

TECH-KNOWLEDGE

The Official PMG Engineering Newsletter

**FOOD & BEVERAGE
INDUSTRY**

**ENGINEERING
& DESIGN**

**SCIENCE &
TECHNOLOGY**

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PREVENTIVE MEASURES IN F&V INDUSTRY



Introduction

In developing countries agriculture is the mainstay of the economy. There should be no surprise that agricultural industries and related activities can account for a considerable proportion of their output. Of various types of activities that can be termed as agriculture based, fruits and vegetable processing are among the most important. Fruits and vegetables, which are among the perishable commodities, are important ingredient in human diet. Due to their high nutritive value, they make significant nutritional contribution to human well-being. They are cheaper and better source of protective foods. These contain non-nutritive secondary metabolites known as phytochemicals that have disease-fighting properties. Some of these phytochemicals are polyphenols, pigments (e.g., carotenoids) and glucosinolates.

Fruit and vegetable production and processing involve a complex supply chain from the farm to fork. From many points of view, it is of great importance to strengthen each link in the chain and improve the integration of the supply chain if high quality and safety of produce must be maintained. International trade of fresh fruits and vegetables is a billion-dollar business that has significantly increased in the last decade. This trade is important also from a safety viewpoint, and involves (primary) producers, manufacturers, distributors, and retailers who place a great deal of value on their reputation for marketing naturally delicious and nutritious products.

Safety of fruits and vegetables starts with agriculture and primary production. One major factor leading to food contamination during food preparation and storage is time-temperature abuse, which results in the survival, growth, and production of toxins by pathogens. In recent decades, microbial safety has become a concern and a series of large foodborne outbreaks has occurred around the world. The situation is more alarming due to several population explosion, urbanization and changes in lifestyle, consumption of, so-called, minimal processed ready-to-eat foods, international trade in food and animal feed, international tourism and immigration, and a short supply of potable drinking water.

A.Types of Hazards

1. Biological hazards: include pathogenic fungi, bacteria, viruses, prions, protozoans and helminthic parasites, namely certain trematodes. These could cause foodborne illness due to pathogen-host interaction. Pathogens most associated with fruits and vegetables include *Salmonella*, *Shigella*, *Escherichia coli* O157:H7, *Listeria*, *Campylobacter*, *Cryptosporidia*, viruses such as Hepatitis A and parasites such as *Entamoeba histolytica*, *Giardia lamblia*, *Cyclospora cayetanensis*, *Cryptosporidium parvum*, *Toxoplasma gondii*, and certain trematodes.

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There are certain sources/factors that contribute to the microbiological contamination of these products with pathogens, all of which must be controlled. Contamination can arise because of treating soil with untreated manure and sewage sludge, untreated effluent water released from meat industry and from irrigation water. Additionally, handling and the application of technologies such as cutting, slicing, skinning, and shredding (in the case of minimally processed fruits and vegetables) will remove the natural protective barriers of the intact plant and open the possibility for providing a suitable medium for the growth of contaminating microorganisms. The numbers of bacteria present in fruits and vegetables will vary depending on seasonal and climatic. Shredding and slicing were found to increase counts of mesophilic bacteria.

2. Physical Hazards: Physical hazards are commonly called “foreign materials” or “foreign bodies” because their presence in food is unnatural. They include unwanted field matter (stones, wood, metal, pieces of bone, insect fragments, etc.); inadvertent processing residues (glass, metal fragments, pieces of plastic, personal objects, etc.); unintentional materials (employee sabotage) and miscellaneous particulates and fragments or food itself (pits, stones, stems). These may enter foods at almost any point of the food supply. Some foreign matters may not act as a hazard but their finding in food may be indicative of poor hygienic practice and a distressing event for consumers.

3. Chemical Hazard: Chemical hazards may appear in food products either by natural occurrence (e.g. naturally occurring toxin in certain mushrooms, solanine in potatoes) in a raw material or by deliberate or unintentional addition during primary production and/or processing. They could result from several sources: the environment such as heavy metals or radionuclides; agricultural chemicals such as insecticides, fungicides; packaging materials; cleaning/sanitizing agents; certain toxins; and misuse of food chemicals.



