

# OVERVIEW OF FOOD PROCESSING EQUIPMENT

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# FOOD PROCESSING!!!!!!



# FOOD PROCESSING

- Food processing is the transformation of agricultural products into food, or of one form of food into other forms.
- Or **Food processing** is a variety of operations by which raw foodstuffs are made suitable for consumption, cooking, or storage.
- Food processing generally includes the basic preparation of foods, the alteration of a food product into another form, and preservation and packaging techniques.



# FOOD PROCESSING EQUIPMENT



Crusher



Mixer



Extruder Machine



Dryer



Finished Products



Packing Machine



Cooling Machine



Flavor Roller



# FOOD PROCESSING EQUIPMENT

- Food processing equipment is an umbrella term referring to the **components**, **processing machines**, and **systems** used to handle, prepare, cook, store, and package food and food products.



LIST OUT THE EQUIPMENT'S EMPLOYED DURING BREAD MAKING!?



# TYPES OF FOOD PROCESSING EQUIPMENT

- □ Preparation
- □ Mechanical processing
- □ Heat processing
- □ Preservation
- □ Packaging



# FOOD PREPARATION EQUIPMENT BY UNIT OPERATION





**FOOD****PREPARATION EQUIPMENT BY UNIT****OPERATION****Unit Operation****Description****Equipment Employed**

Cleaning

Removes foreign matter and contaminants—e.g., soil, oil, insects, skins, chemicals, etc.—from the surface of raw food material via wet and dry cleaning processes

- Wet Processes
  - Soak/floatation tanks
  - (soaking)
  - Spray washers
  - (spray washing)
  - Washing systems
  - (washing) Sterilizers
  - (sterilizing) Ultrasonic cleaners
  -
- Dry Processes
  - Air classifiers
  - Magnetic separators
  - Screening separators

# FOOD PREPARATION EQUIPMENT BY UNIT OPERATION

Unit Operation	Description	Equipment Employed
Grading	<ul style="list-style-type: none"><li>□ Closely related to, and often precluding, sorting processes</li><li>□ Assesses several characteristics of food matter (e.g., flavor, damage, skin color, aroma, etc.) to determine the overall quality</li></ul>	<p>Tungsten lights (candling)</p> <ul style="list-style-type: none"><li>□ Image processors</li><li>□ Laboratory equipment</li></ul>



# FOOD PREPARATION EQUIPMENT BY UNIT OPERATION

Unit Operation	Description	Equipment Employed
Peeling/Skinning	Removes inedible or undesirable material to increase the overall quality and/or appearance of the final food product	<ul style="list-style-type: none"><li><input type="checkbox"/> Pressure vessels (flash steam peeling)</li><li><input type="checkbox"/> Stationary/rotating blades (knife peeling)</li><li><input type="checkbox"/> Carborundum abrasive rollers/bowls (abrasion peeling)</li><li><input type="checkbox"/> Conveyors and furnaces (flame peeling)</li></ul>



# FOOD PREPARATION EQUIPMENT BY UNIT OPERATION

Unit Operation	Description	Equipment Employed
Sorting	<p>Operates similarly to and overlaps with dry cleaning processes</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Classifies and separates foreign matter and contaminants from raw food material based on a measurable physical characteristic (typically size, shape, weight, or color)</li></ul>	<p>Dry Processes</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Air classifiers</li><li><input type="checkbox"/> Magnetic separators</li><li><input type="checkbox"/> Screening separators</li></ul> <p>Sorting machinery</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Disc separators (shape sorting)</li><li><input type="checkbox"/> Sieves/screens (size sorting)</li><li><input type="checkbox"/> Machine vision sorting systems</li><li><input type="checkbox"/> Sorting conveyors</li></ul>

# MECHANICAL PROCESSING EQUIPMENT



# MECHANICAL PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Size Reduction	Reduces the average particle size of solid food matter through mechanical processes involving compression, shear, or impact force.	<p><i>Grinding/Crushing</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Impact mills</li> <li><input type="checkbox"/> Pressure mills</li> <li><input type="checkbox"/> Attrition mills Jaw crushers</li> <li><input type="checkbox"/> Roll crushers</li> <li><input type="checkbox"/> Strainers/pulpers</li> </ul> <p><i>Cutting/Chopping</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Knives/blades</li> <li><input type="checkbox"/> Band saws</li> <li><input type="checkbox"/> Slicing machines</li> <li><input type="checkbox"/> Meat grinders</li> </ul>



