorghum idli mix sorghum fine semolina, blackgram dhal, salt and food grade additives; citric acid and sodium bicarbonate were used as main ingredients. All the ingredients were mixed uniformly in a blender. The formulated mix was packed in a MPET packing material.

Advantages and Uniqueness of technology/Product

- Instantly sorghum idli can be prepared reducing the
- cumbersome time for fermentation.
- It is rich source of phenolic compounds and causes satiety
- resulting in slower digestibility.
- Reduces oxidative stress (Antioxidant)
- The shelf life of idli mix is 3 months.
- The instant idli mix has high amount of calcium, iron, zinc
- and riboflavin when compared to control idli.



Fig 6.8 Sorghum Idli

To produce instant sorghum idli mix, you will need the following ingredients and steps:

Ingredients:

- Sorghum flour: 2 cups
- Urad dal (split black lentils): 1 cup
- Rice flour: 1/4 cup
- Salt: 1 teaspoon
- Baking soda: 1/2 teaspoon (optional)
- Start by dry roasting the urad dal on medium heat until it turns light golden brown. Make sure to stir continuously to prevent burning. Remove from heat and allow it to cool.
- Grind the roasted urad dal into a fine powder using a blender or grinder. Set it aside.
- In a large mixing bowl, combine the sorghum flour, rice flour, and salt. Mix well to ensure even distribution.
- Add the powdered urad dal to the bowl and mix it thoroughly with the flours. You can also sift the mixture to ensure a uniform texture.
- At this point, you can add baking soda if desired. Baking soda helps in fermentation and makes the idlis fluffy. If you prefer not to use it, you can omit this step.

Store the prepared mix in an airtight container or ziplock bag. Label it with the date and name for future reference.

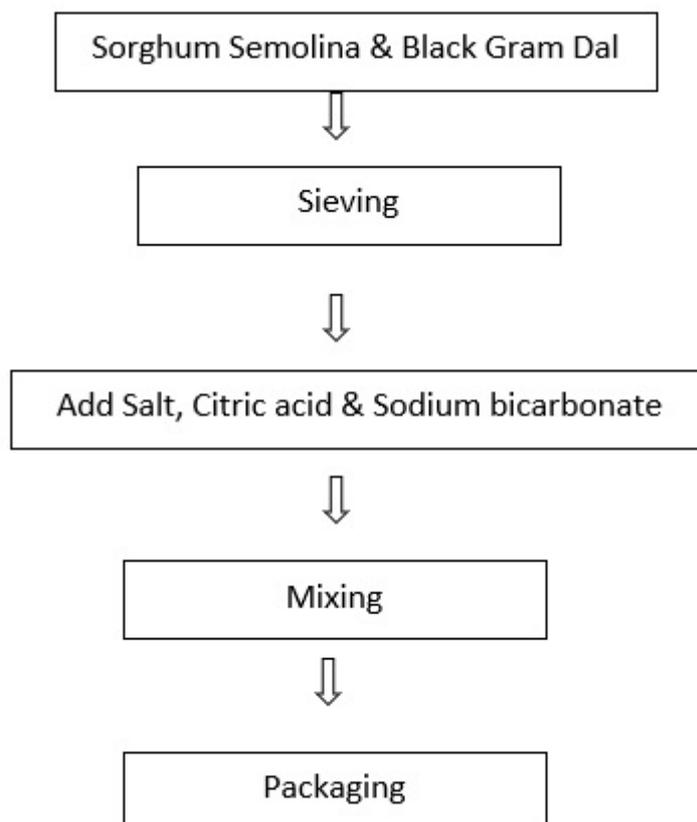


Fig 6.9 Process flow of preparing Sorghum Idli mix

6.3.1. 3 INSTANT UPMA MIX

Upma is an indigenous traditional breakfast food in mostly southern Indian cuisine, which is boiled semolina made from wheat/rice with added pulses, condiments and spices.

We have made an attempt to prepare instant sorghum upma mix sorghum semolina, Bengal gram dal; mustard seeds, curry leaves, dried green chillies, salt, and oil were used as

ingredients. Semolina, mustard seeds and Bengal gram dal were roasted

separately. To the semolina, roasted mustard seeds, Bengal gram dal, dehydrated curry leaves, salt and were added and mixed. The formulated mix was packed in a MPET packing material.

Advantages and Uniqueness of technology/Product

- Instantly sorghum upma can be prepared with added flavor and taste.
- It is Gluten Free and safe for Celiac Patients.
- Rich source of phenolic compounds and causes satiety resulting in slower digestibility.
- Reduces oxidative stress (Antioxidant)
- Low calorie diet (through Dietary fibre) promotes healthy digestion
- The shelf life of upma mix is 6 months.
- The instant upma mix has high amount of fibre, protein and iron when compared to control traditional upma.

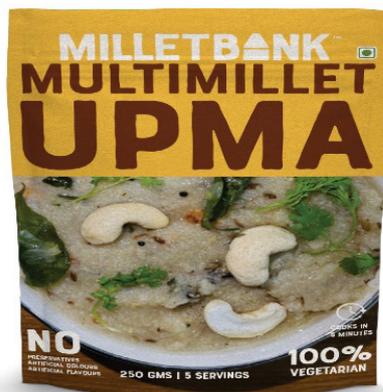


Fig 6.10 Millet Base Instant Upma

To produce instant upma mix using millet as the base ingredient, you will need the following Ingredients:

- Millet grains (such as foxtail millet, pearl millet, or barnyard millet)
- Semolina (optional, for texture)
- Chopped vegetables (such as carrots, peas, beans, and onions)
- Mustard seeds
- Urad dal (split black lentils)
- Chana dal (split chickpeas)
- Curry leaves
- Green chilies (optional, for spiciness)
- Turmeric powder
- Salt
- Vegetable oil or ghee (clarified butter)

Here's a step-by-step guide to producing millet-based instant upma mix:

1. Rinse the millet grains thoroughly to remove any impurities. Soak them in water for 15-20 minutes and then drain.
2. Heat a pan on medium heat and dry roast the millet grains until they become slightly golden and fragrant. Set them aside to cool.
3. In the same pan, dry roast semolina until it turns golden brown. If you prefer a softer texture, you can skip this step.
4. Grind the cooled millet grains into a coarse powder using a mixer or grinder. You can leave it slightly grainy for texture.
5. In another pan, heat oil or ghee on medium heat. Add mustard seeds and let them splutter.
6. Add urad dal, chana dal, and curry leaves to the pan. Sauté until the dals turn golden brown.
7. Add chopped vegetables, green chilies (if using), and turmeric powder to the pan. Cook until the vegetables become tender.
8. Now, add the ground millet powder (and roasted semolina if using) to the pan. Mix well to combine all the ingredients.
9. Add salt according to taste and continue stirring for a few minutes until the flavors blend together.
10. Turn off the heat and let the mixture cool completely.
11. Once cooled, transfer the mixture to an airtight container or ziplock bag for storage. Make sure it is completely dry before sealing.