B. Control Measures

1. Adoption of Good Agricultural Practices at Primary Producing Stage

- Soil can contain harmful microbes that can contaminate crops. Soil can be tested before each planting and remediation completed if it contains harmful microbes called pathogens.
- Contaminated water is one of the most common sources of microbial contamination of crops. Before selecting a field location, growers should examine upstream uses of irrigation water that could lead to contamination. They should also select an area that's free from flooding or run-off.
- It is generally recommended not to irrigate crops for two to seven days before harvest. If water used for irrigation was contaminated, this gap without water provides adequate time for any present harmful pathogens to likely die before the crop is harvested.
- It is not uncommon for manure and other biosolids to contain harmful pathogenic microbes if it is not treated before use. Raw manure should be stored in a separate area from crops and with protection to prevent accidental cross-contamination from occurring. If manure is used as a natural fertilizer on a field crop, it is best practice to wait 120 days before harvesting the produce.
- In conclusion, site selection and layout planning are critical steps that can significantly impact the success of a food industry business. Careful consideration of these factors will help you create an efficient, safe, and profitable operation. Consulting with experts in food industry design and seeking professional advice can also be beneficial in making informed decisions.

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2. Adoption of Good Manufacturing/ Production Practices at processing Stage

- Loading docks should be kept clean and free of grass, dirt or outside debris. When not in use, loading docks should be closed and locked to ensure outside pests or traffic cannot enter the processing facility.
- Any food contact surface should be cleaned and sanitized regularly to prevent cross-contamination or spreading of microbial contamination. This includes counters where food is prepared and tools such as knives and machines used for processing produce.
- Gloves should be worn when handling produce, and employees should practice good personal hygiene. Restrooms and employee break rooms should be in a separate area from anywhere produce is processed.
- While it is important to visually check the cleanliness of food contact surfaces, harmful bacterial pathogens are microscopic and cannot be seen with the naked eye. That is why regular testing for microbes on food contact surfaces is essential to identify and minimize any areas of contamination.
- Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Points (HACCP) are essential and effective measures for identifying and controlling risks during produce processing. Creating a written preventative plan is an essential step for food manufacturing safety.
- Blanching is the process of quickly and briefly boiling or steaming vegetables or fruit. Blanching is an effective method to inactivate enzymes and damage microbes before freezing which can limit deterioration of the produce.
- After blanching produce, it should be frozen rapidly. Reducing the temperature of the product quickly will prevent it from further cooking and help ensure the continued freshness of the product while also slowing the activity of any microbes that might be present.
- Another effective technique for stopping enzyme activity in frozen produce is by addition of ascorbic acid, commonly known as vitamin C, to prevent any further chemical deterioration.

Knowledge of the nature of fruits and as they relate to pre and post-harvest handling, processing, packaging and storage are essential for ensuring their wholesomeness and nutritional value, and for developing the most effective procedures and innovative technologies for maintaining their quality and safety.



MICROFILTRATION



Introduction

The use of membrane technology as a handling and separation method in food industry is gaining importance day-by-day. Membrane separations can be used as a substitute to conventional techniques especially in dairy, sugar, fruits juice processing, and beverage industries. In many cases, membrane processes are more advantageous than traditional technologies and can be considered as green technologies as it does not causes environmental hazards, Using membrane filtration to remove microorganisms for shelf-life extension of foods instead of using additives and preservatives also create a green image for the processed foods as well as for the processing procedure. For example, using cold pasteurization and sterilization with suitable membranes instead of high temperature treatment for the removal of microorganisms is more economical in terms of energy consumption, quality of products, minimize loss of nutritional value.

Principle

Membrane separation is a process of separating food components by using semipermeable membranes, based on the molecular size and molecular weight of the components.

The driving force of the separation process is, for example, differences in concentration or pressure between the two sides of the membrane.

The different membrane processing methods are as follows.

Reverse osmosis (RO): Concentration of solution by removal of water

Nanofiltration (NF): Concentration of organic components by removal of part of monovalent ions like sodium and chlorine (partial demineralization).

Ultrafiltration (UF): Concentration of large and macro molecules

Microfiltration (MF): Removal of bacteria, separation of macromolecules

The basic unit or the heart of a membrane/microfiltration technology is its membrane which acts as a barrier and separate 2 phases. It is important to note that sieving mechanism or size of the particle is the basis for separation in MF while in others it is the molecular weight cut off. The main purpose of MF is clarification and turbidity removal.

As explained Microfiltration (MF) designates a membrane separation process similar to UF but with even larger membrane pore size allowing particles in the range of 0.2 to 2 micrometres to pass through.

- The pressure used is generally lower than that of UF(Ultrafiltration process) process.

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- MF is used in the dairy industry for making low-heat sterile milk.

Membrane-It is semi-permeable in nature i.e. allows some materials to pass through it while restricting others selectively.

Process: Solution or the feed is passed with a driving force or pressure through a membrane that is semi-permeable in nature, which causes it to flow. Depending on the pore size, speed, pressure etc. it allows passage of some particle while retain some component on the other side of the membrane.