# MECHANICAL PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Size Enlargement	Increases the average particle size of solid food matter through mechanical processes, such as extrusion, agglomeration, or forming.	<p><i>Extrusion</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Non-thermal extruders</li> <li><input type="checkbox"/> Single-screw extruders</li> <li><input type="checkbox"/> Twin-screw extruders</li> <li><input type="checkbox"/> Refrigerated extruders</li> </ul> <p><i>Agglomeration</i> Rotating</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> pans Rotating drums</li> <li><input type="checkbox"/> High-speed agitators</li> <li><input type="checkbox"/> Tableting equipment</li> <li><input type="checkbox"/> Pelletizing equipment</li> <li><input type="checkbox"/></li> </ul> <p><i>Forming</i></p> <ul style="list-style-type: none"> <li>Bread molders</li> <li><input type="checkbox"/> Pie and biscuit formers</li> <li><input type="checkbox"/> Confectionary molders</li> <li><input type="checkbox"/> Enrobing machines</li> <li><input type="checkbox"/></li> </ul>

# MECHANICAL PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Homogenization	<ul style="list-style-type: none"><li><input type="checkbox"/> Also referred to as emulsification</li><li><input type="checkbox"/> Reduces the average particle size and increases the consistency of semi-solid and liquid food matter.</li></ul>	<ul style="list-style-type: none"><li><input type="checkbox"/> Homogenizers</li><li><input type="checkbox"/> Emulsifiers</li><li><input type="checkbox"/> Colloid mills</li><li><input type="checkbox"/> High shear mixers</li></ul>





# MECHANICAL PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Mixing	<ul style="list-style-type: none"><li>□ Also referred to as blending</li><li>□ Combines and disperses two or more components into one another to achieve and maintain a uniform mixture and/or an alteration to the functional or aesthetic qualities of the food product (e.g., texture)</li><li>□ Type of equipment depends on the form of the food components—gas/liquid, liquid/liquid, liquid/solid, solid/solid</li></ul>	<p>Fluid Mixers</p> <ul style="list-style-type: none"><li>□ Agitated tanks</li><li>□ Paddle mixers</li><li>□ Anchor mixers</li><li>□ Turbine mixers</li></ul> <p>Dough/Paste Mixers</p> <ul style="list-style-type: none"><li>□ Horizontal dough mixers</li><li>□ Sigma-blade mixers</li><li>□ Cutter mixers</li></ul> <p>Solids Mixers</p> <ul style="list-style-type: none"><li>□ Diffusive (passive) mixers</li><li>□ Convective (active) mixers</li><li>□ Drum blenders</li></ul>

# HEAT PROCESSING EQUIPMENT (PRESERVATION BY THE APPLICATION OF HEAT)



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Baking	<p>Similar to, and often referred interchangeably with, roasting.</p> <ul style="list-style-type: none"><li>□ Employs heated air (heated by convection, conduction, and radiation)—and, in some cases, water vapor—to heat and produce physical and chemical changes in food material, such as texture or flavor</li><li>□ Assists in the preservation of food matter by destroying microorganisms and reducing the amount of moisture at the food surface</li><li>□ Suitable for producing bread, crackers, biscuits, and other flour- based or dough-based products</li></ul>	<p>Baking ovens</p> <ul style="list-style-type: none"><li>□ Direct heating ovens</li><li>□ Indirect heating ovens</li><li>□ Batch ovens</li><li>□ Continuous and semi-continuous ovens</li></ul>



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Blanching	<ul style="list-style-type: none"><li>□ Employs heated water or steam to inactivate undesirable enzymes and reduce the number of microorganisms which can cause spoilage</li><li>□ Also cleans, removes excess air from, softens, and improves the overall quality</li><li>□ Typically follows preparation operations and precedes preservation operations, such as packaging, dehydrating, or freezing</li><li>□ Suitable for fruits and vegetables</li></ul>	<p>Blanchers</p> <ul style="list-style-type: none"><li>□ Steam blanchers</li><li>□ Hot water blanchers</li></ul>



