Paper No.: 12
Paper Title: FOOD PACKAGING TECHNOLOGY
Module – 22: Aseptic Packaging of Food

1. INTRODUCTION:

Heat sterilization is the unit operation in which foods are heated at a sufficiently high temperature for a sufficiently long time to destroy microbial and enzymatic activity present in the raw food. As a result, sterilized foods have a shelf life of 6 to 12 months or more. The most common method of sterilizing solid and viscous food products is in-container sterilization, e.g., canning; however, the main disadvantages associated with in-container sterilization of food products are

(1) The low rate of heat penetration to the thermal center of the container.

(2) Long processing times to achieve the desired sterility.

(3) Damage to the nutritional and sensory characteristics of the product.

(4) Low productivity, and

(5) High energy costs.

To overcome the constraints of in-container sterilization, products can be sterilized at higher temperatures for a shorter time prior to filling into presterilized containers under sterile conditions. This forms the basis of ultra-high-temperature (UHT) processing and aseptic packaging, which has been defined as "the independent sterilization of food and packaging and assembly under sterile conditions". OR. Aseptic packaging can be defined as the filling of a commercially sterile product into a sterile container under aseptic conditions and hermetically sealing the containers so that re-infection is prevented. This results in a product, which is shelf-stable at ambient temperature conditions. OR

Aseptic packaging refers to the filling of a cold, commercially sterile product under sterile conditions into a presterilized container and closure under sterile conditions to form a seal that effectively excludes microorganisms.

Aseptic processing was developed in the early 1940s and has been used effectively in Europe and Japan for over three decades. It has been rapidly gaining reputation as a thermal processing technique in North America since the use of hydrogen peroxide was approved for sterilizing of packaging materials in 1981. The process has long been effectively employed to sterilize a wide range of liquid products, e.g., milk, fruit juices and concentrates, cream, yogurt, salad dressing, egg, and ice cream. Current developments in high-barrier plastic packaging materials and aseptic processing and filling technology have resulted in the

process being expanded to sterilize both acid-low and acid-viscous, and semisolid foods that contain discrete particles, such as tomato paste, baby foods, fruit pulp etc.

2. SCOPE OF ASEPTIC PACKAGING:

There are number of limitations and disadvantages during actual application of this technology. However, we can't ignore the benefits over various lacunas of the process. Thus, it can be concluded that aseptic packaging of sterile/non sterile food and food products is the most significant innovation in the field of food science and technology and there is a big scope in this area.

3. MAJOR CATEGORIES OF ASEPTIC PACKAGING SYSTEMS

- *Can system*: It includes hermetically sealed cans
- *Bottle systems*: Glass containers and plastics bottles fall into this category. The bottles can further be divided into; a) Non-sterile bottles; b) Sterile blown bottles; c) Single station blowing, filling & sealing
- *Sachet and pouch systems*: This system is classified into Form-fill-seal systems and Lay flat tubing
- *Cup systems*: The aseptic packaging of food into cups can be into; Pre-formed plastic cups and Form-fill and seal cups
- *Carton systems*: This type of aseptic packaging system includes Form-fill-seal cartons and Prefabricated cartons
- *Bulk packaging systems*: This type of system classified into; Metal drum and Bag-in-box Packaging Lines for Aseptic Processing.

3.1 There are five basic types of aseptic packaging lines as given below;

i. *Film & Seal*: Pre-formed containers made up of thermoformed plastic, glass or metal are sterilized, filled in aseptic environment and sealed.

ii. *Form, Fill & Seal*: Roll of material is sterilized, formed in sterile environment, filled and sealed. e.g. Ex tetra packs

iii. *Erect, Fill & seal*: Using knocked, down blanks, erected, sterilized, filled sealed. e.g. Ex. Gable-top cartons, Cambri-block.

iv. *Thermoform, Fill:* sealed roll stock sterilized, thermoformed, filled, sealed aseptically. e.g. Ex. Creamers, plastic soup cans.

v. *Blow, Mold, Fill & Seal*: e.g. Different package forms used in Aseptic UHT processing are cans, paperboards/plastic/foil/plastic laminates/flexible pouches, thermoformed plastic containers, bag in box, bulk totes.

