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HANDBOOK

OF

READY TO EAT PRODUCTS

AATMANIRBHAR BHARAT

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CHAPTER – 1

READY TO EAT FOODS

Introduction

The concept of convenience food has been existing in the modern world since long that it makes it penetrates easily with the changing socio-economic patterns, lifestyle and eating habits. Although it made it place in the developed nations, the boom it has caused over the past decade in the Indian market is tremendous. Popularity of such foods are rising as it saves time and labour, while offering an extending shelf life.

Ready-to-eat or RTE food products are described as the type of food derived from animals or plants that can be offered after washing, cooking, frozen and processed by the consumer. RTE food goods are already prepared and can only be eaten after heating up. Such goods are convenient for customers because both time and energy are saved.

RTE in India

RTE products are currently considered to be the largest segment of the overall food industry, consisting of traditional as well as non-conventional products. Over time, Indian RTE products, especially products based on cereals, vegetables and meat, have demonstrated significant demand among non-resident Indians.

Key growth factors

In recent years, the average level of income for Indians has been rising. In addition to that, both men and women work nowadays. As a consequence, there is a rise in the number of people earning in a given family. In exchange, this has increased the capacity for per capita spending. In India, these factors increase the average consumption of RTE items.

The rate of urbanization has increased to a considerable level since the 2009 census, as per the United Nations (UN) World Urbanization Prospects 2018 survey. The fast-evolving urban lifestyle and the latest trend of living away from home for studying and employment purposes have eventually resulted to the increasing demand of RTE food in India.

Scope

India's ready-to-eat food market stood at $261 million in 2017 and is projected to rise to $647 million by 2023 at a CAGR of over 16 percent during 2018-2023. Growing urbanization, increasing disposable income for the middle-class population and shifting taste preferences for Indian consumers can be attributed to the anticipated growth in the sector.

In addition, the rising demand for fast food and the presence of freshness and high nutritional value in these foods further help the growth of the ready-to-eat food market in India. There is a strong growth in metro demand for ready-to-eat food items, where many working people do not have enough time to prepare proper meals. In addition, their demand across the country is further pushed by longer shelf life and easy access to ready-to-eat food items. Ready-to-eat products include paneer preparations, chana masala, rajma masala, pav bhaji, etc. The rise in demand for ready-to-eat food products has created interest in entering this space among many companies, which is likely to contribute to market growth in the coming years. In addition, innovation in product offerings, sustainable packaging, the preference for single serving frozen items, aggressive marketing and promotional strategies will, during the forecast period, drive market growth.

Threats

Because of the lack of an efficient commodity distribution system, the Indian food processing industry is facing serious problems. In addition, the nation's elderly population has a negative view of the nutritional value of packaged RTE items. Such mindsets and increased health issues among Indians have a negative effect on consumer behaviour.

Some of the key players in this segment are listed out as follows:

- **Snacks (Extruded snacks, Chips, Namkeen):** PepsiCo, ITC Foods Ltd, Pratap Snacks, Balaji Wafers, DFM Foods, Bikanervala, Haldirams.
- **Frozen foods:** Apex Frozen Foods Ltd, Godrej Agrovet Ltd, ITC Ltd, Venky’s (India) Ltd, Capricorn Food Products India Ltd, HyFun Frozen Foods Pvt. Ltd, Innovative Foods Ltd, Mother Dairy Fruit and Vegetable Pvt. Ltd, Top Fresh International Pvt. Ltd, McCain Foods (India) Pvt. Ltd, Thermally processed Foods, ITC Foods Ltd, Gits Food Products Pvt. Ltd
- Instant foods/Ready to Cook: MTR Foods, Haldirams, Nestle.

Categories

Basically, convenience foods can be divided into two categories:

- Shelf stable convenience food
- Frozen convenience food

The different categories are mentioned in Image 1.1

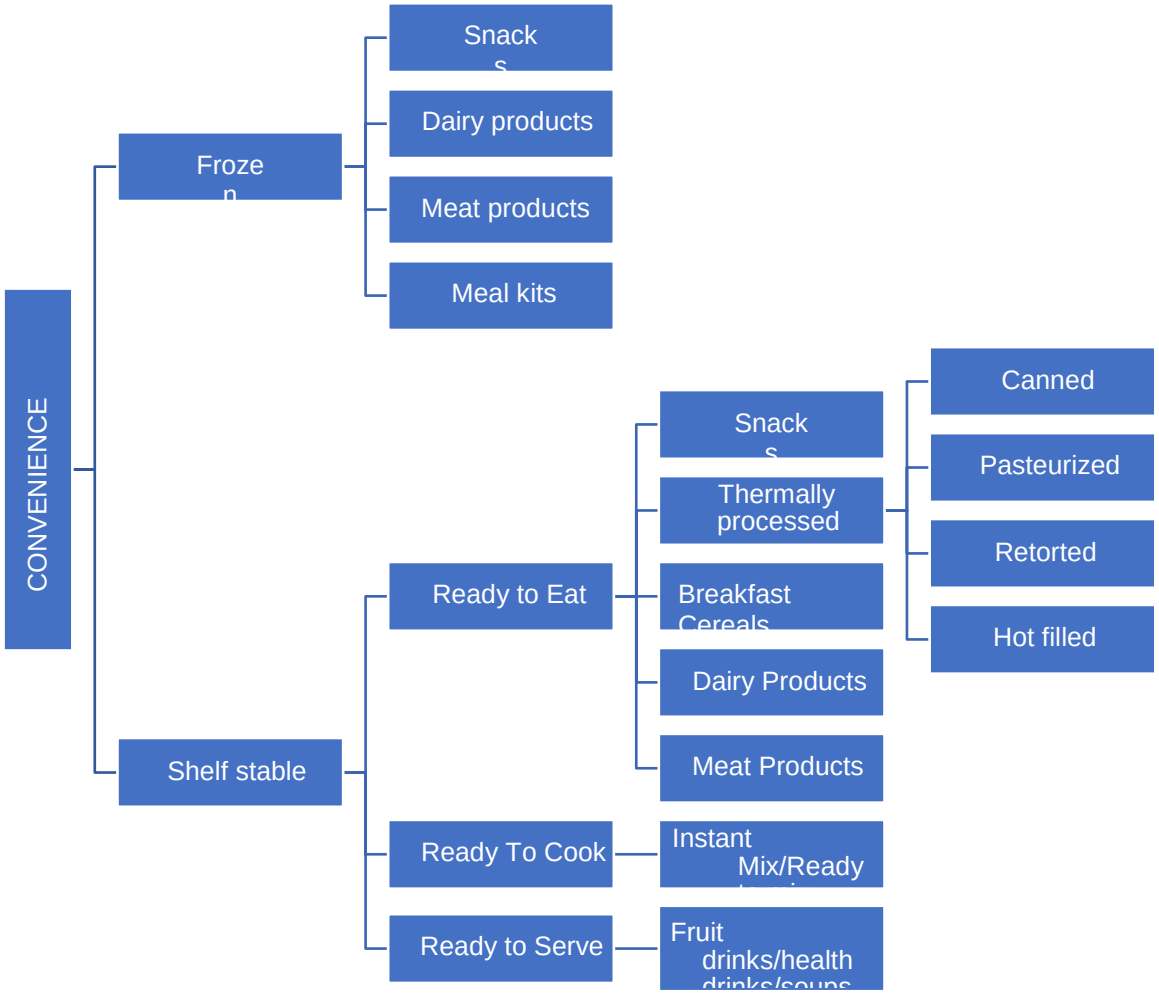

Fig 1.1 Categories of RTE

Market Penetration

The 2 segments of RTE are frozen ready-to-eat and shelf stable ready-to-eat food. Due to the high penetration rate and easy availability of a wide range of ready-to-eat goods in different packaging formats at various retail points, the former dominates the market and is expected to continue its dominance throughout the forecast era. In addition, frozen food items are sold by leading industry players, considering customer tastes and preferences. North India has emerged as a major revenue

generator in India's ready-to-eat food market among regions as the region evolves at a faster pace, resulting in lifestyle improvements. The rise in per capita disposable income due to a higher working population and the increase in the number of migrants is accompanied by the job opportunities available. Consequently, these factors result in the need for convenience food, which, in turn, increases the region's sales of ready-to-eat food items. Most demand in the northern region originates from the area of Delhi & NCR (National Capital Region). In the NCR sector, due to the presence of many offices and other commercial hubs, Gurgaon and Noida are the main demand generators. The working population is among the region's main buyers of ready-to-eat food items. Manufacturers are expanding their distribution network, building aggressive marketing strategies, increasing number of modern retail outlets and innovation in product offerings. Rapid development of fast food retail chain will surely fuel up the demand of RTE in future.