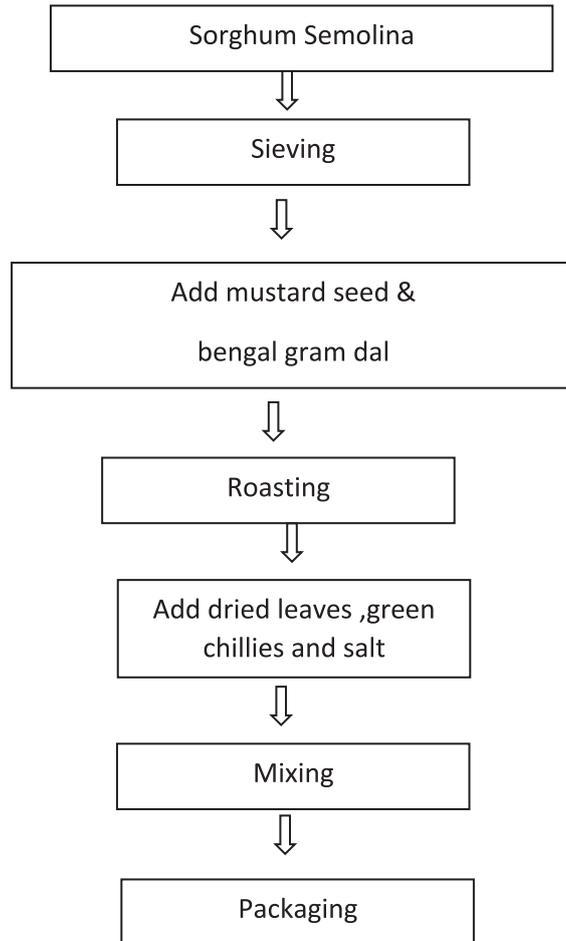


Fig 6.11 Process Flow Chart of Instant Upma mix

6.3.1.4. MILLET PUFFING TECHNOLOGY

Popping is a simultaneous starch gelatinization and expansion process, during which grains are exposed to high temperatures for short time. During this process, super heated vapour produced inside the grains by instantaneous heating, cooks the grain and expands the endosperm suddenly, breaking out the outer skin.

Puffing is a similar process in which controlled expansion of kernel is carried out, while the vapour pressure escapes through the micropores of the grain structure due to high pressure. Popping and puffing imparts acceptable taste and desirable aroma to the snacks.

Though a wide range of cereals and millets such as rice, wheat, corn, sorghum, ragi, foxtail millet are used for popping/puffing; only few of them pop well. The reason behind this may be the factors which influence popping qualities of cereals, such as season, varietal difference, grain characteristics such as moisture content, composition of grain, physical characteristics.

Gun puffing is a process in which the milled grains are introduced in to the gun or high pressure chamber after preheating, and then a superheated steam is introduced to the closed rotating chamber (Luh,1991). The steam pressure is critical to the final texture of the puffed product, as too low pressure would result in product lacking crispiness and too high pressure would shatter the rice. Sufficient time is allowed for the superheated steam to cook the grain in semi-plastic state and in the end, the pressure is suddenly released for obtaining the crispy puffed grain. **Keesenberg (1978)** developed a puffing gun, which was composed of a rotating horizontal cylinder having the length of 1.2 m and the inner diameter of 200 mm.



Fig 6.12 Jowar Puffs

The process involved in millet puffing technology typically includes the following steps:

1. **Cleaning and soaking:** The millet grains are thoroughly cleaned to remove any impurities. They are then soaked in water for a specific period of time to ensure proper moisture content.
2. **Mixing water with grains:** The soaked millet grains are drained of excess water and mixed with a measured amount of water to achieve the desired moisture level. This step helps in making the grains suitable for puffing.
3. **Preheating the puff gun machine:** The puff gun machine is preheated to a specific temperature before introducing the millet grains. This allows the machine to reach the ideal operating conditions.
4. **Loading the puff gun machine:** The mixed grains are carefully loaded into the puff gun machine. The machine typically consists of a chamber or barrel where the grains are placed.
5. **Maintaining controlled pressure and temperature:** Once the grains are loaded, the puff gun machine

is sealed. Controlled pressure and temperature are maintained within the machine to create the conditions required for puffing. This is often achieved by adjusting the settings of the machine and monitoring the pressure and temperature levels.

6. Puffing process: When the pressure and temperature reach the desired levels, a release valve is opened, allowing the grains to rapidly expand or puff. The sudden release of pressure causes the moisture inside the grains to turn into steam, creating the puffing effect.
7. Opening the puff gun machine: After the puffing process is complete, the puff gun machine is opened, and the puffed millet grains are removed. Care is taken to avoid damaging the puffed grains during this step.
8. Frying and flavoring: The puffed millet grains are then typically fried in oil to give them a crispy texture. Flavorings such as salt, spices, or sweeteners may be added to enhance the taste. The frying and flavoring process can be performed in a separate machine or equipment.
9. Cooling and packaging: Once the puffed millet grains are fried and flavored, they are cooled down to room temperature. They are then packaged in suitable containers or bags for storage or distribution.

PUFFS FROM SORGHUM

Sorghum puffs are product which is a resultant of explosive puffing or gun puffing where the sorghum grain is expanded to maximum expansion consistent with the grain identity (similar shape of the grain). It is the RTE (ready to eat) snack which is developed using puff gun machine. The puff gun machine is loaded with dehulled sorghum grain onto a rotating barrel and the mixture is roasted for and fired resulting in a puffed sorghum product.



Fig 6.13 Sorghum puffs

Advantages and Uniqueness of technology/Product

- The sorghum puffs are white in colour and are crispy in nature, similar to the puffed rice.
- The shelf life is for 4 months when packed in air tight MET pouches at ambient temperatures.
- They are rich in protein and fibre.
- Variants available masala coated and fried, and also can be coated with other flours (bajra and channadhal) and fried.
- It can serve as inflight snack or generic evening snack.