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Dehydration	<ul style="list-style-type: none"><li data-bbox="639 401 1684 668">❑ Employs heat to remove (i.e., evaporate) water from solid, semi-solid, or liquid food material with the intention of producing a solid food product with sufficiently low water content</li><li data-bbox="639 686 1684 843">❑ Increases the shelf life of food products due to the reduced water content which inhibits microbial growth and enzyme activity</li><li data-bbox="639 862 1684 953">❑ Reduces weight and volume and/or transforms the form of the final food product.</li></ul>	<p data-bbox="1755 344 1895 386">Dryers</p> <ul style="list-style-type: none"><li data-bbox="1755 401 2181 444">❑ Convective dryers</li><li data-bbox="1755 462 2384 505">❑ Contact (conductive) dryers</li><li data-bbox="1755 524 2117 566">❑ Vacuum dryers</li><li data-bbox="1755 585 2097 628">❑ Freeze dryers</li></ul>



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Evaporation	<ul style="list-style-type: none"><li>❑ Removes volatile solvents (typically water) from food material by boiling to increase the concentration of solid contents</li><li>❑ Increases the shelf life of food products due to the reduced water content, but also increases the rate of chemical deterioration</li><li>❑ Reduces the weight and volume of the final food product</li><li>❑ Typically precedes operations, such as crystallization, precipitation, and coagulation</li><li>❑ Suitable for liquid-based food products</li></ul>	<p>Heat exchangers</p> <ul style="list-style-type: none"><li>❑ Evaporators</li><li>❑ Condensers</li></ul>



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Frying	<ul style="list-style-type: none"><li>□ Employs heated (~160–180 °C) fat or oil to transfer heat directly to food material</li><li>□ Reduces moisture content, forms a surface crust (changes texture and structure), and inactivates microorganisms which improves shelf life and overall quality</li></ul>	<p>Fryers</p> <ul style="list-style-type: none"><li>□ Batch fryers</li><li>□ Continuous fryers</li></ul>



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Pasteurization	<ul style="list-style-type: none"><li>❑ Processes food material under medium temperatures (70–100 °C) to inactivate most enzymes and microorganisms (but not spores) which cause spoilage</li><li>❑ Produces food products with limited shelf lives (short-term preservation method)</li><li>❑ Little to no impact to quality and characteristics beyond the shelf life</li><li>❑ Suitable for dairy, fruit/vegetable-based, wine, beer, and egg products.</li></ul>	<p>Pasteurizers</p> <ul style="list-style-type: none"><li>❑ In-container pasteurizers</li><li>❑ Continuous flow pasteurizers</li></ul> <p>Heat exchangers</p> <ul style="list-style-type: none"><li>❑ Plate heat exchangers</li><li>❑ Tubular Heat Exchanger</li><li>❑ Concentric tube heat exchangers</li></ul>



# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Roasting	<ul style="list-style-type: none"><li><input type="checkbox"/> Similar to, and often referred interchangeably with, baking.</li><li><input type="checkbox"/> Employs heated air (heated by convection, conduction, and radiation)—and, in some cases, water vapor—to heat and produce physical and chemical changes in food material, such as texture or flavor</li><li><input type="checkbox"/> Assists in the preservation of food matter by destroying microorganisms and reducing the amount of water at the food surface.</li><li><input type="checkbox"/> Suitable for meats, nuts, vegetables, etc.</li></ul>	<ul style="list-style-type: none"><li><input type="checkbox"/> Roasting machinery</li><li><input type="checkbox"/> Roasting ovens</li><li><input type="checkbox"/> See Baking Equipment Employed</li></ul> <p>Baking ovens</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Direct heating ovens</li><li><input type="checkbox"/> Indirect heating ovens</li><li><input type="checkbox"/> Batch ovens</li><li><input type="checkbox"/> Continuous and semi-continuous ovens</li></ul>