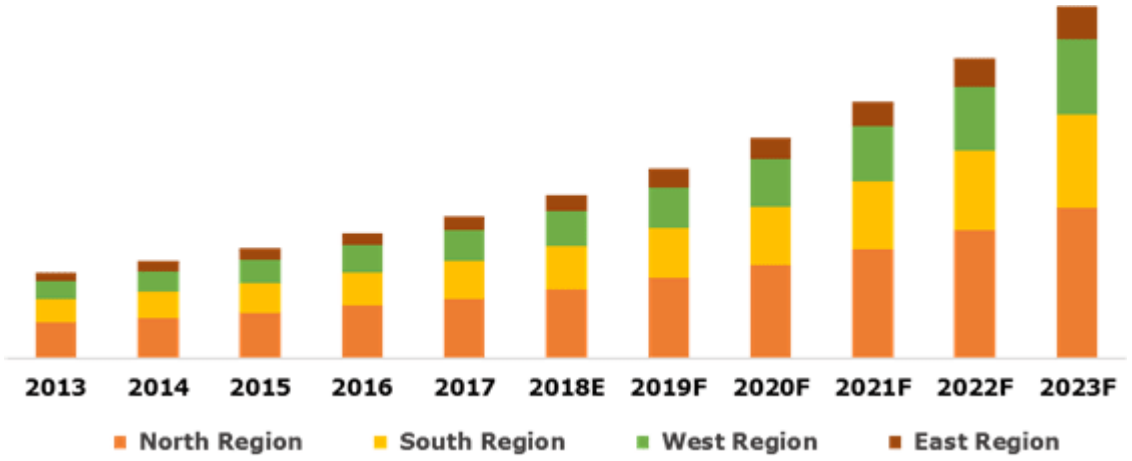

Fig 1.2 India Ready to Eat food market size, by region, by value -2013-2023F.

CHAPTER – 2

PROCESSING AND MACHINERY

Introduction

It is imperative that all food processing equipment be used for the safety of RTE foods. Mixers for dough, conveyors, rounders, dividers for dough, shelves, equipment for proofing, ovens, Pasteurizer, homogenizer, retort, bottling unit, pulper, filtering unit, rollers, slicers, sifters, it should be clean, in good repair and free of proof of evidence, screens, mixing vats, etc. Contact with rats or insects. Oven Time and Temperature Control, Retort, Heat Exchanger.

The cooling area should be strictly adhered to ensure food protection. Before the using any equipment, it should be cleaned. Both vapor producing equipment for cooking Ventilation and an antenna should be provided, such as retort, ovens, grills, and fryers. Automatic extinguishing device approved for preventing excessive condensation in Work. Microorganisms will continue to grow inside this if this is not done Facilities. Utensils such as spoons, beaters, cups, trays, spatulas, etc. should be supplied with After it is manufactured, be sanitized. For monitoring of food safety swabs of machine, working tables, utensils, food contact surfaces should be taken at regular intervals to ensure their microbial safety for food use. Antiseptic/disinfectant foot bath should be provided at the entrance of plant.

As there is a wide range of categories within RTE, the scope is also vast for describing the process and the machaniers used for the same. This chapter will cover the process and machinery used for the major 2 segments-Frozen Foods and Thermally processed Foods.

Retorting

The process of subjecting the product to heat to minimise the microbial load has been in action since the use of these treatments in cans by US military for supplying food for the forces. It has taken a different dimension in the late years because of urbanisation and the demand for ready to eat foods as grown rapidly. Though there has been changes in terms of the product range, packaging and different marketing tools, the fundamental concept of process has remained the same. Exposure of food in a hermitically sealed container to heat, to reduce the microbial population to achieve extended shelf life.

The major factors which must be considered during the design of retorted product is product formulation, process, safety and quality. Fig 2.1 shows a typical retort.

Fig 2.1 Retort

Process Parameters

In case of this thermal processing, processing mistakes or miscalculations may lead to potential food hazard, such as presence of some target microorganisms may lead to a biological hazard, which may even lead to death. It's a complex technology and the foremost importance is that of safety while sustaining the product characteristics. The aim is to provide a commercially sterile product by subjecting the product to high heat and pressurized conditions to destroy the target microorganism.

The target organism of greatest concern is that of *Clostridium botulinum*.It is an anaerobe, gas forming bacteria which produces a lethal exotoxin, which on consumption may even be lethal.
In addition, the process may even destroy/inactivate any other spoilage organisms potentially present in the food. Though the process is designed to inactivate /destroy these organisms, there are possibilities that certain bacterial may survive the process, so the product is safe but not necessarily sterile.

Commercial sterilisation is inactivation of certain organisms of significance to both spoilage and public health when stored under normal conditions. *Clostridium botulinum*.is the most heat resistant organism. The other organism of much concern of *Clostridium sporonges*.These organisms creates putrefactive spoilage.

One of the other types of spoilage caused by these organisms is that of flat sour spoilage or thermophilic anaerobe, which won't produce any gas such as has hydrogen sulphite. If the spores of any thermophilic bacteria survive the process, it won't create any problem under normal conditions. But if it kept under elevated temperatures for a longer period may create spoilage due to improper cooling or hot storage conditions.

The term **"F_0"** is defined as the number of equivalent minutes of s sterilization at 250°F (121°C) delivered to a load (product). For example, if a cycle has an F0 value of 12, the sterilization effectiveness of that cycle is equal to 12 minutes at 250°F (121°C) regardless of the process

temperature and time used in the cycle. The F_0 is the critical parameter which is used in the process design of a retorted product. A F_0 value of 3(12D) is required for achieving complete sterilisation considering the target organism as *Clostridium botulinum.*On a safer side we consider F_0 value of 6 which is double the initial value to ensure safety. The product will be exposed to a defined temp for a defined time to achieve the required F_0.

Factors affecting the rate of heat transfer and the exposure time are as follows:

- Type of process
- Equipment design
- Size and shape of the package
- Product characteristic such as solid content, viscosity, particulates
- Headspace

A relation between thermal lethality and heat transfer is that, higher the temperature, faster the kill rate and reducing the exposure time. The process of heat transfer will be a combination of conduction and convection. In evaluating heat treatments, there are two factors. There is the microbiological side in which we must know what the tolerance of the specific organism. The amount of heat required will be calculated by that. Applying this calculated amount of heat on the manufacturing side to see how much heat the product receives. Bridging the two together provides the thermal mechanism.

There are 2 calculative methods to determine the heating rate- formula method and numerical method. The formula methods use mathematical formula and the heat penetration data to determine the rate of heating and lethality. Knowing the heat transfer properties of the produce, temperature required can be calculated by numerical formula.

Once we know the lethality value, the thermal processing parameters should be measured using the actual process conditions to confirm the validation. The parameters of heat treatment directly impact the quality of the finished product. There is a huge potential to optimize the product through the process, the product and the packaging within the limits of appropriate time/temperature scenarios. assuring the temperature using thermocouples or validation of microbial spore counts. Since heat destroys several quality variables, from a quality point of view, reducing the time of exposure makes sense. The coldest point is that spot in the pouch/container which is the slowest heating point. It differs with the mode of heat transfer. For conduction heated products the coldest point is generally at the centre of the container pouch. Products heated generally by convection, the coldest point will

far near the bottom of the container many cases there will be mixed mode of heat transfer, in which we need to determine the coldest point by various trials using thermocouples.

Types of Retort

Retorts processes are steam based and there are 4 different types of retort processes that are used widely. The use of steam can be in the direct form (saturated steam) or in indirect form (water heated by steam). The different types of retorts are explained below.