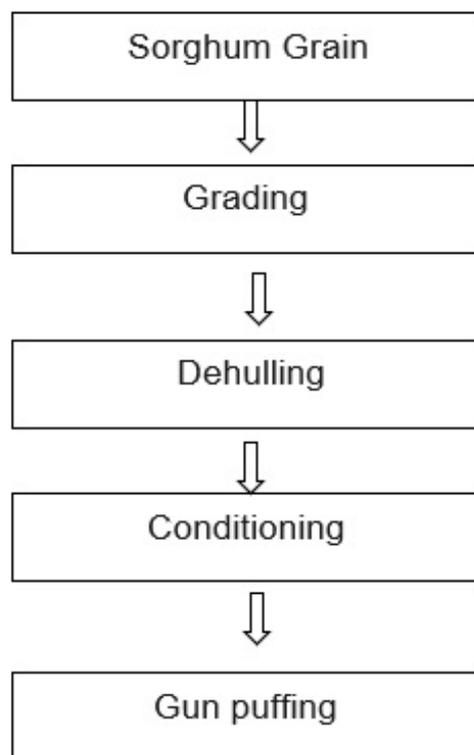


Fig 6.14 Process flow chart for production of Sorghum puff products

Unit 6.4 Equipment requirements for ready to cook snacks

Unit Objectives

At the end of this unit, you will be able to:

1. Describe the various raw materials used in ready to eat snacks.
2. Explain about the processing equipment used in processing of ready to eat snacks.

6.4.1 Processing equipment requirements

To produce millet-based ready-to-eat products, you would need a range of equipment suitable for processing, cooking, packaging, and quality control. Here are some essential equipment commonly used in the production of ready-to-eat products:

Cleaning and Grading Equipment: This includes machines such as destoners, vibratory screens, and air classifiers to remove impurities, stones, and dust from the millet grains and ensure uniform size and quality.



Fig 6.15 Destoner

Milling Equipment: Millet grains may need to be milled into flour or meal, depending on the specific product. This can be accomplished using equipment such as hammer mills, roller mills, or pin mills.



Fig 6.16 Hammer Mills

Mixing and Blending Equipment: Industrial mixers and blenders are used to combine millet flour with other ingredients like spices, flavors, and fortifiers to create the desired taste and nutritional profile. Ribbon blenders or paddle mixers are commonly used for this purpose.

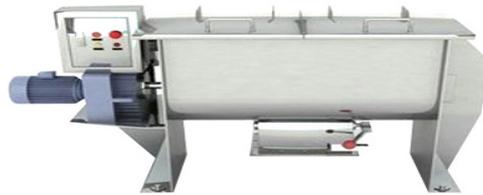


Fig 6.17 Ribbon Blender Mixer

Cooling and Drying Equipment: After cooking or extrusion, the product needs to be cooled and dried to achieve the desired texture and shelf stability. Cooling tunnels, conveyors, and drying ovens or dehydrators can be used for this purpose.



Fig 6.18: Dryer

Packaging Machinery: Once the product is ready, it needs to be packaged. Packaging equipment may include form-fill-seal machines, pouch fillers, baggers, or canning machines, depending on the chosen packaging format (pouches, bags, cans, etc.).



Fig 6.19: Packing Machine

6.4.2 Selection of Vendors

For any new business venture, vendor management defines the processes organizations use to manage their suppliers, also known as vendors. It plays a crucial role in selecting the right vendor for a particular business need. Vendor management also helps manage different suppliers and vendors effectively and ensure the goods and services provided are delivered on time and to the expected standard. In addition, effective vendor management assists organizations build stronger relationships with their vendors that often lead to opportunities to negotiate better rates.

Equipment name	Specifications	Suppliers
Destoner	Operation Mode: Automatic Motor Power: 3 HP Phase: Single Phase Capacity: 1 ton/hour	Avity Agrotech Private Limited N.N.Engineering Products Tulsi Agro Engi Mech Private Limited
Hammer Mill	Model: SEW 1000 Capacity: 12-15 Tons Power: 7.5 H.P	B. K. Engineers. Kaps Engineers. Mitsun Engineering. Jas Enterprises.
Ribbon Blender	Model: RM-600 Gross Volume approx.: 600 Liters Power: 7.5 H.P	Bhardwaj Enterprises Remi Elektrotechnik Limited Zigma Machinery & Equipment Solutions
Dryers	Capacity:10-15 kg Voltage: 220 v Weight:95 Kg	Pushkar Energy Systems Grace Food Processing & Packaging Machinery Zigma Machinery & Equipment Solutions

Table 6.2: Equipment specifications and suppliers

Exercise

Answer the following questions:

1. Describe the process of making millet Rava.

2. Name any 3 equipment's used in processing of of millet base RTE products.

3. Write any two advantages of sorghum idli mix .

4. List the raw materials requirements for millet base instant upma mix.

5. Fill in the blanks:

A. The puffing gun was developed by _____ in the year _____.

B. _____ is an important step in the Process for production of Sorghum puff products.

7. Produce Millet Based Extruded Products



Unit 7.1-Introduction to extruded snacks

Unit 7.2-Recipes for millet based extruded snacks

Unit 7.3- Machinery and equipment used for millet base extruded products



Key Learning Outcomes

At the end of this module, the participants will be able to:

- Explain about the different millets base extruded snack products.
- Describe the various recipes of millet base extruded snacks.
- Explain different processing techniques for millet base extruded snacks.
- Discuss the types of equipment's used in preparing extruded snacks.
- Different packaging materials and packaging techniques for millet base extruded products.

Unit 7.1-Introduction to millet based extruded products

Unit Objectives

At the end of this unit, you will be able to:

- Describe Nutritional Comparison of Common Millet Varieties.
- Explain the various components of millet bakery products.
- Discuss the various types of millets used in millet base bakery products.
- Discuss about variety of Millet based bakery Products.

7.1.1 Introduction to extruded snacks

In today's fast-paced world, individuals are increasingly prioritising their health and wellness, leading to a growing demand for nutritious snack options. Entrepreneurs in the food industry are continuously seeking innovative solutions to meet these consumer needs. Millets, a group of ancient grains, have emerged as a versatile and promising ingredient, particularly in the realm of extruded snacks.

The global millet snacks market, valued at \$2.4 billion in 2021, is projected to reach \$3.7 billion by 2031, growing at a CAGR of 4.9% from 2022 to 2031, according to a report by Allied Market Research. This significant market growth reflects the increasing consumer demand for healthier snack alternatives.

Extrusion technology plays a vital role in the development of various millet-based snacks. This technology enables the creation of healthy snacks using millets and spent grains. There are various Snacking start-ups that have successfully developed multi-millet ready-to-eat extruded snacks such as murukus, bhujia, noodles, vermicelli, and pasta.



Fig 7.1 Millet extruded snacks products

Numerous studies have focused on optimising the extrusion process and improving the quality of millet-based snacks. For example, Sobowale et al. (2021) investigated the effects and optimization of pearl millet flour and African walnut flour feed compositions. Similarly, Seth et al. (2012) developed protein-rich extruded snack food by blending finger millet flour, oat flour, potato starch, and whey protein isolate.