Thus, the feed stream divides into-

1.Permeate-The component that passes to another side or the membrane is known as permeate.

2.Retentate -The components that could not pass through the membrane and remains on one side of the membrane or on the surface of membrane is known as Retentate.

Generally, 2 different flow configurations are employed in Microfiltration:

1.Dead-end-flow: It is the most basic form of filtration. In this the complete feed flow is forced through the membrane and the filtered matter is accumulated on the surface of the membrane. The dead-end filtration is a batch process as accumulated matter on the filter decreases the filtration capacity, due to clogging. The next step in the process is to remove the accumulated matter which is required. Dead-end filtration can be an extremely useful technique for concentrating compounds.

2.Cross Flow Micro-filtration: The process is referred to as "cross-flow", because the feed flow and filtration flow direction have a 90 degrees angle. With cross-flow filtration a constant turbulent flow along the membrane surface prevents the accumulation of matter on the membrane surface.



The membranes used in this process are commonly tubes with a membrane layer on the inside wall of the tube. The feed flow through the membrane tube has an elevated pressure as driving force for the filtration process and a high flow speed to create turbulent conditions. It is an excellent way to filter liquids with a high concentration of filterable matter.

Applications

The application of membrane technology in food industry is growing gradually in both international and domestic market since 1960s. For selected applications, microfiltration is superior to other conventional methods owing to its inherent advances such as low energy consumption, fewer and mild processing steps, greater separation efficiency, improved final product quality, eco-friendly and 'cleaner' processing.

Application in Dairy Industry

The removal of bacteria and spores from milk to extend its shelf-life by MF is an alternative way to ultra-pasteurization. MF for the removal of bacteria and spores can be further applied in the production of other dairy products.

Application in Water Industry

(drinking water + wastewater processing + water desalination) has the largest commercial market for membranes worldwide.

Application in Beverage Industry

As an alternate, reverse osmosis is used for beer dealcoholisation prior to its clarification by microfiltration before pasteurization and bottling. MF is now successfully employed for beer clarification i.e., for removal of yeasts, microorganisms and for haze without adversely affecting its sensorial attributes.

A close-up photograph showing a white ceramic coffee cup filled with dark coffee. A white milk frother is being used to add a thick, white foam on top of the coffee. In the background, a glass container filled with dark coffee beans is visible.

INDUSTRY BUZZ

Karnataka promotes coffee with a sustainability-focused approach.

Karnataka promotes coffee with a focus on sustainability through regenerative agriculture and the circular economy. Over 70% of the nation's coffee is produced in the state, which is, without a doubt, the leader.

The state had 2.33 lakh metric tons of coffee in the most recent fiscal year, the most of any form in the nation. The state is developing methods to minimize waste, maximize resource efficiency, and support environmentally friendly activities throughout the coffee manufacturing process by focusing on sustainability through a circular economy approach. Additionally, regenerative agriculture can help improve and restore the health of the soil, creating a more substantial, more sustainable coffee farm.

The Department of Animal Husbandry and Dairy implements the National Program for Dairy Development.

Since February 2014, the National Programme for Dairy Development (NPDD) scheme has been implemented nationwide by the Department of Animal Husbandry and Dairying (DAHD). The strategy was reorganized/realigned in July 2021 for implementation from 2021-2022 to 2025-2026 with the two components listed below and their corresponding goals:

(i) Component "A" of the NPDD focuses on developing/improving infrastructure for quality milk testing equipment as well as primary chilling facilities.

(ii) Component 'B' of the NPDD program intends to enhance sales of milk and dairy products by improving farmer access to the organized market, modernizing dairy processing facilities and marketing infrastructure, and boosting producer-owned institutions' capabilities.





The FSSAI extends RDA 2020 compliance by six months.

After the stakeholders requested extra time, the FSSAI decided to extend the Recommended Dietary Allowance (RDA) 2020 compliance deadline for a period of six months. On July 1, 2023, the RDA 2020 was set to take effect after the FSSAI's July/August 2021 directives concerning the RDA's deadline for compliance.

Industry associations reportedly requested a delay in the RDA-2020's implementation due to difficulties with product reformulation and inventories of outdated packaging materials that FBOs had on hand. The directive from the FSSAI states, "After careful consideration, it has been decided to extend further the date of coming into force of Recommended Dietary Allowance 2020 for compliance for six months from July 1, 2023."

Friends of the Farmer brew sessions are being introduced by Maverick & Farmer Coffee.