Saturated Steam Retort Process-Direct steam Heating

This is the oldest steam retort type with simple design, operation and low capital investment. It's a good option for people who have limited capital budget and who will be dealing with canned products. Pros and cons are explained in Table 2.1

Table 2.1 Pros and Cons of Saturated steam retort.

Pros	Cons
Low Capital investment, particularly with carbon steel retorts	Venting uses a lot of steam and is not an economical step. Uses a lot of energy.
Easy to operate manually	Inflexible – typically limited to processing heavy sidewall containers, such as cans.
Can process most canned product	Cannot process most fragile containers, such as pouches, plastic bottles and plastic jar

Water Immersion Retort (Static & Rotary)

The Water Immersion Process is the most commonly accepted method of using the overpressure process to sterilize the product. The method of Water Immersion is like that of saturated steam process in that the product is completely separated from any cooling air and the product is completely immersed in water. In this air can be introduced into the retort during the process. Air is introduced on top of water to provide overpressure. In some cases, air is introduced to the steam which then heats the air. The heated air provides agitation to the flow of water and pressurizes the process load. Its flexible in operation and can handle most of the containers but not all fragile containers. Pros and cons are explained in Table 2.2.

Table 2.2 Pros and Cons of Water immersion retort.

Pros	Cons
Can utilize carbon steel vessels. But it's better to use Stainless Steel for all overpressure processes.	Higher Capital Investment – if a double (piggy-back style configuration) tank system is used.
Flexible – can process virtually all types of containers	Virtually impossible to operate manually, given the complexity of piping.
Excellent application for rotary processes due to buoyancy of the load in a full water immersion process.	Machines with rotary processes require significantly more maintenance time and money.
Can provide for a partial immersion process with a rotary configuration.	
Best application for rotary processes more than 10 RPM's.	
The storage tank allows for energy savings by capturing process water after sterilization – particularly in the energy savings mode	

Fig 2.2 Water immersion retort

Water Spray Retort (Static & Rotary)

Like water immersion, the Water Spray method is also an overpressure technique, except that the product is exposed to the effect of the air overpressure. It is like the method of Saturated Steam in that the driving force for hitting the centre of the load is steam and differs from the same as air can be introduced into the steam during the sterilisation process. Overpressure is provided by introducing air or steam into the retort to avoid any deformation of the container or pouch. The spray nozzles vaporize the steam and blend the steam with the air to counteract the insulating effects of the air. Some Water Spray retorts also comes in rotary form. The retort is flexible and cab handle most of the packaging types but not all the fragile containers. Pros and cons are explained in Table.

Table 2.3 Pros and cons of water spray retort.

Pros	Cons
Typically, a lower capital investment – compared to the other types of overpressure retorts	Is generally not a good option for rotary processes – particularly for those that exceed 10 RPM's
Flexible – can process virtually all types of containers	Machines with rotary processes require significantly more maintenance time and money.
Energy efficient – utilizes a heat exchanger and pump to recirculate both sterilizing water and cooling water.	Come Up times are typically longer for high RPM rotary processes.
Sterilizing / cooling water can be reused without chemical treatment for the next process.	Cooling times may be extended due to indirect cooling (via heat exchanger) and for tightly packed product where spray cooling is used.
When configured with a storage tank – The storage tank allows for energy savings by capturing process water after sterilization.	

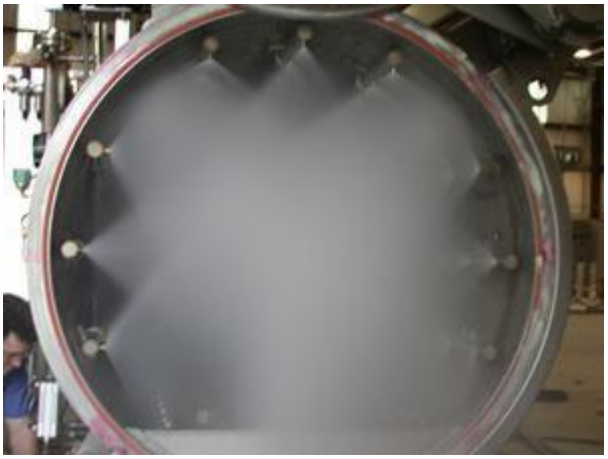

Fig 2.3 Water spray retort

Steam Air Retort (Static & Rotary)

Like water immersion, the Steam-Air process is an overpressure process, except that the product is exposed to the effect of air overpressure. A large fan is used as a driving force to balance the steam with the air to avoid cold spots in the system, because overpressure air enters the retort with steam, and steam is the only heating medium. To direct the heated steam-air mix to the middle of the retort load, the fan is used in combination with a baffling arrangement within the retort. It very flexible. Pros and cons are explained in Table.

Table 2.4 Pros and cons of steam air retort.

Pros	Cons
Typically, a moderate capital investment – compared to Water Immersion retorts	Is generally not a good option for high-RPM rotary processes – particularly for those that exceed 15 RPM's
Flexible – can process virtually all types of containers	Machines with rotary processes require significantly more maintenance time and money.
Energy efficient – utilizes a fan for forced convection.	The Fan is a moving part that adds to the complexity / maintenance of the retort that is unique to the Steam-Air process.
Other than the addition of the fan, the machine is a generally simple design and an easy process to administer.	

Fig 2.4 Steam air retort

Stages in retorting

- Water fill-This differs and is an optional step depending upon the type of retort. Water gets filled at the bottom of the retort, to be used for recirculation till the desired temperature is attained.
- Come up-This is the first step of the process, when the set target parameters come in action and directed to achieve the target cook temp within the set time. If the set parameters are not reached the come-up time will be more and will lag the process
- Cook time-This step involves the sterilising of the product at the designed time-temp combination with other set conditions. The product will be subjected to the conditions such as defined temperature-time for achieving the targeted F_0.
- Cool-Gradual cooling is provided post the cook step, to bring the product to the ambient temperature. The gradual cooling is provided though cooling water and by reducing the pressure. This ensures that the product is not subjected to a sudden shock which may disrupt the packaging and other physico-chemical characteristics of the product. Bring the product temp to the ambient temp will also ensure that there wot be any chance of thermophilic spoilage.
- Drain-Water is drained by the end of the process as to the set level in the process design

Heat Penetration

Heat penetration is used to determine the rate of heating & cooling of the product, to ensure safe a thermal process and asses the deviations occurred. By means of this various validation can be done regarding the process design including the F_0 values,temp,time,pressure,cooling time etc. Thermocouples are used to collect data of the rate of heat transfer and to identify the cold point of

the packaged product. Various trials are run to design a process. There are many factors that affect the rate of heat transfer and need to be considered while conducting HP studies. They are as follows:

- **Product**: Weight, formulation, preparation process, fill weight, solid to liquid ratio, consistency, physico-chemical parameters.
- **Packaging type**: material that the container or pouch is made of, orientation, thickness, headspace, size and dimension,
- **Method of fill:** Fill temp, Fill and net weight, Heat space
- **Sealing:** Proper sealing, De aeration, vacuum.
- **Retort:** Type of retort and operation method, come up time, tray racking systems

The data from the HP studies are obtained through thermocouples and designed software.
The different stages are shown in Fig 2.5 & Fig 2.6.