Millet-based extruded snacks offer several health benefits due to their nutritional value. These snacks have a low fat content, making them a healthier option for snacking (Deshpande et al., 2011). Additionally, millets are rich sources of protein and fibre, providing essential nutrients and promoting satiety (Yadav et al., 2022). Millets also contain antioxidants, polyphenols, and micronutrients that contribute to overall health and well-being (Yadav et al., 2022). Furthermore, millet-based extruded snacks can be an excellent source of iron and calcium, further enhancing their nutritional profile (Wadikar et al., 2014).

The growing awareness of the importance of balanced nutrition and the desire for healthier snack alternatives have fueled a significant surge in the market for millet-based extruded snacks. As consumers become more educated about the impact of their dietary choices on their overall well-being, they are actively seeking nutritious options that do not compromise on taste. Entrepreneurs who can recognize and respond to this emerging trend stand to benefit from tapping into a lucrative market segment.

To cater to the increasing demand, entrepreneurs and food manufacturers are actively engaged in optimizing the extrusion process. By fine-tuning the manufacturing techniques, they can enhance the quality, texture, and flavour of millet-based extruded snacks, making them even more appealing to health-conscious consumers. This optimization process also enables the creation of a diverse range of snack varieties, offering options that cater to different tastes and dietary preferences.



Fig 7.2 Benefits of millet extruded snacks

The projected growth of the millet snacks market further underscores the positive trajectory of the demand for healthier snacking options. As more individuals prioritise their well-being and actively seek out nutritious alternatives, the market for millet-based extruded snacks is expected to experience significant expansion. Entrepreneurs who position themselves strategically in this market have the opportunity to capitalise on this upward trend, offering products that not only satisfy consumers' desires for taste but also align with their health and wellness goals.

7.1.2 Snack food consumption pattern

The snack food market is constantly changing relative to product types, and although most snacks are not primarily consumed for their nutrients, many snacks are made with nutrition in mind. The snack food industry is experiencing extraordinary changes from the consumers' point of view. Consumers want snacks to not only taste good but also smell good, feel good, and look good. Snacks should give the consumer a homemade/fresh feel. Some of the snacks are developed with a special theme in mind like world soccer. These snack pellets are soccer ball-shaped, which on frying or treating in a microwave oven become soccer balls.

Snacking rises due to an increase in factors such as one person households, higher proportions of working spouses and more school-age children obtaining their own meals and refreshments, a highly mobile population, and availability of snack foods in vending machines and convenience markets.

Various products, which were once consumed mainly on impulse, are becoming accepted as side-dish items, for example, corn chips or potato chips served in place of mashed potatoes. The established position of snack foods in the diet is demonstrated by the continuous growth in sales. In the last 10 years, changes in lifestyle and eating patterns have led to a gradual increase in demand for snack foods. The pattern of snacking in different countries can be affected by several factors such as the lifestyle in each area, the economic climate, rival foods, and public receptiveness of current views on nutritional matters. Snacks can provide an increased dietary intake of essential amino acids and other nutrients for developing countries. Some of the most recent factors driving the newer snack food trends are as follows:



Fig 7.3 Driving factors for millet extruded snacks

7.1.3 Utilisation of Millets in extruded snacks

The utilisation of millets in the production of extruded snacks offers a promising avenue for incorporating these nutritious grains into convenient and tasty food options. Based on the research, different types of millets exhibit suitability for utilisation in various extruded snack products.

Sorghum, with its high fiber and protein content, proves to be a suitable choice for the production of extruded noodles. Pearl millet, on the other hand, is ideal for extruded pasta, offering a unique and nutritious alternative to traditional wheat-based pasta. Finger millet, known for its rich protein and iron content, is well-suited for the production of extruded noodles, contributing to the nutritional value of the snack.

Little millet is appropriate for creating extruded flakes, which can be utilized in the production of flake-based snacks. Its nutritional composition, including protein and fiber, makes it a valuable addition to snack formulations. Foxtail millet, with its high carbohydrate and protein content, is also suitable for extruded flakes, providing a nutritious base for flake-based snacks.

Kodo millet, similar to sorghum, exhibits its compatibility with extruded noodle production. Its nutrient profile, including high fiber and calcium content, adds nutritional value to the snack. Barnyard millet, known for its protein and fiber content, is ideal for extruded noodles, allowing for the development of nutritious and flavorful noodle-based snacks.

Proso millet, rich in protein and fibre, is suitable for the extrusion process and can be utilised in the production of noodles. Browntop millet, with its similar nutrient composition to proso millet, also proves to be well-suited for extruded noodles.

Millets in extruded snacks offers a wide range of possibilities for incorporating these nutritious grains into convenient and flavorful snack options. The table delineates the suitability of different millet types for specific extruded snack products, providing a valuable reference for snack manufacturers and consumers seeking healthier snack alternatives.

Sl.No.	Type of Millet	Extruded Product	Applicability
1	Sorghum	Noodles	Suitable for extrusion process
2	Pearl Millet	Pasta	Ideal for extruded pasta
3	Finger Millet	Noodles	Well-suited for extrusion
4	Little Millet	Extruded Flakes	Appropriate for flake snacks
5	Foxtail Millet	Extruded Flakes	Suitable for flake-based snacks
6	Kodo Millet	Noodles	Well-suited for extrusion
7	Barnyard Millet	Noodles	Ideal for extruded noodles
8	Proso Millet	Noodles	Suitable for extrusion process
9	Browntop Millet	Noodles	Well-suited for extrusion

Table 7.1: Utilization of millets in extruded snacks

From the perspective of new product development using millets, several factors need to be considered to create successful and appealing millet-based products. These factors include texture, appearance, nutritional value, quality, shelf life, and flavour. Let's explore each factor in more detail:

Texture: Each millet variety has its own unique texture, which can significantly impact the eating experience. When replacing one millet with another, it is important to consider the texture to ensure the desired mouthfeel and consistency of the final product. Texture can vary from soft and fluffy to chewy or crunchy, and the choice of millet should align with the desired texture of the product.

Appearance: Millets, such as sorghum, finger millet, and pearl millet, come in different colours and grain varieties. The colour of the grain can have a visual impact on the product's appearance. It is crucial to take into account the colour variations of different millet varieties when developing new products to achieve the desired appearance and appeal to consumer preferences.

Nutritional Value: Millets possess unique nutritional profiles, with variations in carbohydrate, protein, fibre, vitamin, and mineral content. When developing millet-based products, considering the specific nutritional value of each millet variety is essential. Highlighting the nutritional benefits of the particular millet used in the product can attract health-conscious consumers and create a positive association with the brand.

