

FOOD PROCESSING UNIT




Food Processing

Rapid and continued developments in various branches of science and technology led to considerable improvements in food processing methods.

The new processing technologies contributed to enhancement in the quality and acceptability of foods.

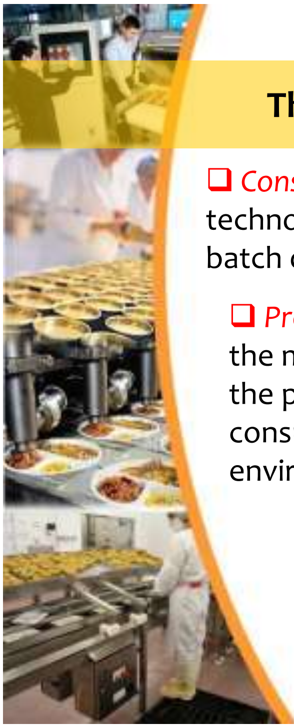
Food Processing

Food processing is the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption humans or animals either in the home or by the food processing industry.

Food processing typically takes clean, harvested crops or slaughter and butchered animal products and uses these to produce attractive, marketable and often long life food products.

The goals of modern Food processing

- *Formulation. A logical basic sequence of steps* to produce an acceptable and quality food product from raw materials.
- *Easy production procedures. Develop methods* that can facilitate the various steps of production.
- *Time economy. A cohesive plan that combines* the science of production and manual labor to reduce the time needed to produce the product.

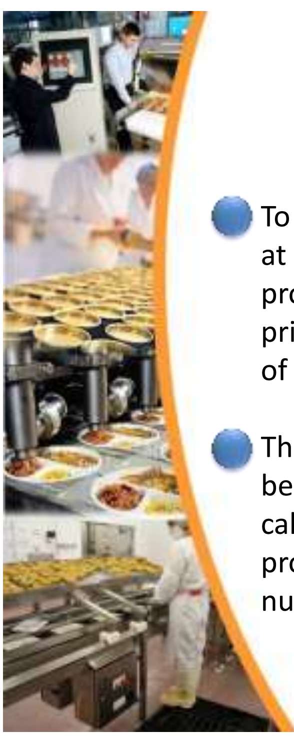


The goals of modern Food processing

❑ *Consistency. Application of modern science and* technology to assure the consistency of each batch of products.

❑ *Product and worker safety. The government and* the manufacturers work closely to make sure that the product is wholesome for public consumption, and the workers work in a safe environment.

❑ *Buyer friendliness. Assuming the buyer likes the* product, the manufacturer must do everything humanly possible to ensure that the product is user friendly (size, cooking instructions, keeping quality, convenience, etc.).



UNITS OF OPERATIONS

- To facilitate the technological processing of food at the educational and commercial levels, food processing professionals have developed unifying principles and a systematic approach to the study of these operations.
- The involved processes of the food industry can be divided into a number of common operations, called unit operations. Depending on the processor, such unit operations vary in name and number.

UNITS OF OPERATIONS

- The unit operations may also include numerous different activities. For example agitating, beating, blending, diffusing, dispersing, emulsifying, homogenizing, etc.
- One of the key elements to food processing is the proper selection and combination of unit operations into more complex integrated processing systems

UNIT OPERATIONS IN FOOD PROCESSING INDUSTRY

- Cleaning
- Coating
- Concentrating
- Controlling
- Disintegrating
- Forming
- heating/Cooling
- Materials handling
- Mixing
- Packaging
- Drying
- Evaporating
- Fermentation
- Pumping
- Separating and others

- **The above operations are listed in alphabetical order not in sequence of importance**
- **The application of many operations depends on its product produced**

UNIT OPERATIONS IN FOOD PROCESSING INDUSTRY

Applications:

Bakery: Muffins, Yeast-leavened Breads

Beverages: Nonalcoholic, Carbonated Beverages, Alcoholic, Beer Making

Grain, Cereal: Ready-to-Eat Breakfast Cereals

Grain, Paste Products: Pasta and Asian Noodles

Dairy: Cheese, Ice Cream, Yogurt, Milk Powders

Fats: Mayonnaise, Vegetable Shortening, Edible Fat and Oil Processing

Fruits: Orange Juice Processing

Meat: Fermented Meats

Vegetables: Tomato Processing

YOGURT

Fermented dairy foods have long been considered safe and nutritious. Yogurt has become very popular and is leading the way in educating consumers about probiotics. The development of dairy products that contains probiotic bacteria has taken great importance because of the benefits attributed to those bacteria. It has been demonstrated that probiotics bacteria have the capacity to inhibit bacterial pathogen by the production of diverse metabolites.