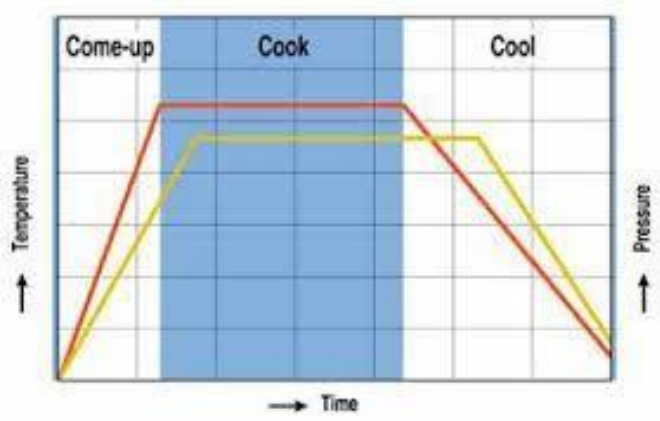

Fig 2.5 Different stages of retorting

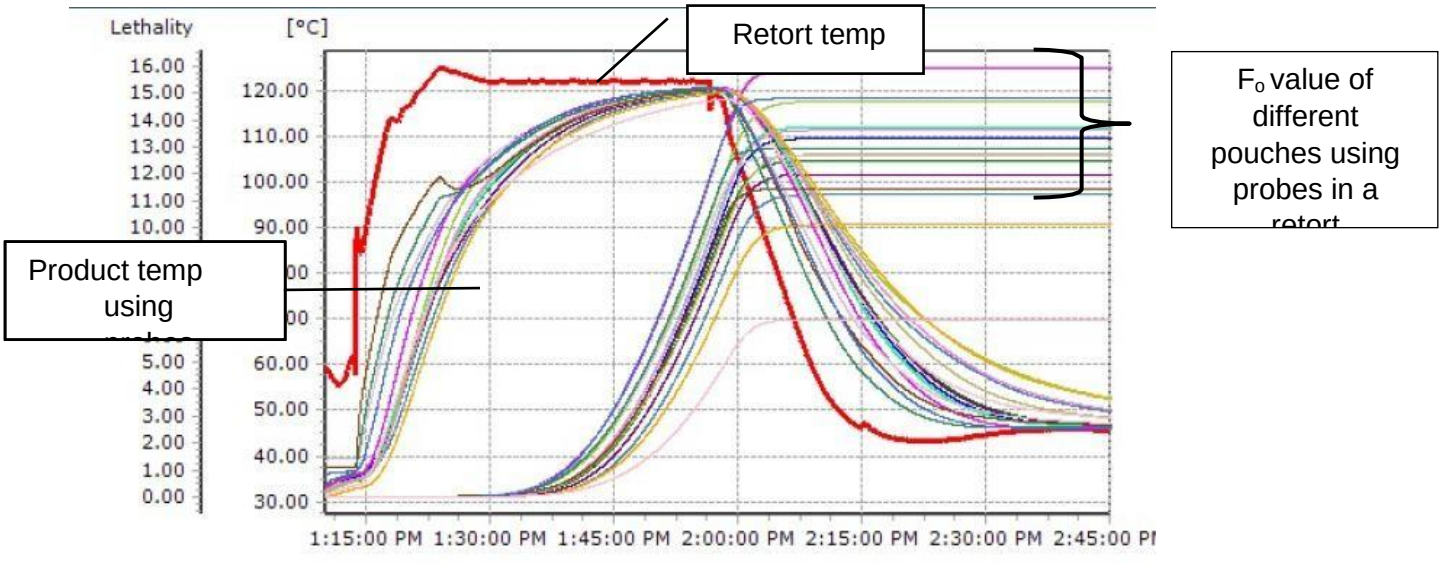

Fig 2.6 Actual cycle graph of a retorted product

Flow Chart of the retort process

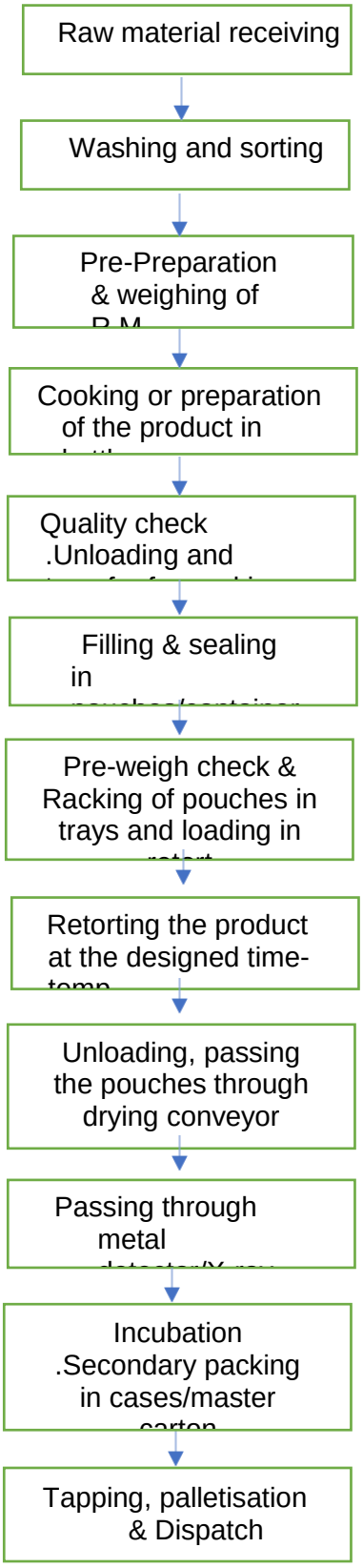

Fig 2.7 Flow chart of retort processed product

Market

Retort machines are widely used in food and beverage sterilization. Sterilization is a procedure that prevents microorganism contamination, such as bacteria, viruses, fungi, unicellular organisms. The retort system is used for food sterilization, which can be achieved by different methods, such as filtration, irradiation, chemicals and heating. In the food and beverage industry, the retort system is used for aseptic packaging to manufacture shelf-stable items that do not require refrigeration. Because of the sterilization process, the Retort system offers efficient shelf stability. The Retort machine has shortened the timing of cooking, resulting in energy savings and less loss of food.

The need to control both the temperature and the product itself in the retort system has been increased by developments in retort technology. Food products are packaged in metal cans or pouches through this process, and heated to high temperatures, sterilized and kept safe for consumption. It's widely used in processing facilities for vegetables, poultry, meat etc.

Scope

The advancements in the food processing and improvements in the sterilisation process have projected the demand for retorts .The rising awareness of food born illness and prevailing incidents of the same also have an impact on the drive. Main driving countries are the China and India along with Japan who has already established the sterilised food market. The demand for the same is expected to grow because of growing population and per capita income in countries like China, India, Australia and New Zealand.

JBT Company, Ventilex, Surdry S. L., Cosmed Group, Steriflow, Allpax Products, LLC, Systec Gmbh, Hisaka Works, Ltd, De Lama S.P.A., Henan Dafu Mechanical Import and Export Co.Ltd,KM Grand,Lagarde are among the players operating in the Retort Machine Industry. It is predicted that many local and unorganized players will contribute to the market for the Retort Machine.

CHAPTER – 3

PACKAGING

Introduction

Packaging refers to a protective wrapper or container to protect from contamination, improving shelf-life, communicating through consumer, storage and shipment ,which aids for general protection such as physical & mechanical damages. Basic functions are mentioned as follows:

- Containing
- Informing/Selling
- Protecting/Storing
- Transporting

Based on its areas of use, packaging is classified as follows:

a) **Primary packaging or sales packaging** - as it is known to the final customer, is the packaging that covers the product. This involves the packaging in direct contact with the product and the other components of the packaging (i.e. the lid, the label) necessary to complete the sales unit.

b) **Secondary packaging or group packaging** -packaging is used to bundle the sales units together in the sales setting for quick transportation. This method could be carried out by bundling the goods to be sold to the customer (i.e. shrink film wrap and corrugated cardboard box).

c) **Tertiary packaging or transport packaging-** is used to make it easier for a collection of sales units or secondary packaging to be transported/delivered to avoid physical harm during packaging/delivery (i.e. corrugated cardboard box).

d) **Unit load** - is a packaging category consisting of more than one distribution box for loading/unloading processes packed together (i.e., unit re-packaged with stretch film on the palette). In addition to its features, a package is also characterized by its specified point of arrival.

The packaged convenience food products sector has started to focus on the great potential of India's 250 million strong middle class. But demand has risen at a good pace due to increasing urbanisation ,evolving food preferences, and there is ample consumer potential waiting to be tapped through development efforts.

Advances in food technology and packaging technology have allowed the shelf-life of these items to be extended. Before determining which packaging, material is to be used, the packaging specifications of the product must be identified, i.e. what risks will cause product degradation and the conditions under which the packaged product will be exposed during its shelf-life. Some significant packaging factors are highlighted, which affect the selection criteria for the choice of packaging materials.