Quality: Millets come in various varieties, each having its own taste, texture, nutrition, and appearance characteristics. To ensure uniformity and consistency in millet products, selecting a specific variety is important. For instance, choosing a specific variety of pearl millet, like DhanaShakti, which is known for its richness in iron and zinc, can enhance the overall quality and nutritional profile of the product.

Shelf Life: Millets, once processed into flour or with the husk removed, can have a limited shelf life. It is crucial to implement measures to improve the shelf life of millet-based products. Various treatments such as pearling, fermentation, germination, blanching, microwave treatment, dry heat treatment, steaming, defatting, and appropriate packaging materials can help extend the shelf life and maintain product quality.

Flavour: Each millet variety possesses its own distinct flavour profile, ranging from mild and nutty to earthy or slightly sweet. Considering the flavour of the millet is important when developing new products to ensure a pleasant taste experience for consumers. Balancing and enhancing the flavour can be achieved through the selection of complementary ingredients and flavouring techniques.

By carefully addressing these aforementioned aspects, food manufacturers can create innovative and appealing millet-based products that cater to consumer preferences and provide the nutritional benefits associated with these versatile grains.

Unit 7.2-Recipes for millet based extruded snacks

Unit Objectives

At the end of this unit, you will be able to:

- Explain the recipes of millet based extruded snacks.
- Discuss the raw material requirements for processing of extruded snacks.
- Explain the equipment used in the processing of extruded snacks.
- Discuss the processing the steps for production of extruded snacks.

7.2.1 Production of Millet Based Extruded Products

1. Millet-based Murukku:

Murukku is a savoury and crunchy snack with its roots in the Indian subcontinent. Traditionally made from rice and urad dal flour, it is seasoned with spices like chilli powder, asafoetida, and sesame or cumin seeds. The dough is shaped into spiral or coil patterns, either by hand or using a mould, and then deep-fried in vegetable oil. Murukku holds a special place in South Indian cuisine and is commonly enjoyed during festive occasions such as Diwali, Sankranti, and Dasara/Vijayadashami. The term "Murukku" comes from the Tamil language, meaning "to twist".

Millet-based Murukku offers a healthier variation of this beloved snack by incorporating nutritious millet flours. Different types of millet flour, such as little millet, pearl millet, and finger millet, can be used to prepare this delightful treat. The choice of ingredients may vary depending on the recipe, but common components include:

1. Millet flour (e.g., little millet samai, pearl millet flour, finger millet flour)
2. Rice flour
3. Gram flour (e.g., besan, pottukadalai flour, kadalai mavu)
4. Vegetable oil
5. Spices (e.g., red chilli powder, cumin seeds, ajwain, asafoetida)
6. Salt

Product Formulation:

The following table presents a typical product formulation for millet-based Murukku:

Ingredient	Composition (%)
Millet flour	50%
Roasted gram flour	25%
Rice flour	25%
Spices	As required
Salt	As required

Please note that the percentages mentioned in the product formulation table may vary depending on the specific recipe and manufacturer's preferences.



Fig 7.4: Millet base Murakku

Production Process of Murakku :**1. Raw Material Handling and Preparation:**

To ensure quality and safety, the millet, rice, and urad dal are received and thoroughly inspected. Industrial cleaning and washing equipment is utilised to remove any impurities from the raw materials.

2. Milling and Grinding:

The cleaned millet, rice, and urad dal are processed separately in industrial milling machines to obtain finely ground flour, which forms the base for the Murukku dough.

3. Mixing and Blending:

In large industrial mixing vessels or blenders, the millet flour, rice flour, urad dal flour, salt, red chilli powder, sesame seeds, and asafoetida are precisely weighed and blended together to achieve a homogeneous mixture. This ensures that the flavours and spices are evenly distributed.

4. Moisture Adjustment and Conditioning:

To attain the desired dough consistency, moisture adjustment and conditioning equipment are employed. This process helps optimise the moisture content of the blended mixture.

5. Resting and Fermentation:

6. The dough is then transferred to temperature and humidity-controlled fermentation chambers, allowing it to rest for a specified period. This resting period enhances the flavour and texture of the Murukku.
7. Extrusion: The fermented dough is fed into automated extruders or depositors equipped with interchangeable dies. This step shapes the Murukku into the desired sizes and patterns, ensuring consistency throughout the production.
8. Pre-Frying and Drying: To partially cook or dry the shaped Murukku, they pass through pre-frying ovens or conveyORIZED dryers. This step helps remove excess moisture and improves the shelf life of the product.
9. Frying: The partially cooked Murukku is carefully transferred to industrial fryers with precise temperature controls. They are then fried in hot oil at predetermined temperatures and times to achieve a uniform and consistent crunchiness.
10. Oil Draining, Cooling, and Seasoning: After frying, the Murukku is drained to remove excess oil. Suitable equipment, such as conveyor belts or cooling racks, is utilised for efficient cooling. Optionally, the cooled Murukku can be seasoned with additional spices or flavourings according to taste preferences, enhancing its taste profile.
11. Inspection and Quality Control: Throughout the production process, rigorous quality checks are conducted. Visual inspection, sensory evaluation, and testing for parameters like taste, texture, oil content, and shelf life ensure that the Murukku meets the highest standards of quality. Automated sorting systems are employed to remove any defective pieces, ensuring that only the finest Murukku reaches the packaging stage.
12. Packaging and Labelling: The inspected Murukku is accurately weighed and packed into suitable industrial packaging materials using automated packaging machines. Stringent sealing techniques are applied to maintain product freshness and prevent any contamination. Additionally, relevant product information, including labelling in compliance with regulatory requirements, is ensured.
13. Storage and Distribution:
The packaged Murukku is stored in controlled warehousing facilities, where appropriate temperature and humidity conditions are maintained to preserve its quality. Efficient distribution channels are established to deliver the product to retailers, wholesalers, or consumers, ensuring widespread availability and customer satisfaction.

The resulting millet noodles are hard, brittle pieces formed into different shapes through extrusion, cutting, and drying. The dough, made from the chosen millet-based material mixed with water, offers a unique texture and flavour profile that sets millet noodles apart from other varieties. These noodles can be cooked by boiling in water until they reach the desired tenderness, making them a convenient and versatile option for various recipes.

Millet noodles have gained popularity in India, not only as a Continental or Italian delicacy but also as a standalone favourite. Their availability as ready-to-eat options further enhances their appeal, catering to individuals seeking quick and convenient meal solutions.