Yogurt Nutrition

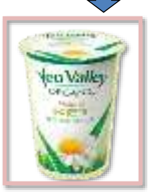
Nonfat Yogurt/1 cup	
Calories	100
Total fat (g)	0
Saturated fat (g)	0
Monounsaturated fat (g)	0
Polyunsaturated fat (g)	0
Dietary fiber (g)	0
Protein (g)	10
Carbohydrate (g)	19
Cholesterol (mg)	5
Sodium (mg)	135
Calcium (mg)	300

Low-fat Yogurt/1 cup	
Calories	155
Total fat (g)	3.8
Saturated fat (g)	2.5
Monounsaturated fat (g)	1
Polyunsaturated fat (g)	0.1
Dietary fiber (g)	0
Protein (g)	13
Carbohydrate (g)	17
Cholesterol (mg)	15
Sodium (mg)	172
Riboflavin (mg)	0.5
Vitamin B12 (mcg)	1.4
Calcium (mg)	448
Phosphorus (mg)	353
Potassium (mg)	573
Zinc (mg)	2.2

http://www.wholehealthmd.com/refshelf/foods_view/1,1523,97,00.html

Types of Yogurt

Set Yogurt- this type of yogurt is incubated and cooled in the final package. Firm "jelly like" texture.



Stirred Yogurt- incubated in a tank and final coagulum is broken by stirring before cooling. Less firm then set yogurt (like a thick cream). A little reformation of coagulum will occur after packaging.

Drinking Yogurt- also has coagulum broken before cooling. Very little reformation of coagulum will occur.

http://www.cip.ukcentre.com/yogurt.htm

Types of Yogurt (continued)

Frozen Yogurt- Incubated like stirred yogurt. Cooling is achieved by pumping through a freezer like ice cream. Has a texture like ice cream.

Concentrated Yogurt- incubated like stirred yogurt. After coagulum is broken, some water is boiled off. Produces rough and gritty textures.

http://www.cip.ukcentre.com/yogurt.htm

Flavored Yogurt- Flavors are added just before yogurt is poured into pots. Add in usually contain about 50 % sugar.

YOGURT PROCESSING UNIT

YOGURT PROCESSING UNIT

1 **PRODUCTION OF YOGURT STARTERS**

Frozen culture concentrates available from commercial culture suppliers have received wide acceptance in the industry.

Reasons for their use include convenience and ease of handling, and reliable quality and activity. The concentrates are shipped frozen in dry ice and stored at the plant in special freezers at 40°C or below for a limited period of time specified by the culture supplier.

1

Fermentor to produce starter

YOGURT PROCESSING UNIT

1 **PRODUCTION OF YOGURT STARTERS**

The incubation period for yogurt bulk starter ranges from four to six hours; the incubation temperature (43°C) is maintained by holding hot water in the jacket of the tank.

The fermentation must be quiescent (lack of agitation and vibrations) to avoid phase separation in the starter following incubation.

YOGURT PROCESSING UNIT

2 MIX PREPARATION

A yogurt plant requires a special design to minimize contamination of the products with phage and spoilage organisms. Filtered air is useful in this regard.

The plant is generally equipped with a receiving room to receive, meter or weigh, and store milk and other raw materials. In addition, facilities include a process and production control laboratory, a dry storage area, a refrigerated storage area, a mix processing room, a fermentation room, and a packaging room.

YOGURT PROCESSING UNIT

2 MIX PREPARATION

The mix processing room contains equipment for standardizing and separating milk, pasteurizing and heating, and homogenizing along with the necessary pipelines, fittings, pumps, valves, and controls.

The fermentation room housing fermentation tanks is isolated from the rest of the plant. Filtered air under positive pressure is supplied to the room to generate clean room conditions.

2

Yogurt Mixer

YOGURT PROCESSING UNIT

2 **MIX PREPARATION**

A utility room is required for maintenance and engineering services needed by the plant. The refrigerated storage area is used for holding fruit, finished products, and other heat-labile materials. A dry storage area at ambient temperature is primarily utilized for temperature stable raw materials and packaging supplies.

YOGURT PROCESSING UNIT

2 MIX PREPARATION

Standardization of milk for fat and milk solids not-fat content results in fat reduction and in an increase of 30–35% in lactose, protein, mineral, and vitamin content. The nutrient density of yogurt mix is thus increased over that of milk. Specific gravity changes from 1.03 to 1.04 g/ml at 20°C. Addition of stabilizers (gelatin, starch, pectin, agar, alginates, gums, and carrageenans) and sweeteners further impacts physical properties.

PASTEURIZATION UNIT 3

YOGURT PROCESSING UNIT

3 HEAT TREATMENT

The common pasteurization equipment consists of a vat, plate, triple-tube, scraped, or swept surface heat exchanger. In yogurt processing, a plate heat exchanger and high-temperature short-time (HTST) pasteurization system is commonly used. The mix is subjected to much more severe heat treatment than in conventional pasteurization temperature-time combinations. Heat treatment at 85°C for 30 minutes or 95–99°C for 7–10 minutes is an important step in manufacture.

