PACKAGING OF READY-TO-EAT/READY-TO-COOK FOOD

Convenience food is a concept that is prevalent in the developed world since long, while its inception into the Indian market has been recent. With the changing socio-economic pattern of life and the increasing number of working couples, the concept is fast becoming popular in Indian market. This type of food is becoming popular because it saves time and labour. This food has extended shelf-life and is available off the market shelves.

Extruded Ready-to-Cook Products Packed in Plastic Pouches

Ready-to-Cook/Ready-to-Eat Food in Plastic Pouches

Packaged/convenience food products sector has been slow in penetrating the large potential presented by Indian 250 million strong middle class. But due to growing urbanisation and changing food habits, the demand has been rising at a good pace and there is enough latent market potential waiting to be exploited through developmental efforts.

The convenience food could be basically classified into two categories:

- Shelf – stable convenience food
- Frozen convenience food

Shelf-stable convenience food are further classified as:

- Ready-to-Eat (RTE) and Ready-To-Serve (RTS) food - e.g. Idlis, dosas, pav bhaji, meat products like pre-cooked sausages, ham, chicken products, curries, chapattis, rice, vegetables like aloo chole, navratan kurma, channa masala etc.
- Ready-to-Cook food – e.g. instant mixes like cake mixes, gulab-jamun mix, falooda mix, ice-cream mix, jelly mix, pudding mix etc., pasta products like noodles, macaroni, vermicelli etc.

Packaging Requirements of Ready-to-Eat (RTE) and Ready-to-Serve (RTS) Food

A "ready-to-eat" food product may be defined as any food product which does not require any elaborate processing procedures on the part of consumer before it is good enough for

consumption. It is ready-to-eat as soon as the pack is opened in a form, which is tasty and appetizing.

The advancements in food technology and packaging technology have made it possible to extend the shelf-life of these products. Before deciding which packaging material is to be used, it is necessary to know the packaging requirements of the product i.e. what hazards will cause product deterioration and the conditions to which the packaged product will be subjected throughout its shelf-life. Some important packaging considerations, which influence the selection criteria for choosing packaging materials, are highlighted.

- Product Characteristics
  - The type of food and its composition, moisture, fat, protein, flavour etc.
  - Form and shape of the product – smooth, regular, irregular, with sharp edges etc.
  - Nature of the product – crisp, brittle, sticky etc.
- Factors Affecting Packaging

  Factors responsible for the spoilage of the food products:
  - Biological spoilage due to micro-organisms
  - Abiotic spoilage due to chemical reactions like oxidation, hydrolysis and enzymatic reactions.
- The environmental factors like light, humidity and temperature.
- The food processing parameters eg. processing temperature and duration.
- The shelf-life desired for a given ready-to-eat food, influences the type of packaging and processing parameters to be used.

Ready-to-eat snacks like idlis, dosas, pav bhaji etc. are sold across the counter and have a very short shelf-life, hence the packaging requirements of these products are different from those of ready to eat products like curry rice, upma, vegetable biryani etc., which are retort processed for longer shelf-life.

Products like idlis, dosas, pizzas are packed in packaging materials having low water vapour and oxygen permeability, odour and grease resistance, and good physical strength. The packaging materials generally used are injection moulded plastic containers, plastic film/bag pouches or paperboard cartons.

In normal practice, the ready-to-eat food are consumed in a short span of time, but with the advancement in packaging technology, it is now possible to produce these items commercially and to extend the shelf-life up to a few years.

Ready-to-Eat Products Packed in Retort Packs

TABLE 1

Use of Various Packaging Laminates/Composites

Material	Properties	Use
9 mm foil / 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/m^2)	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

Indian food like palak paneer, dal fry, curry rice, upma, vegetables biryani etc. are retort processed hence their packaging requirements are different. These products are retort processed because they are low acid food with moderate to large size particles; hence it is easy to remove oxygen from the head-space by gas flushing. The selection of a polymer or its combination is based on the requirement of barrier properties.