Product Formulation:

The following table presents a typical product formulation for millet-based Noodles:

Ingredient	Percentage
Wheat Flour	50-60 %
Millet Flour	30-40 %
Other flours (tapioca flour/defatted soy)	10-15 %
Oil	2-3%
Salt	As needed

Table 7.2

Please note that the percentages mentioned in the product formulation table may vary depending on the specific recipe and manufacturer's preferences.



Fig 7.6 Millet noodles

Production Process of Millet Based Noodles:

To produce millet-based noodles through extrusion on an industrial scale, the following steps can be taken:

1. **Mixing:** Mix millet flour with water and other ingredients, such as hydrocolloids, to form a dough. Hydrocolloids can be added to improve the texture and elasticity of the dough
2. **Extrusion:** The dough is then fed into an extruder, which is a machine that uses heat and pressure to force the dough through a die. The die is a metal plate with small holes that shape the pasta into the desired form, such as noodles
3. **Cutting and Drying:** The noodles are then cut into the desired length and dried to remove the moisture and increase their shelf life. The drying process can be done either by air-drying or by using a drying machine
4. **Packaging:** The final step is to package the noodles in airtight containers to prevent moisture from entering and spoiling the product. The noodles are packaged in bags or cups and sealed for distribution.

Equipment Requirements:

Extruder: A machine with an extrusion mechanism and a die used to extrude the dough through the die to form the desired shape of the noodles.

Cutter: Used to cut the extruded noodles to the desired length.

Steamer: A vessel or steaming chamber used to steam the noodles for a specific period, pregelatinized the starch and made them digestible.

Seasoning Bath: A container or tank used for dipping the steamed noodles in a seasoning solution to add flavour.

Air Drying: Drying racks or trays are used to allow the noodles to air dry in a controlled environment with proper ventilation.

Cooling Rack or Conveyor: Used to cool the dried noodles to room temperature after the drying process.

Packaging Equipment: Includes various machines for packaging the noodles, such as:

- **Bagging Machine:** Automatically fills and seals bags with the noodles.
- **Cup Filling and Sealing Machine:** Used for packaging noodles in cups with airtight seals.

3. Millet-Based Pasta

Millet pasta, similar to its traditional Italian counterpart, is a staple food made from a combination of millet flour. This nutritious pasta is known for its versatility and various shapes, including penne, spaghetti, farfalle, fettuccine, barbine, and more.

Millet pasta offers several health benefits due to its high concentration of vitamins and minerals. Millet grains, the key ingredient, provide essential nutrients, including dietary fibre, protein, and various micronutrients. This makes millet pasta a wholesome choice for individuals seeking a nutritious and satisfying meal.

In recent years, the demand for pasta, including millet-based options, has been on the rise in India. The expansion of food-service restaurants and the evolving preferences of the younger population have contributed to its increasing popularity.

While pasta has been enjoyed in Italy since the 13th century, it wasn't until the 20th century that efficient production equipment and high-quality ingredients became readily available. Today, most pasta production is facilitated by continuous high-capacity extruders that operate on the principle of auger extrusion. This advanced machinery allows for the kneading and extrusion processes to be carried out in a single operation, streamlining the pasta manufacturing process.

Millet pasta can be produced in various forms, including dry macaroni, noodles, and spaghetti. The use of millet flour provides a unique taste and texture to the pasta, making it an exciting alternative for pasta enthusiasts. The dough made from millet flour, combined with water, and oil, undergoes extrusion, cutting, and drying processes to form the desired pasta shapes.



Fig 7.7 Millets Pasta

Product Formulation:

The following table presents a typical product formulation for millet-based Noodles:

Ingredient	Percentage
Wheat Flour	50-60 %
Millet Flour	30-40 %
Other flours (tapioca flour/defatted soy)	10-15 %
Oil	2-3%
Salt	As needed

Please note that the percentages mentioned in the product formulation table may vary depending on the specific recipe and manufacturer's preferences.

Production Process of Millet Based Pasta

1. Extrusion is a common method used in the industrial production of pasta. Here are the steps involved in the extrusion process:
2. Mixing and Kneading: The first step is to mix the flour with water and knead the mixture to form a dough. In the case of millet-based pasta, other ingredients may need to be added to improve the texture and elasticity of the dough
3. Extrusion: The dough is then fed into an extruder, which is a machine that uses heat and pressure to force the dough through a die. The die is a metal plate with small holes that shape the pasta into the desired form, such as spaghetti or macaroni
4. Cutting and Drying: The pasta is then cut into the desired length and dried to remove the moisture and increase its shelf life. The drying process can be done either by air-drying or by using a drying machine
5. Packaging: The final step is to package the pasta in airtight containers to prevent moisture from entering and spoiling the product

The extrusion process can be optimised by adjusting the extrusion operating conditions such as barrel temperature, feed moisture content, feeder speed, and screw speed to feeder speed ratio. The optimization process can be done through response surface methodology to achieve the desired quality of the pasta

Equipment Requirement:

Mixing Machine: Used to mix the ingredients, such as flour, water, and salt, to form a dough.

Kneading Machine: Used to knead the dough, developing gluten and improving the texture of the pasta

Extruder: A machine with an extrusion mechanism and a die used to extrude the dough through the die to form the desired shape of the pasta such as Spaghetti, Penne, Ravioli, Linguine.

Air Drying: Drying racks or trays are used to allow the noodles to air dry in a controlled environment with proper ventilation.

Cooling Rack or Conveyor: Used to cool the dried pasta to room temperature after the drying process.

4. Millet Based- Vermicelli

Millet-based vermicelli presents a delightful twist on traditional pasta, offering a thin, spaghetti-like texture that has found its culinary niche in Indian cuisine, notably in the beloved dish known as vermicelli upma. This dish is a breakfast staple in South India, cherished for its flavors and versatility.

Vermicelli upma is a quick and convenient meal, perfect for busy mornings or a light dinner option. Its preparation involves cooking vermicelli with an array of aromatic spices, colorful vegetables, and crunchy nuts, resulting in a dish bursting with flavor and nutrition.

What makes millet-based vermicelli particularly intriguing is its adaptability. This pasta alternative can be fashioned from various types of vermicelli, including wheat, foxtail millet, and little millet, offering a wide canvas for culinary creativity.

But vermicelli upma isn't just about taste; it's also a healthy and nutritious choice. This dish is rich in fiber and protein, making it an ideal option for those seeking a balanced diet that satiates taste buds while nourishing the body.

In the world of Indian cuisine, millet-based vermicelli brings an exciting dimension to the breakfast table. Whether you're savoring its unique texture, exploring the diverse types of vermicelli, or prioritizing health-conscious eating, millet-based vermicelli offers a delectable and wholesome journey through the flavors of India.