The first of Maverick & Farmer's Friends of the Farmer brew sessions, which aims to highlight local coffee producers' outstanding efforts and products, has been announced. This session will feature farmer Lynn Mascarenhas from St Margaret Estate and take place at the Ulsoor cafe. For two months, the highlighted single-estate coffee will also be sold at outlet cafés and online.

The sessions, organized by co-founder and farmer Tej Thammaiah of Maverick & Farmer Coffee, provide a venue for local farmers to display their remarkable and inventive produce, with a focus on those who practice maverick farming.



Production-related Industry Incentive Program for Food Processing

The Production Linked Incentive Scheme for the Food Processing Industry (PLISFPI), a Central Sector Scheme with an outlay of Rs 10,900 crore, was approved by the Union Cabinet on March 31, 2021. It is scheduled to be implemented from 2021-2022 to 2026-2027.

The program is divided into three parts:

Encouraging the production of food products in the four main food product categories (processed fruits and vegetables, mozzarella cheese, marine products, and ready-to-cook/ready-to-eat foods).

Supporting the branding and international marketing of Indian brands.

Promoting innovative and organic products made by SMEs.

Furthermore, using the savings from PLISFPI, the PLI Scheme for Millet-based Products (PLISMBP) was introduced in FY 2022-2023 at an expense of Rs 800 crore.

WEEKS HIGHLIGHT

NON-TECHNICAL CONTENT



28 JULY

WORLD HEPATITIS DAY

World Hepatitis Day takes place every year on 28 July bringing the world together under a single theme to raise awareness of the global burden of viral hepatitis and to influence real change.



28 JULY

WORLD NATURE CONSERVATION DAY

The World Nature Conservation Day is observed annually on July 28. The occasion aims to create awareness about the need to preserve the environment and natural resources in order to keep the world healthy.



29 JULY

J. R. D TATA

Jehangir Ratanji Dadabhoy Tata (29 July 1904-29 November 1993) is an inspiration, an idol, a role model, a pioneer, a humanitarian, a nation-builder, and whatnot. He was the strength who not only pushed the automobile and Telecom industry forward but also pushed the society and nation to excellency. JRD Tata is one of the most successful businessmen in India.

AUGUST



29 JULY

INTERNATIONAL TIGER DAY

Tiger Day is celebrated every year on July 29th as a way to raise awareness about this magnificent but endangered big cat. The goal of the day is to promote a global system for protecting the natural habitats of tigers and to raise public awareness and support for tiger conservation issues.



31 JULY

WORLD RANGER DAY

World Ranger Day is observed every year on 31 July to commemorate the Rangers killed or injured while on duty and to celebrate the work that Rangers do to protect the world's natural and cultural heritage.



7 AUGUST

WORLD BREASTFEEDING WEEK

World Breastfeeding week is celebrated globally between 1st to 7th of August. The goal of the week is to highlight the importance of breastfeeding, to encourage and promote breastfeeding and to improve the health of babies and mothers all around the globe.

DID YOU KNOW?



Fact 1

Frozen vegetarian meals are pre-prepared meals that do not contain any meat or fish and are designed to be stored in the freezer for later consumption specifically catered to vegetarians. They provide a convenient option for those who are busy, want to minimize cooking time, or need to maintain a vegetarian or plant-based diet.



Water activity (a_w) is a fundamental parameter that quantifies the availability of water molecules in a food product or material.

It is defined as the ratio of the vapor pressure of water in the food to the vapor pressure of pure water at the same temperature.

$$a_w = \frac{P}{P_0}$$

P = Vapour pressure in food
 P_0 = Vapour pressure in pure water

- This dimensionless value, typically ranging from 0 to 1, represents the extent to which water is free and mobile within the product's matrix.
- Most foods have a water activity above 0.95 and that will provide sufficient moisture to support the growth of bacteria, yeasts, and mold.

2/5

Limit for Microorganism growth

Microorganism	A_w
Bacteria	0.91-0.86
Yeast	0.88-0.80
Molds	0.70
Osmophilic yeast	0.62
Xerophilic Molds	0.61
Absolute limit for all growth	0.60
No microbial proliferation	0.50

- Most bacteria, do not grow at water activities **below 0.91**, and most molds cease to grow at water activities **below 0.80**.

3/5

The water activity level in food directly affects its shelf life, safety, and overall quality.

- Microbial Growth and Spoilage**
The higher the water activity, the more favorable the conditions for microbial proliferation.
- Shelf Life**
Foods with lower water activity levels can slow down the rate of oxidation and enzymatic reactions like, helping to maintain the quality and taste of the food.

4/5

4. Flavor Stability

- In products with high water activity, volatile flavor compounds are more likely to evaporate, leading to a loss of taste and aroma.
- This can impact the overall sensory experience of the food.