YOGURT PROCESSING UNIT

3 HEAT TREATMENT

The heat treatment (1) produces a relatively sterile medium for the exclusive growth of the starter; (2) removes air from the medium to produce a more conducive medium for microaerophilic lactic cultures to grow; (3) effects thermal breakdown of milk constituents, especially proteins, releasing peptones and sulfhydryl groups, which provide nutrition and anaerobic conditions for yogurt culture; and (4) denatures and coagulates whey proteins of milk, thereby enhancing the viscosity, leading to a custard-like consistency in the product.

YOGURT PROCESSING UNIT

3 **HEAT TREATMENT**

The intense heat treatment during yogurt processing destroys all the pathogenic flora and most vegetative cells of all microorganisms contained therein. In addition, milk enzymes inherently present are inactivated. Consequently, the shelf life of yogurt is assured

Homogenizer

YOGURT PROCESSING UNIT

4 HOMOGENIZATION

The homogenizer is a high-pressure pump that forces the mix through extremely small orifices. It includes a bypass for safety of operation. The process is usually conducted by applying pressure in two stages. In the first stage, pressure of the order of approximately 14 MPa (2000 psi) reduces the average diameter of the average milk fat globule from approximately 4 micrometers (µm) (range 0.1 to 16 µm) to less than 1 micrometer.

YOGURT PROCESSING UNIT

4 HOMOGENIZATION

The second stage uses a pressure of 3.5 MPa (500 psi) and is designed to break the clusters of fat globules apart, with the objective of inhibiting creaming in the milk. Homogenization aids in texture development and alleviates surface creaming and syneresis problems. Since homogenization reduces the fat globules to an average of less than 1 µm in diameter, no distinct creamy layer (crust) is observed on the surface of yogurt produced from homogenized mix.

YOGURT PROCESSING UNIT

4 HOMOGENIZATION

In general, homogenized milk produces soft coagulum in the stomach, which may enhance digestibility.

The homogenized mix is brought to 43°C by pumping it through an appropriate heat exchanger. It is then collected in fermentation tanks.

Fermented

YOGURT PROCESSING UNIT

5 FERMENTATION

Fermentation tanks for the production of cultured dairy products are generally designed with a cone bottom to facilitate draining of relatively viscous fluids after incubation.

YOGURT PROCESSING UNIT

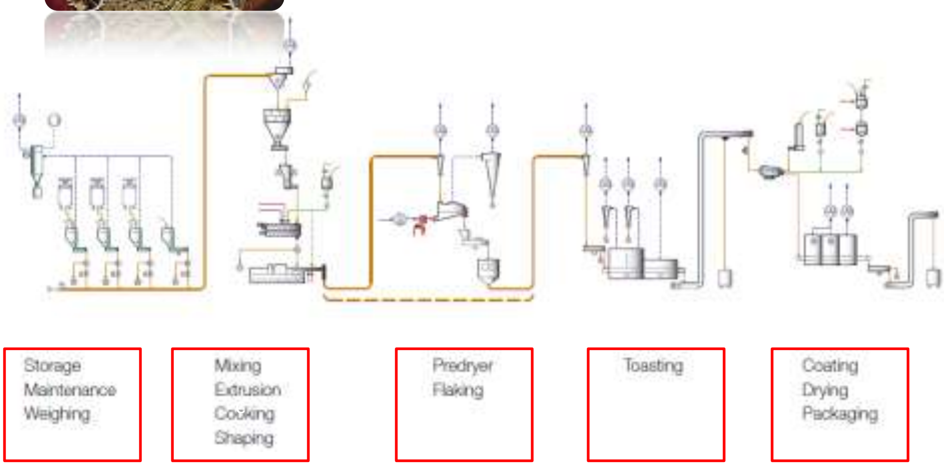
5 FERMENTATION

For temperature maintenance during the incubation period, the fermentation vat is usually insulated and covered with an outer surface of stainless steel. The vat is equipped with a heavy-duty, multispeed agitation system, a manhole containing a sight glass, and appropriate spray balls for CIP (clean-in-place) cleaning. The agitator is often of the swept surface type for optimum agitation of relatively viscous cultured dairy products. For efficient cooling after culturing, plate or triple-tube heat exchangers are used.

CEREAL

Breakfast cereals have become firmly established on breakfast tables almost all over the world. In addition to a wide variety of forms, tastes and colours, they are expected today to also meet stringent nutritional quality requirements. A consistently high product quality, high operating reliability, and maximum efficiency are the most important requirements that state of-the-art production systems must satisfy.