Characteristics of the product:

- The food type and its structure, moisture, fat, protein, taste, etc.
- Product form and shape-smooth, regular, irregular, with sharp edges etc.
- Crisp, brittle, sticky etc. Quality of the substance
- Factors affecting spoilage of food such as microbiological spoilage, Abiotic spoilage due to chemical reactions like hydrolysis, oxidation, and enzymatic reactions.
- Different environmental factors like Humidity,temperature,light etc.
- Different processing parameters such as processing temp,pressure,time etc.
- The desired shelf life of the product and storage parameters.
- Desired properties like barrier property, mechanical properties ,Antimicrobial property, Vapour barrier, Thermal properties, Aroma barrier, Optical properties, Gas barrier, environment friendly etc

Different convenience foods require different packaging requirements based on the above-mentioned factors. Like the packaging materials for snack chips are different from that of thermally processed or retorted products. Items such as idlis, dosas, pizzas are wrapped in packaging materials with low permeability of water vapor and oxygen, tolerance to odour and grease, and good physical power. Injection moulded plastic tubes, plastic film/bag pouches or paperboard boxes are the packaging materials commonly used.

In general, ready-to-eat foods are consumed within a limited period, but with the advent in packaging technology, these goods can now be commercially manufactured, and the shelf life can be extended for up to a few years.

General Packaging Composites

Commonly used packaging laminates and composites are mentioned in the Table 3.1

Table 3.1 General packaging composites

Material	Properties	Use
9mmfoil/adhesive/paper coated with heat sealing vinyl resin	Good moisture barrier runs well on machine	Over wraps confectioneries
9 mm foil / adhesive / paper /polyethylene (extruded)	Good moisture barrier runs well on machine	Fin-sealed pouches and sachets – soups, etc.
1 in. polyethylene /9 mm foil / adhesive / paper	Heat seals by the wax bleeding through the tissue	Over wraps for confectionery
9 mm foil / adhesive / paper / micro-wax comp. / tissue (20 g/m2)	Low WVTR	Over wraps for biscuits, etc.
Foil	Excellent WVTR, good machinability	Candy wrap, biscuit wrap
Cellophane/wad /cellophane	Excellent WVTR, sandwich printing, good machine performance	Bags or pouches for hygroscopic items
Cellophane/adhesive/ pliofilm	Excellent gas barrier, transparent pack	Nut packing with inert gas
Cellophane/polyethylene	Excellent gas barrier trapped printing	Chocolate, etc.
Polyester film / Saran coated polyethylene	High strength, positive sealing	Vacuum food Pouches
Polyester/adhesive/foil/ polyethylene	Excellent gas barrier, good heat resistance, good rigidity, aroma retention	Flexible processable cans

Retortable Packaging

Since 1978 retort packaging has been a solution for preserving the shelf stability of ready-made, microwaveable food products. Most of the major companies in the retort packaging market are expected to match their product range with changing food industry demands, with offerings such as pâtés, meats, salads and olives. Retort packaging is a heat-resistant package used for packaging food and beverages. Laminated inside with several layers of flexible plastic and metal foils, healthcare packaging can withstand high temperatures and pressures. The different layers consist of aluminium foil, nylon and polyethylene terephthalate (PET), consisting of materials such as polypropylene, aluminium and silica oxide that serve as a barrier to oxygen and water vapor.

The retort packs are used mainly to store food that is heat-treated. They are also used in food packaging as an alternative to cans because they provide packaged goods with a longer shelf life. To produce various types of packaging items with features such as spouts and fitments, zippers, pour spouts, slider closures, and release valves, Retort packaging undergoes a thorough conversion process including printing, lamination, coating, and extrusion.

Market

The demand for retort packaging was estimated at USD 41.65 billion in 2020 and a CAGR of 7.11 percent over the forecast period is projected to occur (2021-2026). A traditional means of preserving food has been the thermal sterilization of low-acid food products and is the basis of the evolution of retort packaging. The versatility and adaptability of the retort packaging technology has resulted in rapid market development.

- In packaging solutions, simplicity is a big differentiating factor. Recent advances in retort packaging have stressed the reduction of the total material weight, without losing the consistency of the packaging. The focus on weight reduction of the materials had been widely appreciated.
- To achieve a competitive advantage in the market, consumer goods companies are increasingly relying on packaging solutions. Consumers are demanding and quick to use goods that have extended shelf life, which in turn pushes businesses to find alternative packaging solutions.

Key Market Trends

For most nations, reducing the waste of food has become a major concern. According to the UN Food and Agriculture Organisation, almost one third of the food produced for human consumption is projected to be wasted globally, or about 1.3 billion tons annually. Many products such as meat,dairy,bakery and daily meal items are having a shelf life maximum of one month. This contributes for the wastage loss which leads for the financial losses. To resolve this emerging problem ,manufacturers are focussing upon shelf stable options of which retorted products holds an edge.

Because of various benefits, such as high shelf life comparable to metal containers, corrosion resistance, adjustable size, etc., pouches are one of the most commonly used packaging methods compared to the other available alternatives.

Compared to other types of packing, the processing of pouches is simpler. Fast heat transfer helps in the preparation and sterilization of the packaging. The thin pouch profile leads to a reduction of processing times of about 30-40 %.These factors have further led to the growth of retort packaging pouches.

To prevent contamination of goods, India has been keen on growing vegetables and other ready-to-eat food in pouches. This also requires certain foods to be available off the shelf. These pouches, which can be used for items such as smoked salmon, can also be vacuum packed. The size of consumption has decreased due to the growth of on-the-go food consumption, which has further provided a boost for pouches. Compared to rigid packaging, there has been a move towards flexible packaging that further allows the growth of pouches.

Retort pouches

The retort pouch/tray is a kit intended for the thermal preservation of low-acid particulate food items, although it is not forbidden by any physical or other regulation to be used for high-acid foods, liquids or refrigerated pasteurized foods. Many foods, such as tomato sauces, fruit drinks, chilled soups, entrees, and side dishes, are packaged in what are retort pouches or trays or some combination of the two using similar technologies.

The retort pouch is a flexible packaging structure that is hermetically heat-sealed to accommodate low-acid foods and to withstand thermal post-fill processing necessary to sterilize the contents in compliance with the regulatory specifications of the 12D low-acid canning process so that, when delivered at ambient temperature, the package contents will be free from any microbiological contamination. They are made from heat resistant plastics, unlike the normal flexible containers, making them ideal for retort processing at a temperature of about 121 ° C with good barrier properties. Fig 3.1 shows retort pouches.

Fig 3.1 Retort Pouches

The retort pouch normally consists of a polyester or nylon outer layer for printability and toughness/protection, a middle aluminium foil layer that acts as the main barrier to oxygen and water vapor, and a heat-sealant material such as polypropylene inner or food-contact layer. The other materials commonly used in the structure of the retort pouch include nylon coated silica, ethylene vinyl alcohol (EVOH) and polyvinylene chloride (PVDC). These products have high moisture barrier properties and are used effectively for packaging Indian foods that are ready-to-eat with high moisture. The common structures used are given in Table 3.2 and images are shown in Fig 3.2.

Table 3.2 Common structures of retort pouch

Product Type	Structure	Features
Microwaveable pouches	High Barrier Pet/Nylon/CPP Pet/AluFoil/PE Pet/AluFoil/CPP Pet/AluFoil/Nylon/CPP Most commonly used is 12 µ AlOx PET / 15 µ BON / 70 µ CPP	Other forms are pillow (three-side-seal) & Bottom gusseted stand-up formats provides shelf appeal Available with Heat-free-handles Spouted or tear-notch for easy dispensing and opening
Pillow pouches		Sealed on three sides Tear notch for easy opening
Spouted retort pouch		Reclose able spouts offer convenience on-the-go Can be attached to any combination of stand-up or pillow pouches in microwaveable or non-microwaveable variants Spouts can be placed anywhere on the pouch, top or side

The key players in the market are: Amcor, Berry Plastics, Coveris, Mondi, Sonoco, Astrapak, Bemis, Clondalkin, Flair Flexible Packaging, Floeter India, Fres-co System USA, Graham Packaging, Logos packaging, Nittopack, Otsuka.