Fig 7.8 Millet-based vermicelli

Product Formulation:

The following table presents a typical product formulation for millet-based vermicelli:

Ingredient	Percentage
Wheat Flour	50-60 %
Millet Flour	30-40 %
Other flours (tapioca flour/defatted soy)	10-15 %
Oil	2-3%
Salt	As needed

Please note that the percentages mentioned in the product formulation table may vary depending on the specific recipe and manufacturer's preferences.

Production Process of Millet Based vermicelli:

To produce millet-based noodles through extrusion on an industrial scale, the following steps can be taken:

1. **Mixing:** Mix millet flour with water and other ingredients, such as hydrocolloids, to form a dough. Hydrocolloids can be added to improve the texture and elasticity of the dough
2. **Extrusion:** The dough is then fed into an extruder, which is a machine that uses heat and pressure to force the dough through a die. The die is a metal plate with small holes that shape the dough into the desired form, such as thin noodles.
3. **Cutting and Drying:** The noodles are then cut into the desired length and dried to remove the moisture and increase their shelf life. The drying process can be done either by air-drying or by using a drying machine.
4. **Packaging:** The final step is to package the noodles in airtight containers to prevent moisture from entering and spoiling the product. The Vermicelli are packaged in bags or cups and sealed for distribution.

Equipment Requirement:

Mixing Machine: Used to mix the ingredients, such as flour, water, and salt, to form a dough.

Kneading Machine: Used to knead the dough, developing gluten and improving the texture of the noodles.

Extruder: A machine with an extrusion mechanism and a die used to extrude the dough through the die to form the desired shape of the noodles.

Cutter: Used to cut the extruded noodles to the desired length.

Steamer: A vessel or steaming chamber used to steam the noodles for a specific period, pregelatinized the starch and made them digestible.

Seasoning Bath: A container or tank used for dipping the steamed noodles in a seasoning solution to add flavour.

Air Drying: Drying racks or trays are used to allow the noodles to air dry in a controlled environment with proper ventilation.

Cooling Rack or Conveyor: Used to cool the dried noodles to room temperature after the drying process.

Packaging Equipment: Includes various machines for packaging the product, such as:

- **Bagging Machine:** Automatically fills and seals bags with the product.
- **Cup Filling and Sealing Machine:** Used for packaging vermicelli in cups with airtight seals.

Unit 7.3- Machinery and equipment requirements for millet base extruded products

Unit Objectives



At the end of this unit, you will be able to:

1. Describe the classification of extruder.
2. Equipment's used in the processing of millet base extruded snacks.

7.3.1 Machinery and equipment requirements

In the manufacturing of millet-based extruded products, a range of specialized equipment is employed to transform millet flour and other ingredients into various delicious and nutritious items like millet noodles, vermicelli, pasta, and Murukku (a popular Indian snack). Each piece of equipment plays a crucial role in shaping, cooking, seasoning, and packaging these products. This chapter delves into the intricate details of the equipment involved in the production process and their suitability for different millet-based items.

Mixing Machine:

Mixing machines for millet-based products are designed with precision to blend millet flour, water, and other ingredients thoroughly. They feature large mixing bowls with rotating blades or agitators that ensure an even distribution of ingredients. These machines are capable of handling various formulations, incorporating salt, spices, or additives as required. The optimal mixing time and speed are meticulously controlled to achieve a homogeneous and well-hydrated dough, a fundamental step in the production process.



Fig 7.9

Types: Various mixing machines can be used for millet-based products, including planetary mixers, spiral mixers, and horizontal mixers. Planetary mixers are adaptable for smaller batches and offer versatility. Spiral mixers are adept at promoting gluten development in the dough. Horizontal mixers excel in high-capacity production scenarios.

Applicability: Mixing machines are indispensable for preparing the dough used in millet noodles, vermicelli, pasta, and Murukku. They are the cornerstone of consistency in ingredient distribution and dough quality.

Extruder:

Extruders for millet-based products are intricate machines designed to precisely shape the dough into the desired product form. They feature a feed hopper for dough input, a screw conveyor to transport the dough, and a die with specific openings to create unique shapes and sizes. The extruders exert controlled pressure on the dough, ensuring it passes through the die uniformly, giving the final products their distinct form.



Fig 7.10

Types: Millet-based production benefits from both single-screw and twin-screw extruders. Single-screw extruders offer versatility, while twin-screw extruders provide finer control over the extrusion process.

Applicability: Extruders are pivotal in crafting millet noodles, vermicelli, pasta, and even Murukku. They dictate the final product's shape and texture, making them indispensable in the manufacturing process.

Cutter:

Cutters for millet-based products are precision tools responsible for shaping the extruded dough into uniform lengths or shapes. These cutters are often synchronized with the extruder to maintain consistency in the product's dimensions. They can employ rotary blades or guillotine-style mechanisms, depending on the desired outcome.



Fig 7.11

Types: Guillotine cutters, rotary cutters, and adjustable cutters are commonly used in millet-based product production. The choice of cutter depends on the specific product shape and size.

Applicability: Cutters play a vital role in shaping millet noodles, vermicelli, and pasta, ensuring uniformity in the final product, which is essential for consumer satisfaction.

Steamer:

Steamers for millet-based products are specialized chambers or vessels that utilize steam to cook the extruded items. This cooking process serves multiple purposes, including pregelatinizing the starch in the millet, enhancing digestibility, and imparting specific textures to the products.



Fig 7.12

Types: Both continuous steamers and batch steamers find applications in millet-based product production. The choice depends on the production scale and desired cooking characteristics.

Applicability: Steamers are critical for millet noodle, vermicelli, and pasta production, ensuring proper cooking and texture development that align with consumer expectations.

Air Dryer:

Air drying for millet-based products involves the systematic placement of these items on racks or trays within a controlled environment characterized by proper ventilation. This meticulous process facilitates the gradual evaporation of moisture from the products, preserving their quality, texture, and flavor.



Fig 7.13

Types: Multiple drying methods can be employed, such as tunnel dryers, room drying, and specialized drying cabinets, based on the specific requirements and production scale.

Applicability: Air drying is fundamental in millet noodles, vermicelli, and pasta production, as it influences moisture content and shelf stability, essential factors for product quality.

Cooling Rack or Conveyor:

Cooling racks or conveyors are indispensable for the post-drying phase of millet-based product production. They facilitate the gradual cooling of the dried items to room temperature, preventing condensation and maintaining product quality during this critical phase.

Types: Conveyor systems with adjustable speeds are commonly employed, allowing precise control over the cooling process to ensure uniform product temperature.