Retort pouch is a special package in which the perishable food items are preserved by physical, and/or chemical means. **It is a flexible laminate, which can withstand thermal processing, and combines the advantages of the metal can and the boil-in-bag.**

Ready-to-use retort pouches are flexible packages made from multilayer plastic films with or without aluminium foil as one of the layers. Unlike the usual flexible packages, they are made of heat resistant plastics, thus making them suitable for processing in retort at a temperature of around 121°C. These retort pouches posses toughness and puncture resistance normally required for any flexible packaging. It can also withstand the rigours of handling and distribution. The material is heat sealable and has good barrier properties.

In India, 3-ply laminate consisting of PET/Al Foil/PP is commonly used for packaging of ready to eat retort packed food. The product packed in such laminates has a shelf-life of one year. The other materials generally used in retort pouch structure includes nylon, silica coated nylon, ethylene vinyl alcohol (EVOH) and polyvinyledene chloride (PVDC). These materials have high moisture barrier properties and are used successfully for packaging of ready-to-eat high moisture Indian food. Table 1 gives typical materials used for packaging of various food.

Both preformed pouches as well as pouches formed on FFS machines are used. Preformed pouches are of flat and stand - up type. The typical structure of these pouches are:

Flat configuration	:	12µ PET/12µ Al foil/ 75µ PP
Stand up configuration	:	12µ PET/9µ Al foil/ 15µ OPA/60µ PP

The pouches are printed in attractive colours. The retort pouch is a space saving package by value of its design. It is a good substitute for tinplate cans as it eliminates the need for the addition of brine in the food.

In conclusion, the market for retort pouches is certainly one that will continue to experience growth over the next few years, as the retort pouch gets acceptable as equal to or even superior to glass or metal containers. The pouch has the same shelf-life as the can or the

Ready-to-Cook Products Packed in Flexible Plastic Pouches

jar. The retort pouch needs to address ease of opening and re-closing (compared to glass jars). In addition, the packaging economics of the pack for mass volume products will depend upon the ability to increase filling speeds and to move from batch to continuous retort processing.

Also, the retort pouch can save about 60% energy while processing. Furthermore, as the product is already sterile, it does not require additional low temperature storage.

Packaging Requirements of Ready-to-Cook (RTC) Food

Based on their initial moisture content, RTC food can be broadly classified as:

Low Moisture Food

- Moisture 1 to 5%
- Equilibrium Relative Humidity (ERH) 18-20%

These food have very low moisture and ERH. Hence they have the tendency to absorb moisture from the surroundings and turn soggy, thereby, loosing their crisp, brittle nature and taste. The most important factor to be considered, is moisture vapour transmission rate (MVTR) of the packaging materials used. MVTR values of less than 1 gm / m^2 / 24 hours are required.

Vermiclli in Plastic Pouches

Medium Moisture Food

- Moisture 6 to 20%
- ERH up to 65%
- Typical examples: Indian savory snacks, sweetmeats

Barrier property (MVTR) requirement for these food is less stringent, however, for longer shelf-life, microbiological spoilage has to be given due importance. Use of preservatives is often required.

High Moisture Food

- Moisture 20 to 60%
- ERH up to 85%
- Typical examples: Freshly baked products – bread, cake, chapatti, pickles, chutneys, sauces etc.

Plastic Pouches for Ready-to-Cook Food

For freshly baked products such as bread, cake, ERH is often higher than the ambient ERH. Therefore the products tend to breathe out the moisture and if excess water vapour is not allowed to escape from the closed package, condensation on the outer surface of the product occurs, spoiling the product quality and leading to mould / yeast growth. Plastic films such as low density polyethylene (LDPE), which are permeable to water vapour are normally used for packaging these products for shorter shelf-life.

For longer shelf-life, microbial spoilage is the main consideration. The products are sterilized and packed in hermetically sealed containers such as cans, retort pouches or aseptic packs.