4. PRE-REQUISITE CONDITIONS FOR ASEPTIC PACKAGING:

- It should contain the product.
- It should prevent physical damage to packaged product.
- It should run effortlessly on filling lines.
- It should survive packaging processes.
- It should be easy to handle throughout distribution process.
- It should avoid dirt and other contamination.
- It should be able to protect the product from odours and taints.
- It should be resistant to rodent attack.
- It should be able to stop insect infestation.
- It should be biologically safe i.e. non toxic.
- It should be compatible to foodstuff.
- It should maintain sterility of product.
- It should prevent entry of microorganisms.
- It should show evidence of tampering.
- It should control moisture loss or gain.
- It should offer a barrier to oxygen.
- It should be protective against the light.
- It should maintain gas atmospheres, i.e.CO_2/N_2.
- It should communicate all the information regarding product and manufacturer.
- It should have good sales appeal.
- It should be easy to open and handle.
- It should be cost efficient.

4.1 The above given pack criteria are separated into seven areas, mainly as follows:

1. **Product Containment**: The need to contain the product in the sense that liquids or powders do not leak out.
2. **Physical Protection**: This is required when dealing with fragile foods like eggs or snack foods, but minor impacts on fresh fruits, for example, will release enzymes and

lead to browning and softening. Equally important is the adverse effects on sales of damaged packages themselves-even though the product is in good condition.

3. **Food Safety**: The need to ensure that the aseptically packed food retains its sterility, through a package that prevents adventitious contamination by microorganisms. Tamper evidence is also a desirable requirement. The other aspect of food safety is the avoidance of long-term chronic effects from the food packaging materials themselves.
4. **Shelf-Life**: For dried foods moisture gain is a major factor in determining shelf-life. Atmospheric oxidation, often catalyzed by light, is more critical for aseptically packed foods such as milk, fruit juices, or cream soups. Hence a good oxygen and light barrier, as provided by tinplate or aluminum foil, is needed to ensure maximum shelf life for aseptically packed products.
5. **Communication of Information**: The package should need to tell the purchaser what food is inside it and whose product it is. Apart from this, more information should be passed on to the customer, such as net weight, list of ingredients, batch number, use-by date, nutritional information etc.
6. **Sale-Appeal**: The package must look attractive and 'catch the eye' of prospective purchasers, and it should also be easy to open and dispense the product.
7. **Cost-Effectiveness**: Value for money in packaging is more important than looking for the lowest price. A cheap but dimensionally variable container could cause more damage during production or an increase of 'leakers' in the market place, thereby affects the sale of the product.

A currently popular packaging material used for aseptic packaging is a paperboard/foil/plastic laminate made by Tetra-Pak. This laminated structure consists of as many as six layers of materials viz. polypropylene, surlyn, aluminum foil, polyethylene, paperboard, and polyethylene as the innermost layer.

Other variations that can also be used for thermal sterilization include laminates consisting of saran, ethyl vinyl alcohol (EVOH), polyethylene, and polystyrene or metalized polyester consisting of vinyl ethyl acetate, nylon, foil, and polyethylene. Aluminum foil is the most commonly used barrier material, with polypropylene or polyolefin (type of polyethylene) being the universal heat-sealing and food contact surfaces. When foil is used, it needs to be protected against mechanical harm, which is usually provided by paperboard. All of these composite packages yield the desirable moisture, oxygen, light and microbial barrier properties, strength and heat stability needed for successful aseptic package.

5. ASEPTIC TANK:

The aseptic tank is used for intermediate storage of UHT treated food products. It can be used in different ways in UHT lines, depending on plant design and the capacities of the various units in the process and packaging lines.