5. Nutritional Content

- Water activity can influence the stability of vitamins and other essential nutrients in food.
- High water activity may accelerate nutrient degradation, leading to reduced nutritional value in the product over time.

6. Physical Stability

- Water activity can affect the physical stability of food products.
- For example, certain confections and chocolate products require specific water activity levels to maintain their shape and prevent crystallization.



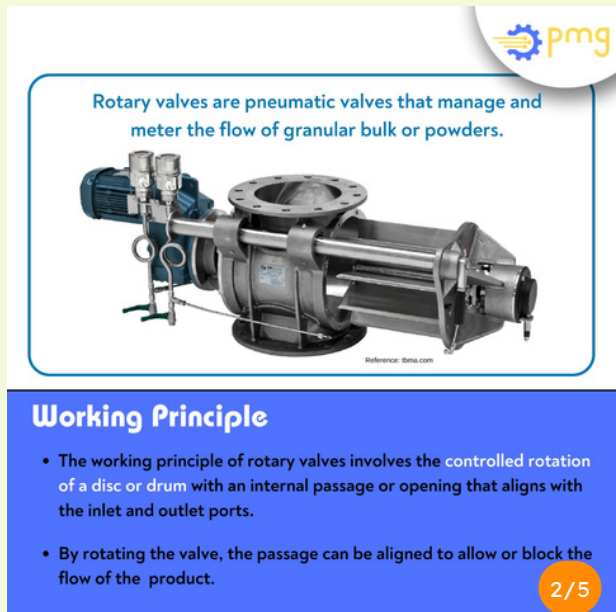
5/5

Fact 2

Water activity (aw) in food is a crucial concept in food science and preservation. It is a measurement of the free or unbound water present in a food product. Water activity is represented on a scale ranging from 0.0 to 1.0, with pure water having an aw of 1.0



1/5



Rotary valves are pneumatic valves that manage and meter the flow of granular bulk or powders.

Working Principle

- The working principle of rotary valves involves the controlled rotation of a disc or drum with an internal passage or opening that aligns with the inlet and outlet ports.
- By rotating the valve, the passage can be aligned to allow or block the flow of the product.

2/5

Components

- **Housing:** The housing is the main body of the rotary valve and provides a sturdy enclosure for all the internal components.
- **Rotor or Disc:** The rotating component of the rotary valve. The rotor contains a passage or opening that aligns with the inlet and outlet ports to control the fluid flow.
- **Inlet and Outlet Ports:** These are openings in the valve housing where the fluid enters and exits the valve.
- **Drive Mechanism:** In automated rotary valves, there is a drive mechanism that powers the actuator, whether it be an electric motor, pneumatic piston, hydraulic cylinder, or another source of power.
- **End Plates:** End plates are used to close off the ends of the housing and provide additional support to the rotor and bearings. They help to create a contained space within the valve.



3/5

Uses in Food Industry

- 1. Metering and Feeding:**
 - Used to meter and feed bulk food materials helping regulate the precise amount of material flowing into processing equipment or mixing systems.
- 2. Pneumatic Conveying:**
 - Serve as airlocks in pneumatic conveying systems, ensuring a continuous and controlled transfer of food materials.
- 3. Dust and Contaminant Control:**
 - When handling powders or fine particles, rotary valves help to control dust and airborne contaminants.
- 4. Ingredient Mixing:**
 - Used in mixing and blending systems, allowing precise ingredient dosing.
- 5. Packaging:**
 - Utilized to control the flow of granular or powdered food products into packaging machines, ensuring accurate filling.



4/5



Specifications + Selection Criteria

- 1. Material of Construction :**
 - Food-grade materials like stainless steel (316L or 304), aluminum, or other approved alloys are commonly used. These materials should be resistant to corrosion, easy to clean, and non-toxic, ensuring they do not contaminate the food product.
- 2. Operating Pressure and Temperature:**
 - Rotary valve to be able handle the required pressure and temperature conditions of the food processing system.
- 3. Material Handling:**
 - Rotary valve should be suitable for handling the type of food material being processed, whether it's dry powders, granules, or other ingredients.
- 4. Integration with System:**
 - Rotary valve should integrates well with the existing food processing system, connecting seamlessly with upstream and downstream equipment.

5/5

Fact 3

A rotary valve in the food industry is a mechanical device used to control the flow of food materials (liquids, powders, granules, or other ingredients) within a processing system. It consists of a rotating disc, drum, or star-shaped rotor with an internal passage or opening that aligns with the inlet and outlet ports.



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