CEREAL PROCESSING UNIT



RAW MATERIALS PREPARATION: DRY MILLING FIELD CORN

Field corn is an entirely different product than the sweet corn with which consumers are familiar. Field corn is allowed to mature and partially dry in the field prior to harvest in the fall. During harvesting, the kernels are removed from the cob by shelling. Field corn is typically dried on the farm prior to delivery to grain terminals or mills to prevent the growth of mold during storage. Corn kernels are dry milled to separate the germ and bran layers from the endosperm. The majority of the oil in a corn kernel is located in the germ

UNIT PROCESSING

UNIT PROCESSING

1 ADDITION OF COOKING LIQUOR

The grits must be cooked prior to flaking. Much of the flavor of cornflakes is due to the addition of sugars, proteins (or amino acids), and salt to the cooking water (cooking liquor). In a typical formulation six pounds of sucrose, two pounds of malt syrup, and two pounds of salt are added to 100 pounds of grits with enough water to yield cooked grits containing about 28–34% moisture.

UNIT PROCESSING

1 ADDITION OF COOKING LIQUOR

Salt is added to improve flavor. Malt syrup contains reducing sugars (maltose and glucose) and proteins or free amino acids that are critical to the creation of desired flavors and colors due to nonenzymatic browning, as discussed in the following sections. Malt syrup is made from barley using a controlled germination step.

UNIT PROCESSING

1 ADDITION OF COOKING LIQUOR

Malt is the dried and ground germinated barley kernels produced in this process. Malt syrup is the concentrated water extract of the dried malt. Malt syrup used in cereal manufacture does not contain residual active starch-degrading enzymes since they would soften the grit and destroy desirable milling properties. The sugars that are not reducing (e.g., sucrose) do not react during the cooking process and may contribute to the residual sweetness of the product

UNIT PROCESSING

UNIT PROCESSING

2 COOKING

Weighed amounts of raw corn grits and cooking liquor are loaded into batch cookers. Batch cookers are cylindrical stainless steel steam pressure cookers that are typically four to eight feet long and rotate at one to four revolutions per minute (rpm) during processing. The tumbling action of the cookers provides sufficient agitation to keep the grits separated while cooking.

UNIT PROCESSING

2 COOKING

The grits are cooked for approximately two hours at 15–18 psig of steam pressure. Cooking is complete when the original hard, white grits have turned a golden brown color and are soft and translucent. Applications cooking results in grits with white centers that will carry through processing and result in cornflakes with white spots. The moisture content of the cooked grits should be 28–34%.

UNIT PROCESSING

3 Extrusion processes

Extrusion is the most frequently used process for cooking and for complete or partial forming of cereal products. As an HTST (High Temperature Short Time) process, extrusion is a comparatively gentle process. As it uses a minimum of water, it is a low-energy process and therefore ecological as well as economical. Using steam and water, the premixed solids are fed into the process.

UNIT PROCESSING

3 Extrusion processes

They are partially heated almost to boiling temperature using an additional preconditioning stage and precooked more or less intensively, depending on the water content and the selectable retention (dwell) time. If required, the taste-imparting substances are also added to the preconditioner stage in order to promote aroma reactions as early as during this stage. This allows the raw materials to be cooked with the introduction of more or less mechanical energy as a function of the product.

What is Extrusion?

Generally, extrusion is defined as a process of forcing material through a defined opening.

For this to happen, the material must be either completely or partly in a fluid form so that it doesn't block the opening when operating under reasonable pressure conditions.

In reality, extrusion systems provide many other functions including solid conveying, melting, mixing, metering and in the process, the material may undergo chemical as well as physical changes.

Buhler Twin Screw Extruder

UNIT PROCESSING

4 Forming and cutting

Cutting can be accomplished directly at the die face or farther downstream in a separate cutter. Together with the process conditions prevailing inside the extruder, the suitable die hole geometry, the extrusion speed, and the cutting mode determine the form and texture of the product. Depending on the requirements, it is possible to extrude direct-expanded products with two- or three-dimensional forms or semi-finished pellets for subsequent indirect expansion.

UNIT PROCESSING

5 Cold-forming, flaking

Beside the cooking process with subsequent forming at the extruder die face, Buhler also offers two-stage cooking processes. In these, cooking and final forming are separately performed in two machines. Two common representatives for indirectexpanded cereal processes are single-screw extrusion and flaking by rolls. Single-screw extrusion with vertical face cutting is applied for making high-precision products and/or when high throughputs are involved. For rolled breakfast cereals, Buhler offers its tried-and-tested flaking roller mills.

Flaking Machine

UNIT PROCESSING

6 Coating

Liquids metering and solids proportioning units allow the application of fat- or water-based solutions in combination with spices, nut slivers, etc. These systems guarantee a wide variety of solutions, thanks to heatable or coolable drum types: Even critical applications such as high-Brix coating up to 95 Brix are possible.

Coating Machine