(a) (b)

(c) (d)

Fig 3.2(a) Gusseted stand up pouch,(b) Spout Pouches (c) Aluminium/Transparent pillow pouches (d) Spout Pouches

Retortable Trays

In general, the retort tray (or cup, bowl, container, bottle) consists of a moulded base with a wide opening and a flat flexible structure hermetically sealed to the base by heat.Co-extrusions or laminations of water-vapor-barrier polypropylene plus oxygen-barrier ethylene vinyl alcohol have been the foundation materials in recent years. For dish-like trays and extrusion-blow-moulded barrier coextrusions for bottles and jars, the base materials are usually shallow thermoforms. Retort pouches and trays have higher ratios of surface to volume than cylindrical or rectangular metal cans or jars and thus transmit heat faster without overcooking the product to achieve the necessary pathogenic microbiological killing.

Retort pouches and trays and their relatives are lower-mass structures than containers of metal and glass. They take up a lower amount of space than cylinders and related types. Pouches, including those with easy open closures, are typically easier to open and access than metal cans and glass jars. Products in flexible pouches/trays are often easier to re heat than the contents of cans. Fig 3.3 shows retort able tray.

In recent years, the prices of container structures have fallen to far below those of metal cans and glass jars as more responsible converters have entered the market. The common structures used for the retort able trays are given in Table 3.2

Fig 3.3 Retortable Trays

Table 3.2 Common structures of retort pouch

Food Application	Type	Materials	Properties
Gravies/Rice/Vegetables & proteins	Tray	PP/EVOH/PP	1)Retort food package sterilizable at high pressure (over 120 ℃) 2)Reheat able in a microwave oven 3)Long ambient shelf stability with oxygen barrier and excellent hygienic function 4)Easy peel lid)
	Lid	PET/EVOH/OPA/CPP OPA/PP	
	Bowl	PS/EVOH/PS	

Equipment

Since the early years of nearly manual speeds, machinery to produce pouches and trays, fill and seal them, and subsequently sterilize and cool them has been greatly improved. Retort pouch and tray production speeds and efficiencies have not nearly approached those of metal cans or glass jars because of sealing limitations. Speeds of less than 100/min/line are not rare, although higher outputs can be achieved by ganged lines.

The major manufacturers who provide the same are Toyo Jidoki from Japan (www.alliedflex.com), Robert's from the U.S., and Bossar (www.bossar.com) and Laudenberg from Europe. Equipment that produces pouches from roll stock has become commercially viable in recent years.

The secret to pouch-filling equipment is that the food product flows through the pouch's top opening and does not contaminate the seal area, which can interfere with heat-sealing. During the heating and cooling cycles, air removal minimizes the risk of pressure from inside.

Trays, cups, or bowls are covered with aluminium foil, metallized plastic, or all-plastic barrier laminations, now typically peel able, and precisely heat sealed. The widely used tray manufacturing equipment is from Switzerland's Hans Rychiger AG .

Pros and Cons

Pros

a) They are lightweight, quick to open, use, transport and re-close.
b) For ease of use, you can have ergonomic shapes.
c) It can be modified to include features such as tear-notches, spouts, etc. in different formats such as microwaveable, non-microwaveable etc
d) Provide solutions for reclosing and dispensing
e) Require less storage space
f) Provides extended shelf life without using preservatives and without cold chain
g) Enhance shelf appeal, which provides more visibility of the branding a graphics.
h) Up to 97% reduction in the amount of raw material needed for the same product volume compared to other packaging formats such as metal, glass, rigid plastic
i) Improved quality of packaging by reducing the ratio of product to box by up to 35:1 vs. rigid containers

Cons

a) Pouches are more sensitive to mechanical damages, snagging which leads to microbial spoilage of the product.

b) In general, the convectional retort pouches are not recyclable , but recently some companies are in the phase of developing recyclable pouches.

Frozen Food Packaging

Packaging for frozen foods is unique since altered deterioration mechanisms and rates must be avoided. Some degradative reactions are reduced in the frozen setting, but others increase or are unique to frozen products. It is important to be compliant with low-temperature environments and to promote rapid cooling and space efficiency with packaging that protects items in freezers. Examples of packaging coated with moisture barriers are paperboard-based folding cartons for frozen pizzas. Coatings on this type of packaging are minimal and designed to ensure that the paperboard can still be recycled or composted industrially as required.

Depending upon the food ,the way its handled in the storage condition and end use, packing will be designed to meet the safety and quality of the product.

Market

The demand for frozen food packaging was estimated at USD 41.53 million in 2020 and is projected to hit USD 56.2 million by 2026, with a CAGR of 5.18% over the forecast period (2021 - 2026).Recently, according to customer convenience, frozen food packaging offers features such as lightweight, unbreakable, and resealable packings, lower usage of fossil fuel, and also capable of emissions of greenhouse gases, water use to create an atmosphere that is eco-friendly.

Wide department outlets, supermarkets, and hypermarkets are favoured by major buyers of frozen food products. Organized department stores, which have a massive presence in the global market, are an integral part of major retail chains. The growth in the organized retail chain translates directly into the frozen food industry's demand for food packaging solutions.

- Walmart is scheduled to host more than 11,000 shops, including Amazon Go, worldwide. By 2021, it is estimated that Amazon will open more than 3,000 cashier-less stores. The frozen demand for food packaging is therefore expected to flourish.

- To minimize the amount of waste they produce, customers are also moving to frozen food, as a report in the British Food Journal found that families decreased their food waste by more than 47 percent by switching to frozen food.
- The fastest gains in major frozen food applications are packaging for frozen specialties such as beef, poultry, and seafood. In North America and Asia-Pacific, several major food packaging companies are investing tremendously in innovative and decorative packaging.

Key Trends

Bags Packaging Form to account for a substantial market share

- The demand for frozen food bags is rising due to numerous factors, such as changing lifestyles, increasing disposable incomes, and rapid urbanization in developing countries, especially the growing population of middle-income countries. The increasing adoption of freezer bags has increased the growth of the frozen food packaging market in the United States.
- Plastic bags of various types & sizes are available. It provides a range of advantages, such as the ability to withstand temperatures and technological advantages that further drive the market for frozen food packaging bags.
- A major example of bag packaging is the Ziploc bag. This kind of bag is available in different sizes and can be used for meat and dairy food storage. For example, in freezer bags, dairy products can be frozen, as these are suitable for short-term use and space saving. Another important trend is the customization of the product according to customer requirements.

Packaging

Cardboard, metal cans, paperboard, wax coated paper and other flexible packaging supplies are often, but not limited to, the most popular options for frozen food packaging. Polyethylene (PE) shrink film is one of the most popular forms of frozen food packaging that can withstand temperatures all the way down to -40 degrees. Frozen food products have unique characteristics and features which impacts the choice of packaging materials. Besides the potential sharp edges of a frozen object, it is important for the packaging to be able to withstand the pressures of Sealing, freezing, storing, transportation, defrosting and storage and in certain cases cooking. The product expands during freezing ,depending upon the water content, like water can expand up to 9% when converted to ice.Similaly it should be not be light senstitive,with minimum WVTR (water vapour transmission rate)& OTR(Oxygen transfer rate). And when it comes to thawing, it should be liquid

tight for packaging materials to avoid leakages. Therefore, when packaging these types of products, the choice of the packaging material and the thickness of the packaging film are essential attributes.

While there are single layer films available, packaging is available. Films are normally focused on several layers of various polymers. By combining specific film can be achieved with various laminates features based on what is needed in terms of the properties of barriers, sealability, printability etc. For the products which recommend boil in the bag process, usually laminates of polyester either PP/PE are used. PET (polyethylene terephthalate) has a heat sealable layer of PE which can withstand high temperatures. Some of the features of the frozen food packaging are as follows:

- Protection against spoilage and colouration
- Easy in filling
- Sealable
- Easy to store
- Resistance to moisture,oil,grease etc
- Produced with food-grade substrates from the FDA
- Should not crack once the product is frozen

Types of Packaging Materials

Dual ovenability, that is, products that can be heated in a microwave oven or a traditional oven, is the latest trend in frozen food. Shelf-stable retort able foods for microwave heating are best suited. Other products such as paperboard, thermoset plastics and thermoplastics are replacing aluminium trays that accounted for 85% the demand in the eighties.