Medium and high moisture food are very susceptible to the microbial spoilage and need adequate processing and preservation methods, prior to their packaging.

Oxygen /Air Permeability

RTC food normally contain fat as well as other ingredients that can be oxidised. If oxygen/ air is allowed to come in contact with the packaged food, oxidative degradation of fat occurs, and many other oxidative changes take place, which cause rancidity, off flavour and discolouration in the food. Hence, packaging material for high fat should have low oxygen permeability.

Nitrogen Permeability

To protect the food from oxygen/moisture, the food is usually packed in an inert atmosphere of Nitrogen (N_2). The N_2 permeability of the package should be low to prevent its escape into the atmosphere.

Grease Resistance Properties

A variety of RTC food have edible oil and fat as their ingredients. Fat/oil during storage should not adversely affect the packaging material used for these products, as fat may ooze out.

HDPE and LDPE are affected by fat and are not suitable for packing fatty products. Polyester films, cellophane, polypropylene, inomer films etc. are suitable for such applications. If made in laminates, then the film offering excellent grease resistance is used as the innermost liner of the laminate.

Flavour and essential oils contribute to the organoleptic qualities of many RTC food. They are volatile substances and hence gas permeability of the packaging material should be very low to prevent flavour loss. This is also necessary to block the entry of the outside oxygen and air, which could bring out the oxidative changes in flavour.

Light Sensitivity

Light accelerates oxidative changes associated with the flavours and fats in food. Opaque packaging materials such as cans and aluminium foil offer best protection from light. Metallised polyester and pigmented plastics are found quite satisfactory. Light could cause discolouration in coloured food. Some films are opaque to visible light but allow U.V. light to penetrate.

Based on their major ingredients the ready to cook mixes can be divided into four groups:

- Cereal based
- Legumes based
- Fat rich, and
- Spice enriched mixes

The first category consisting of mixes for idli, dosa, chakli are mainly sensitive to moisture pick up only and require protection against this. These generally have moisture content in the region of 8 to 10% and become soft and unacceptable at about 12 to 13% moisture content. **Polyolefin plastic pouches of 37 to 75µ thickness are generally used for packaging, which provides 3-4 months shelf-life.**

Legume or pulses based mixes comprise vada, khara sev, bonda, urad bath etc. have packaging requirements similar to those of cereal based mixes, but have lower permissible moisture pickup. Hence, this requires packaging material having good water vapour impermeability. **LDPE and PP pouches have been found to offer 1½ to 3 months storage life under high temperature/RH conditions, which would correspond to 5 to 6 months under normal conditions.**

Ready mixes of Jamun, cake, doughnut etc., which have high fat content and milk solids are susceptible to rancidity and interactions with oxygen and water vapour. **CPP pouches of 200 grams capacity have been found to give short shelf-life of 2-3 months, which is adequate for local marketing.** However, for longer shelf-life and export purposes, plain printed polyester with LDPE or HD-LDPE co-extruded films would be better suited from the point of protection and attractive appearance.

Spice enriched mixes such as those of rasam, sambar, soup, bisibele bath are highly susceptible to aroma loss, oxidative deterioration changes and seepage of oil. Unsupported PE or PP pouches are inadequate to pack these items. More functional ones based on cellophane/PE, plain or metallised PET/PE, and co-extruded films with polyamide core layer provide longer shelf-life.

Food mixes such as orange peel gravy, tamarind sauce etc. have very low moisture pickup tolerance and necessitate the use of highly fat resistant and flavour resistant packages. **Innermost layer of HD-LDPE coextruded film, ethylene-acrylic acid copolymer provide the required properties and good heat sealability.**