- If one of the packaging machines incidentally stops, the aseptic tank can take care of the surplus product during the stoppage.
- Simultaneous packaging of two products.

The aseptic tank is first filled with one product, sufficient to last for a full shift of packaging. Then the UHT plant is switched over to another product which is packed directly in the line of packaging machines. One or more aseptic tanks included in the production line offer flexibility in production planning.

Direct packaging from a UHT plant requires recirculation of a minimum extra volume of 300 litres per hour to maintain a constant pressure to the filling machines. Products which are sensitive to overtreatment cannot tolerate this and the required overcapacity must then be fed from an aseptic tank.

The optimum arrangement must thus be decided for each individual process with UHT plants, aseptic tanks and aseptic packaging machines.

6. ROLE OF MICROPROCESSORS IN ASEPTIC PACKAGING

Microprocessors & microcomputers are first used in packaging machines in 1973. Microprocessor-based equipment controls were first used in 1977. Microprocessor-controlled packaging machinery was first commercially used in 1978. Microprocessor-based aseptic packaging has capability of monitoring one or more process variables simultaneously.

6.1 Main operations that are taken care by microprocessors are

1. Feeding of film to the machine
2. Converting of film into required shape of specific dimensions
3. Filling the product with specific volume of product
4. Heat sealing
5. Collecting up of specific no of packs and shrink wrapping them into one single pack.

All these operations are taken care by Microprocessors.

7. STERILIZATION OF PACKAGING MATERIAL:

Whatever the choice of packaging material used, it must be pre-sterilized prior to filling. Sterilization of the packaging material should not impair that material. Methods commonly

used for sterilization of packaging materials or packages include steam (saturated or superheated), hot air, hydrogen peroxide, ultraviolet light, irradiation, or the heat generated during co-extrusion of certain films.

7.1 Precautions to be taken: Since aseptic packaging systems are complex, there is considerable scope for packaging faults to occur, which will lead to spoiled products. Thus, following precautions are to be taken.

1. Packages should be inspected regularly to ensure that they are airtight, again focusing upon those more critical parts of the process, such as start-up, shutdown, product changeovers and, for carton systems, reel splices and paper splices.
2. Pipes, storage tank, and surfaces of the packaging machine come into contact with the sterilized product have to be sterilized.
3. Sterilization procedures should be verified.
4. The seal integrity of the package should be monitored as well as the overall microbial quality of packaging material itself.
5. Care should be taken to minimize contamination during subsequent handling. All these could result in an increase in spoilage rate.
6. Rinsing, cleaning and disinfecting procedures are also very important, especially the removal of fouling deposits, which may provide a breeding ground for the growth of micro-organisms, especially thermofiles.

8. QUALITY ASSURANCE ASPECTS OF ASEPTIC PACKAGING

Aseptic packaging has to be meticulously checked. Not only must the packaged product be examined, but so must all preceding steps, as well as the operators, which are potential carriers of pathogens. If just one bacterium reaches the product, and that bacterium is pathogenic and can proliferate (for example, *Staphylococcus aureus*), the result could be disastrous. In addition to regular sampling during production, further samples should be taken at the times or in situations known to be associated with an increased risk of contamination. It is advisable to incubate these samples long enough, in most cases from 5 to 7 days at 30^0C to allow sub-lethally damaged bacteria also to grow to detectable counts. The products should only be delivered if the result of the shelf-life test is Satisfactory.

9. CONCLUSION

Packaging of aseptically processed food is the most critical key for a successful operation. The product has to be packaged in the form desired, which will yield the benefits anticipated

after the product has been sterilized, but, this quality of aseptic packaging provides more shelf life to the food product and thus, more transportability, which will incur more profit to the processor. The cost of aseptic package is still more, which needs to be brought down, so that customers can have long life products at lower prices.

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