Paperboard is viewed by customers as a commodity of poor quality. Also, under high temperature conditions, it softens in the presence of moisture. There are some drawbacks of thermoset plastics as well. It is costly and high, which raises shipping expenses. It is brittle, quick to stain and slow to process. Processors are therefore searching for other materials, such as thermoplastics. Three vital properties to be taken into consideration when choosing 158 thermoplastics for dual-oven are dimensional stability up to 200 °-250 ° C, strong impact strength at freezer temperatures to minimize damage to shipping and storage, and microwaveability.Also the material should be odour free and and the food product should not stick to the surface, especially for baked food. Different types of packaging materials are as follows:

a) Shrink Film

One of the most popular types of frozen food packaging is shrink film (also known as shrink wrap). It is used throughout the world on millions of packaging lines, including those of the world's largest food packaging companies. Shrink film is a plastic film commonly made of polyethylene, polyolefin, or poly-vinyl-chloride, which is one of three main formulations. Fig 3.4 shows shrink film.

Polyolefin is the best option for shrink film and is FDA approved for food-safe use and can be made kosher as well. For sealing boxed frozen foods such as pies, pizzas, cakes, baked goods, vegetables, fruit, and almost every other type of frozen food, the polyolefin shrink film is perfect. The box wrapped with shrink film and passed though heating tunnel, this prevents the formation of vapour, moisture and prevents freezer burn.

Fig 3.4 Shrink film

b) Cardboard/Chipboard

In the packaging of frozen foods, chipboard is pervasive. For packaging pies, veggies, pizza, cakes, and various other types of frozen food products, boxes made from chipboard are often used. Robust, durable, and easy to shrink wrap chipboard boxes (as shown in Fig 3.5). They also make it easy to unify pallets for shipment across the country. Commonly used in tandem with shrink film, chipboard boxes are also popular because they can be printed, edge-to-edge, with vibrant and colourful branding imagery, text, and graphics.

Fig 3.5 Cardboard/Chipboard

c) Ovenable Board

Earlier technologies were based on Polymethylpentene (PMP) coated paperboard. This was costly and has been replaced by solid bleached sulphate sheet with extrusion coated polyethylene terephthalate(PET).This material is resistant to exposure and temperatures of 200-250 °C in hot-air ovens. It is also used to re-heat food containers in microwave ovens.

Two methods are used for rendering coated board into containers. One process creates containers by shaping presses to supply trays or dishes like conventionally pressed foil trays. An alternative device is based on current cardboard technology and erects flat trays from cartons. Ovenable boards are gaining popularity as reheating is done through ovens.

Ovenable board containers must meet several criteria for efficiency. First and foremost, the material must be microwave-radiation-permeable. The metal surface reflects microwave radiation so that the aluminium foil dishes are not enough for the use of microwave ovens Ovenable board containers must meet several criteria for efficiency. First and foremost, the material must be microwave-radiation-permeable. Must be heat resistant for a temp range of 200-250^{o}C with no thermal oxidation, browning or odour production can take place. The food-contact material must be chemically inert and approved for food contact. It should also be resistant to grease.

The coating should be heat-sealable, and it should be easy to transform the material. The oven board must have good deep-freeze efficiency because the filled containers are usually stored under deep-freeze conditions. Strong printability is a prerequisite as well. PET-coated board processing is carried out by extrusion coating. To give good adhesion to the coating, pre-treatment of the board is required. Fig 3.6 shows ovenable board.

Fig 3.6 Ovenable Boards

d) Glass

Containers made with specific food graded glass are used in Asian countries for the some of the food items.

e) Flexible Pouches

Fig 3.7 Flexible Pouches

Most of the products such as snacks has this packaging. The product will be having a shell life of more than 12 months, so the packaging material should be durable and must have low temperature stability as frosting happens on a longer run. Some of the commonly used structures are mentioned in Table 3.4.Eg for flexible pouch is shown in Fig 3.7.

Table 3.4 Common structures of flexible pouch

Packaging Type	Structure	Features
Flexible pouches/ bags	Transparent or Matte PET/Adhesive layer/Transparent or White PE	Resistance to puncture, high elasticity & durability at temp below $0^{o}C$ **PET**: have good barrier properties resistant to water condensation and have high transparency **PE** : Structural and sealing layer Durability against frost & water vapour,puncture.Good elasticity. Good oxygen barrier property. **PP:**have good barrier properties resistant to water condensation and good transparency.
	Transparent or Matte PP/Adhesive layer/Transparent or White PE	
	Transparent or White PE/Adhesive layer/Transparent or White PE	

f) Lidding Films

Lidding film is a food grade plastic film used to produce lids for various kinds of containers. Its used in form-fill seal process or in thermoformed trays which are used in modified atmospheric packaging/vacuum packaging High-quality, full-colour branding and graphic design elements can be printed with lidding films that serve to draw the consumer's attention in the frozen food aisle. For maximum visibility of the substance found inside, they are also left transparent as well. The mostly used are shrink lidding layer (for form ,fill and seal)and Vacuum skin packaging(VSP) which have high barrier properties, usually used for meat ,fish and poultry. These films have good clarity and anti-fog properties. Fig 3.8 shows different lidding films. These are shown in Fig 3.8.

(a) (b)

Fig 3.8 (a)Shrink lidding film (b) vacuum skin packaging films(VSP)

g) High barrier thermoforming film

It has impressive thermoformability that makes it the ideal solution for different applications. It is made of plastic resins and is made specifically for specialty films of these kinds. Thick corners and better film memory are provided by this form of film. Fig 3.9 shows thermoforming films used for sausages.

Strong barrier thermoforming films have excellent strength and increased resistance to puncture.

Fig 3.9 Thermoforming film

h) IQF polyethylene

IQF stands for "individual quick freezing," is a process in which freezing of food happens extremely fast, so there is little to no damage to the cell structure of the frozen food. IQF polyethylene wrapped food is passed through blast freezer around $40^{o}F/(-18^{o}C)$. The finished food items are then sent to the cold stores.IQF poly bags/laminates are widely used for products such as vegetables, seafood ,poultry and meat. These are made from PE /or mix of other layers. Available in all forms like guesetted,stand up, pillow etc. Fig 3.10 shows IQF polyethylene bags.

Fig 3.10 IQF polyethylene

i) Skin film

Skin film is a specialty film designed to wrap products evenly and seal the product on a printed skin board or plate of corrugated cardboard. For packaging seafood especially salmon, trout, and other different kinds of frozen seafood, skin film is widely used. Fig 3.11 skin film used for fish.

Fig 3.11 Skin film

j) Ovenable Plastic Based Food Trays

These trays are produced using polypropylene (PP), high impact polystyrene (HIPS) and crystalline polyethylene terephthalate (CPET) thermoforming sheets, each of which provides unique performance and economic advantages. The trays are either vacuum-formed or thermoformed from a sheet reel. PP is co-extruded with barrier resins such as EVOH to enhance barrier properties for shaping when extended shelf-life is necessary.

PP trays do not handle the temperatures of traditional ovens and are mainly used for microwave ovens. Foamed polystyrene trays with special low-density polystyrene blends can withstand much higher temperatures, but are typically only used for microwaves ,while CPET trays can be used for both. Fig 3.12 shows different ovenable trays. Their other benefits include simplicity of

design, oil and grease tolerance and no appreciable effect on the taste of food. CPET trays are stable from 40 °C -200 °C .All food trays will be be heat sealable lidding films.

Fig 3.12 Ovenable plastic trays

CHAPTER – 4

FOOD SAFETY REGULATIONS AND STANDARDS

Introduction

FSSAI has defined the requirements for registration ,licensing ,sanitary and hygienic requirements need to establish a business.