Frozen Convenience Food

The current trend in frozen food is dual ovenability i.e. products that can be heated in a microwave oven or a conventional oven. Shelf – stable retortable food are better suited for microwave heating. Aluminium trays which represented 85% of the market in the eighties are being replaced by other materials like paperboard, thermoset plastics and thermoplastics owing to the growing importance of microwave ovens. Among the three materials, paperboard has a image as well as functional problem. Consumers perceieve it as a low quality material. Also, it softens in the presence of moisture and chars under high temperature conditions. Thermoset plastics also have several disadvantages. It is expensive and heavy, which increases shipping costs. It is brittle, stains easily and processes slowly. Therefore, processors are looking to other materials like thermoplastics. Three critical properties to be considered when selecting

thermoplastics for dual-ovenable packages are dimensional stability up to 200°C to 250°C, good impact strength at freezer temperatures to reduce shipping and storage damage and microwaveability. Other important properties include compliance with FDA regulations, absence of taste and odour, good release characteristics so that the food does not stick. This property is very important for baked food. The different types of dual ovenable packages are explained here.

Ovenable Plastic Based Food Trays

These trays are manufactured by thermoforming sheets of polypropylene (PP), high impact polystyrene (HIPS) and crystalline polyethylene terephthalate (CPET), each material offering specific advantages in performance and economics. The trays are vacuum formed or thermoformed from a reel of sheet.

When extended shelf-life is required, PP is co-extruded with barrier resins such as EVOH to improve barrier properties for forming. PP trays cannot withstand conventional oven temperatures and are used only for microwave ovens. Foamed polystyrene trays with special blends of low density polystyrene can withstand much higher temperatures, however, they are used generally only for microwave with an advantage of good cost saving as compared to the CPET trays. CPET trays have distinct advantage of dual ovenability. They also very remarkably withstand the abuse of retail distribution. Their other advantages include design flexibility, resistance to oil and grease and no appreciable effect on food taste. CPET trays are stable from – 40°C to as high as 200°C and exhibit improved oxygen and water vapour barrier.

All plastic trays are topped with heat-sealable lidding films or snap-on plastic domes.

Ovenable Board

Earlier developments were based on paperboard coated with TPX. This was expensive and the preferred material now is solid bleached sulphate board, extrusion coated with polyethylene terephthalate (PET). This material is resistant to exposure in hot-air ovens and to temperatures of 200-250°C. It is also used for containers for food to be re-heated in microwave ovens only.

The coated board is made into containers by two main methods. One technique produces containers by press forming to give trays or dishes similar to the conventionally pressed foil trays. An alternative system is based on existing carton technology and erects trays from flat carton blanks. The main reasons for the current interest in ovenable board trays are:

- Growing popularity of convenience food
- Developments of the microwave oven
- Developments of polyester coated ovenable board that is suitable for use in both microwave and conventional hot - air ovens

Ovenable board containers have to satisfy a number of performance requirements. First and foremost, the material must be permeable to microwave radiation. Metal surface reflects microwave radiation so that the aluminium foil dishes are not really suitable for microwave oven use. Containers intended for general use must also be heat resistant at temperatures up

to 200-250°C, which will normally be encountered in hot air ovens. Resistance to heat includes a requirement that there should be no thermal degradation, browning or odour development. The material in contact with the food must be chemically inert and have food contact approval. It should also be grease resistant.

The coating should be heat sealable and the material as a whole should be easily convertible at high speeds. Because the filled containers will normally be stored under deep-freeze conditions, the ovenable board must have good deep-freeze performance. Good printability is also a requirement.

Production of PET-coated board is carried out by extrusion coating. Pre-treatment of the board is necessary to give good adhesion of the coating. The behaviour of the total coated structure of both flame and corona board is limited by the cohesion of the clay coating.

References

1. Guide on Food Products, Vol II by Laad, V. D.
2. Modern Food Packaging
3. Packaging India, Vol 35, No. 5, Dec–Jan '03, Plastic Films for Processed Food – Special Requirements by Rashmi Motey, Smita Lele
4. Packaging India, Vol 33, No 5, Dec 2000 – Jan '01, Specialized Packaging for Food Products by A. S. Athalye
5. Handbook of Packaging – Plastics by A. S. Athalye