# HEAT PROCESSING EQUIPMENT

Unit Operation	Description	Equipment Employed
Sterilization	<ul style="list-style-type: none"><li>□ Processes food material under high temperatures (100+ °C) to inactivate all microorganisms and enzymes (including microbial spores)</li><li>□ Can be heated by steam, hot water, or direct flames</li><li>□ Produces food products with long shelf lives (long-term preservation method)</li><li>□ May result in a significant impact on quality and characteristics</li></ul>	<p>Sterilizers/sterilizing retorts</p> <ul style="list-style-type: none"><li>□ In-container sterilizers</li><li>□ Continuous flow sterilizers</li></ul> <p>Heat exchangers</p>



# PRESERVATION EQUIPMENT



# PRESERVATION EQUIPMENT

Unit Operation	Description	Equipment Employed
Chemical	<ul style="list-style-type: none"><li><input type="checkbox"/> Employs natural and non-natural chemical substances to prevent or inhibit spoilage</li><li><input type="checkbox"/> Can change the pH and other qualities of food material</li></ul>	<p>Natural</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Salt (salting)</li><li><input type="checkbox"/> Smokers (smoking)</li><li><input type="checkbox"/> Acids (e.g., acetic acid, vinegar, etc.)</li></ul> <p>Non-Natural</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Sorbic acid</li><li><input type="checkbox"/> Sulfur dioxide</li><li><input type="checkbox"/> Benzoic acid</li></ul>



# PRESERVATION EQUIPMENT

Unit Operation	Description	Equipment Employed
Heat Processing	See <i>Heat Processing Equipment</i> section	



# PRESERVATION EQUIPMENT

Unit Operation	Description	Equipment Employed
Irradiation	<ul style="list-style-type: none"><li>□ Employs ionizing radiation to destroy microorganisms and inactivate enzymes which cause spoilage</li><li>□ Little to no heating of food material</li></ul>	<ul style="list-style-type: none"><li>□ Irradiation equipment, such as isotopes and electron accelerators</li></ul>



# PRESERVATION EQUIPMENT

Unit Operation	Description	Equipment Employed
Refrigeration** (Removal of Heat)	<ul style="list-style-type: none"><li><input type="checkbox"/> Reduces the temperature of food material to depress the biochemical and microbiological processes of microorganisms and enzymes which cause spoilage</li><li><input type="checkbox"/> Helps maintain quality and characteristics of food material</li></ul>	<p>Chilling (-1°C–8°C)</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Chillers</li><li><input type="checkbox"/> Mechanical refrigerators</li><li><input type="checkbox"/> Cryogenic systems</li></ul> <p>Freezing (below freezing point)</p> <ul style="list-style-type: none"><li><input type="checkbox"/> Freezers</li><li><input type="checkbox"/> Mechanical refrigerators</li><li><input type="checkbox"/> Cryogenic systems</li></ul>

# PRESERVATION EQUIPMENT

Unit Operation	Description	Equipment Employed
Water Reduction	<ul style="list-style-type: none"><li>□ Reduces the amount of water in food matter in solid, semi-solid, or liquid food material to inhibit microbiological and enzymatic process which cause spoilage</li></ul>	<p>Drying</p> <ul style="list-style-type: none"><li>□ Convective dryers</li><li>□ Contact (conductive) dryers</li><li>□ Vacuum/freeze dryers</li></ul> <p>Solute Addition</p> <ul style="list-style-type: none"><li>□ Sugar</li><li>□ Salt</li></ul> <p>Concentration</p> <ul style="list-style-type: none"><li>□ Evaporators</li><li>□ Condensers</li></ul>





# PACKAGING EQUIPMENT



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# PACKAGING EQUIPMENT

Unit Operation	Description	Equipment Employed
Packaging Material Creation	<ul style="list-style-type: none"><li>□ Enables the identification of food contents and the indication of handling, storage, and usage instructions (e.g., ingredient list, production date, barcodes, etc.)</li><li>□ Allows for branding and marketing (e.g., brand name, logo, etc.)</li></ul>	Printers (e.g., flexographic, photogravure, planographic, screen, or ink-jet)



# PACKAGING EQUIPMENT

Unit Operation	Description	Equipment Employed
Filling	Used to fill a set volume of the packaging containers with liquid, paste, or small pieces of solid food material	Volumetric Fillers