Kindly go through following of FSSAI Regulation, 2011, which covers the following:

I. **Food safety and standards (Licensing and registration of food business) regulations,2011**

- Chapter 2-Licensing and registration of Food business.
    - Schedule 1- List of food business falling under the purview of Central Licensing Authority
    - Schedule 2- List of food business falling under the purview of Central Licensing Authority
        - Form A- Application for Registration / Renewal of Registration under Food Safety and Standards Act, 2006
        - Form B- Application for License / Renewal of license under Food Safety and Standards Act, 2006
        - Form C- License Format
        - Form D-1- Annual Return
          (For business other than Milk and Milk products)
        - Form E- Form of Guarantee
    - Schedule 3- Fee for Grant/ Renewal of License Registration / License Fee Per Annum in Rupees
    - Schedule 4- General Hygienic and Sanitary practices to be followed by Food Business operators
        - PART-I- General Hygienic and Sanitary practices to be followed by Petty Food Business Operators applying for Registration
        - PART-II- General Requirements on Hygienic and Sanitary Practices to be followed by all Food Business Operators applying for License
            - Establishment -Design & Facilities
            - Control of operation

- Establishment-Maintenance and sanitation
- Establishment-Personal Hygiene
- Establishment-Product information and consumer awareness
- Establishment-Training and Management
- Establishment-Audit ,documentation and record keeping.

- PART V-Good hygienic and manufacturing practices to be followed by licensed food business operators engaged in catering or food service operations.

II. Food safety and standards(Food products standards and food additives)regulations,2011

- Chapter 3
  - Appendix B:Microbiological requirements: Table 4A

Food Categories

From the major food categories, thermally processed and frozen foods can be part of most of the food items such as Dairy, Fruits and Vegetables, Meat and meat products, Fish and fish products, Egg and egg products, beverages etc. This is a vast sector until there is a specific category to be explored after. In this Chapter, categories of thermally processed food (Retorted vegetables) and frozen vegetables will be covered. Below Fig 4.1 shows the category used for Cooked or fried vegetables.

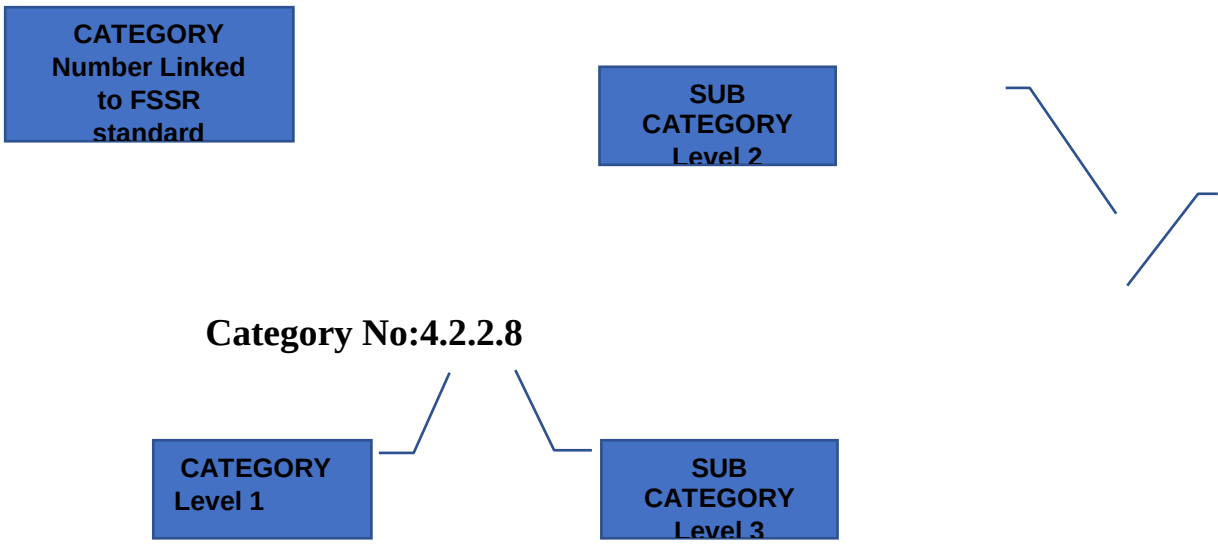

Fig 4.1 Category for Cooked or fried vegetables

04.2.2.8 **Cooked or fried vegetables (including mushrooms and fungi, roots and tubers, fresh pulses and legumes, and aloe vera), and seaweeds:**	Vegetables that are steamed, boiled, baked, cooked or fried, with or without a coating, with or without curry, for presentation to the consumer. Examples include: simmered beans, pre-fried potatoes, fried okra, and vegetables boiled down in soy sauce (tsukudani), ready to eat curries like paneermakhani, kadhaipaneer, palakpaneer, baigankabharta, alootamatar, mixed vegetable, dal makhani, Frozen Curried vegetables /Ready to eat vegetables; vegetable gravies, etc.

Category Definitions

a. Thermally Processed Curried Vegetables / Ready to Eat Vegetables

It means the product prepared from fresh, dehydrated or frozen or previously processed vegetables, legumes, cereals or pulses, whether whole or cut into pieces. The vegetable(s), either singly or in combination, may be prepared in any suitable style applicable for the

respective vegetable in normal culinary preparation. It may contain salt, nutritive sweeteners, spices and condiments, edible vegetable oils and fats, milk fat and any other ingredients suitable to the product and processed by heat, in an appropriate manner, before or after being- in a container, to prevent spoilage.

2. The product may contain food additives permitted in these regulations mentioned in Table The product shall conform to the microbiological requirements given in **Appendix B of Chapter 3,FSS.**

3. The container shall be well filled with the product and shall occupy not less than 90.0 percent of the water capacity of the container, when packed in the rigid containers. The water capacity of the container is the volume of distilled water at 20ºC which the sealed container is capable of holding when filled.

b. Frozen Curried Vegetables/Ready-to-Eat Vegetables

means the product prepared from Fresh, Dehydrated or Frozen or previously processed vegetables, legumes, cereals or pulses, whether whole or cut into pieces. Vegetable(s) either singly or in combination may be prepared in any suitable style applicable for the respective vegetables in normal

culinary preparation. It may contain salt, nutritive sweeteners, spices and condiments, edible

vegetable oils and facts and milk fat and any other ingredients suitable to the product and subjected to freezing process in appropriate equipment. Freezing operation shall not be regarded as complete unless and until the product temperature has reached (minus) - 18°C at the thermal center after thermal sterilization.

Packaging & Labelling requirements

Go through the following mentioned chapters of **FOOD SAFETY AND STANDARDS (PACKAGING AND LABELLING) REGULATIONS,2011**

- Chapter 2-Packaging and Labelling
  - 2.1.2 Product specific requirements- Packaging requirements for Fruits and Vegetables Products
  - 2.2 Labelling
  - 2.3 Manner of Declaration
  - 2.6: Exemptions from labelling requirements-

Documentation and Record Keeping

Every organization must maintain records of raw material procurement, production processes, and sales. This is to ensure that the business runs effectively and is profitable. Listed below are some reasons why there is a need for documentation:

1. It gives detailed knowledge about running the business.
2. It helps to control product quality.
3. It helps to keep track of the money invested in the business.
4. It helps to identify the separate costs of raw material or product ingredients.
5. It helps to identify the production cost of a process.
6. It helps to make sure that all the quality assurance practices were followed during the production.
7. It helps to make sure that the production equipment is running smoothly/effectively.
8. It works as an evidence for legal procedures.
9. It helps to set an appropriate product price.
10. It helps to take corrective measures at the right time.

How to Keep Records?

Every food processing organization follows a more or less similar way of keeping records. Production records keep a log of the following:

The quantity and type of raw materials received

- The quantity and type of ingredients used during processing
- The processing conditions in which production took place (e.g. the temperature set, or the air pressure applied)
- The product quality produced

Product quality can be maintained only when:

- The same quantity and quality of ingredients and raw materials are mixed in every batch
- A standard formulation is used for every batch
- Standard process parameters are applied for every batch

Every batch of food is given a batch number. This number is recorded in:

- Stock control books (where raw material procurement is noted)
- Processing logbooks (where production process is noted)
- Product sales records (where sales and distribution are noted)

The batch number must correlate with the product code number, which is printed on labels. This helps the processor to trace any fault found in a batch back to the raw material used or the production process.

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APPENDIX

A. List of Tables

B. List of Figures