Applicability: Cooling racks or conveyors are instrumental in ensuring that millet-based products are ready for packaging without compromising their quality, texture, or taste.



Fig 7.14

Packaging Equipment:

Packaging equipment is a crucial aspect of millet-based product production, ensuring the products are properly packaged for distribution and sale while preserving their freshness and safety.

Bagging Machine: Bagging machines are automated systems that fill and seal bags with millet noodles, vermicelli, pasta, or Murukku. They are particularly suited for bulk packaging, efficiently handling large quantities of product.



Fig 7.15

Cup Filling and Sealing Machine: These machines are tailored for portioned packaging, expertly filling cups with millet-based products and providing airtight seals that safeguard freshness and extend shelf life.

Applicability: Packaging equipment plays a pivotal role in preparing millet-based products for distribution, ensuring that they reach consumers in impeccable condition, ready for consumption.

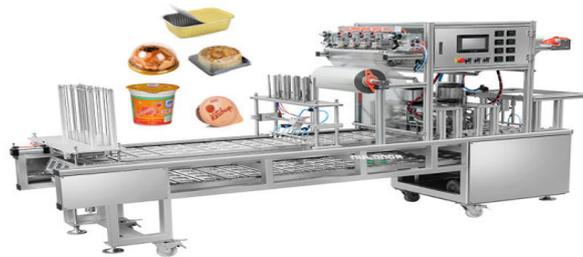


Fig 7.16

Fryer (for Murukku):

The fryer is an essential component specific to Murukku production. It consists of a specialized vessel or chamber equipped with a heating system. The extruded Murukku dough is carefully immersed in hot oil and fried until it reaches the desired level of crispiness, imparting the classic texture and flavor associated with this snack.

Types: Both continuous fryers and batch fryers can be used, with the choice dependent on the production volume and required consistency.

Applicability: The fryer is exclusively used for Murukku production, an integral step in achieving the signature crispy texture and flavour of this popular snack.



Fig 7.17

7.3.2 Contact Details of Equipment Manufactures

Consistent vendor management empowers businesses to improve transparency, mitigate risks by ensuring compliance is up to date, and save money by maximizing the benefits of full modernization. For any business to grow in long runs, vendor management and selection is an important aspects.

The table below contains the vendor details for the machinery and equipment required for processing of millets base extruded snacks.

Equipment Type	Company Name	Location	Contact Number	Email
Mixer	Machine World	Kolkata, West Bengal	+91-9830-777-940	sales@machineworld.co.in
	Grace Food Processing & Packaging Machinery	Noida, Uttar Pradesh	+91-9810-678-232	info@gracefood.in
	Maruti Machinery Consultant	Ahmedabad, Gujarat	+91-9904-555-580	info@marutimachinery.com
Kneader	Machine World	Kolkata, West Bengal	+91-9830-777-940	sales@machineworld.co.in
	Grace Food Processing & Packaging Machinery	Noida, Uttar Pradesh	+91-9810-678-232	info@gracefood.in
	S. K. Industries	Noida, Uttar Pradesh	+91-9818-945-499	skindustries@skengineers.info
Extruder	Grace Food Processing & Packaging Machinery	Noida, Uttar Pradesh	+91-9810-678-232	info@gracefood.in
	Nong Shim Co., Ltd.	South Korea	+82-2-529-6800	nongshim@nongshim.com
	Machine World	Kolkata, West Bengal	+91-9830-777-940	sales@machineworld.co.in
Dehydrator	Grace Food Processing & Packaging Machinery	Noida, Uttar Pradesh	+91-9810-678-232	info@gracefood.in
	Maruti Machinery Consultant	Ahmedabad, Gujarat	+91-9904-555-580	info@marutimachinery.com
	S. K. Industries	Noida, Uttar Pradesh	+91-9818-945-499	skindustries@skengineers.info
Packaging Machinery for Pasta	Machine World	Kolkata, West Bengal	+91-9830-777-940	sales@machineworld.co.in
	Maruti Machinery Consultant	Ahmedabad, Gujarat	+91-9904-555-580	info@marutimachinery.com
	Buhler India Pvt. Ltd.	Bengaluru, Karnataka	+91-80-3041-1000	info.buhler@buhlergroup.com

Table 7.3

Exercise

Answer the following questions:

1. Name the type of extruders used in processing of millet base extruded snacks.

2. Give examples of different types of extruded snacks.

3. Describe the packaging requirements of extruded snacks.



8. Employability Skills



Scan the QR code below to access the eBook
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DGT/VSQ/N0101



9. Annexure

Unit 9.1 - List of QR Codes Used in Book



UNIT 9.1: List of QR Codes Used in Book

Module No.	Name	Page No.	URL	QR Code (s)
1. Introduction to the program and overview of food processing industry (FIC/N9026)	Scope of food processing in India with National and International perspective	40	https://www.youtube.com/watch?v=5VIYw38hCxU	
	Overview of Food Processing Industry	40	https://www.youtube.com/watch?v=J-2EiMVNtpM	
	Mainstreaming Millets for Nutritional Security	40	https://www.youtube.com/watch?v=MhYtjVc8u5M	
	Entrepreneurship Opportunities in Millet Processing Sector	40	https://www.youtube.com/watch?v=e_dTiISWq2U&t=1s	
2. Prepare for Production (FIC/N9026)	Procedure for Production Planning	56	https://www.youtube.com/watch?v=MiUgOzXfUYs	
	Waste management	56	https://www.youtube.com/watch?v=K6ppCC3lboU	

Module No.	Name	Page No.	URL	QR Code (s)
3. Ensuring Food Safety and Personal Hygiene (FIC/N9906)	Personal Hygiene	88	https://www.youtube.com/watch?v=6WXc6cH_gil&t=1s	
	General Requirement on Hygiene and sanitation	88	https://www.youtube.com/watch?v=d5kn5ns0zWM	
	Food Safety	88	https://www.youtube.com/watch?v=KBvU4Bmu500	
4. Produce Millet Base Composite Flour (FIC/N1038)	Sorghum Flour Processing	112	https://www.youtube.com/watch?v=dzA_T9rrYd0	
5. Produce Millet Based Baked Products (FIC/N1039)	Millet Cookies making machines and its value addition	152	https://www.youtube.com/watch?v=9fnNqGhcbJ5Q	
	Kodo Millet Cookies Processing	152	https://www.youtube.com/watch?v=UoAIBYgD0hs	
6. Produce Millet Based Ready to Cook Products (FIC/N1040)	Millet Idli	176	https://www.youtube.com/watch?v=fXORixTEk0M	
	Millets Puff Gun Machine	176	https://www.youtube.com/watch?v=KeNRYM-MHkU&t=60s	



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