# PACKAGING EQUIPMENT

Unit Operation	Description	Equipment Employed
Sealing	<input type="checkbox"/> Creates a double seam in filled food and beverage cans	Seamers
Sealing	<input type="checkbox"/> Capable of forming, filling, and sealing flexible film packaging containers	Form-Fill-Seal (FFS) Systems



# PACKAGING EQUIPMENT

Unit Operation	Description	Equipment Employed
Quality Control	<input type="checkbox"/> Verifies that filled packaging containers are at the required fill weight and removes underweight products from the production line	Check-weighers



# FOOD QUALITY MEASUREMENT INSTRUMENTS



# FOOD QUALITY MEASUREMENT INSTRUMENTS

Instrument	Function
<b>Alcoholic beverage analyzers –</b>	Can be used to measure the alcohol content, density, color, and pH of alcoholic beverages
<b>Carbonated beverage analyzers</b>	– measure product density, temperature, current/fresh/inverted sugar concentrations, degree of inversion, and CO2 levels.
<b>Food analysis equipment</b>	various instruments that can be used to measure the fat, protein, and oil concentrations in food samples and detect the level of gluten in foods.



# FOOD QUALITY MEASUREMENT INSTRUMENTS

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<b>Pesticide detection instruments</b>	detects the presence of pesticides in food samples.
<b>Electron Spin Resonance Spectrometers</b>	– also known as electron paramagnetic resonance (EPR), these instruments can be used to test the purity of products without physically destroying or altering samples.





# FOOD QUALITY MEASUREMENT INSTRUMENTS

<b>Electron Spin Resonance Spectrometers</b>	also known as electron paramagnetic resonance (EPR), these instruments can be used to test the purity of products without physically destroying or altering samples.
<b>Chemical imaging (NIR/Raman) systems</b>	devices that use analysis of samples by detecting and analyzing light that is in the near-infrared, visible, or near-ultraviolet light areas of the electromagnetic spectrum.
<b>Magnetic analyzers</b>	detect low levels of iron in food samples by measuring the imbalance in resonance between two air core coils which can be translated into a signal that reflects the level of iron present in the sample.



# FOOD QUALITY MEASUREMENT INSTRUMENTS

<b>Moisture analyzers</b>	also known as moisture balances, these devices are used to establish the percentage of moisture in a food sample, either by weighing the sample before and after an evaporation process or by using an absorption spectrometer to analyze the gas emitted during evaporation to establish its content.
<b>Polarimeters</b>	devices that pass polarized light through a sample and measure the angle at which the emitted light emerges. Optically active substances will cause a change in the polarization angle of the emitted light, which can be used to establish concentrations of sugars such as <b>glucose and sucrose</b> .
<b>Refractometers –</b>	are devices that measure the angle of refraction from light that is passed through a liquid, gel, or solid substance and using that to establish parameters such as the salinity and sugar content.

# FOOD QUALITY MEASUREMENT INSTRUMENTS

<b>Rheometers &amp; Viscometers</b>	are instruments that can measure the viscosity of a fluid and the behavior of fluids when shear or stress forces are applied to it. Having this information can reveal the properties of the fluid that relate to its structure and elasticity.
<b>Saccharimeters</b>	are instruments that specifically measure the concentration of <b>sugars</b> present in a solution. They do so by measuring the refractive index of the liquid as light is passed through it.
<b>Titration Equipment</b>	can be used to detect and measure the concentration of a substance within a liquid through acid/base titration. The addition of titrant of known concentration to a known volume of solution with unknown concentration can determine that unknown concentration through a reaction neutralization.



# FOOD QUALITY MEASUREMENT INSTRUMENTS

<b>Other equipment</b>	– additional equipment often employed in food quality applications includes ovens, centrifuges, water baths, and dry baths.



ANY QUESTION



Thank  
you!

The text 'Thank you!' is rendered in a vibrant, 3D pop-art style. 'Thank' is in a pink-to-orange gradient, while 'you!' is in a blue-to-green gradient. The letters are thick and blocky, with yellow stars and striped patterns on their sides. The exclamation point is a small green heart. The entire graphic is set against a white background with a thin orange border on the right.