Retort Pouch Processing for Fish Products

T. K. Srinivasa Gopal

Humans used to spend much time and labor to preserve food and in modern ages when demand for greater quantities of better quality processed food has incresed, we have seen development of a large food processing industry capable of meeting such demand both in quality and economy. It is no exaggeration to say that thermoprocessing procedures served as the basis for this food processing industry. The growth of large scale industrialization of canned and bottled food is considered to be attributable, in part, to the fact that thermo processing is more suitable to meet food preservation demands, both in economy and quality, than other means. While other food preservation means can only suppress or retard microbial growth, thermo processing can completely eliminate microbes from food and such sterility can be readily and permanently kept once the containers are tightly sealed. These features of thermoprocessing procedures for food preservation have been taken over by thermoprocess resistant films emerging with the progress of the petrochemical industry and such plastics combined with establishment of package manufacturing, filling and sealing and thermoprocessing procedures have given rise to retortable packaging which now plays a very important role in food packaging.

Retort Pouch Packaging of Fish Products

The Indian fishery industry grew up in stature from the mid fifties after the Second World War to an almost entirely export oriented one. Shrimp has been the main stay of seafood processing industry. It contributes only less than 10% of all fish landings and has been remaining stagnant at this level for the last several years and does not hold much promise of improvement in the near future. However it is known that the world demand for fish products is so diverse that the multiplicity in the species make up in marine landings and the possibility of processing them into various value added products could go a long way in satisfying the demands from the consumers, both domestic and overseas. Diversification and value addition are two terms most talked about in the fish processing industry circles and both are inter related to a great extent. The fish processing industry the world over is investing heavily to achieve diversification and value addition to products. This has resulted in the development of modern technologies for processing several value added products especially out of low cost fish and shellfish commanding export and domestic market potential. Most of such value added products are either ready-to-serve or ready-to-cook and belong to the category of convenience foods.

The sophisticated consumers from abroad and at home demand diversified products, which are hygienically processed, nutritionally balanced and attractively packed. Marketing of value added products is completely different from that of the traditional seafood. It is dynamic, sensitive, complex and very expensive. Appearance, consumer acceptability, packaging and display are important factors leading to successful marketing of diversified products. One such type of value added product developed at Central Institute of Fisheries Technology (CIFT) is Ready-to-serve fish preparations processed in flexible retortable pouches.

Fish curries have only limited storage life of a day or two at normal conditions of temperature of our country as no preservatives are employed in such preparations. At refrigerated temperatures (2 to 3 °C) they may exhibit shelf life of a further couple of days. One method of long term preservation of fish curry is by freezing. Discoloration, desiccation and rancidity are the common problems met with in frozen storage. Another method of long term preservation is by canning. Fish in curry in a ready to consume form processed in metal cans is an item in the overseas markets. Sardines, seer, mackerel, herring etc are available in curried form in cans. However the metal cans used as containers impose several restrictions on the viability of the process. Firstly, metal can impart an undesirable taste to the product on storage. Secondly, as far as India is concerned, tinplate for making cans is imported and hence it is disadvantageous economically. Flexible pouches till now available in the country were not heat stable and suffered from several other disadvantages like poor seal strength, poor barrier properties, pin holing etc. The earlier attempts on popularizing a ready to serve fish curry could not meet with success because of the above limitations imposed by the metal containers. Now CIFT has successfully developed a suitable three layer configuration of flexible pouch which can perform the packaging function equally well as metal cans and is free from the disadvantages met with them. This is a retortable flexible pouch based on polyester/aluminium foil/cast polypropylene. The outer polyester film protects the aluminium foil and provides the laminate with strength and abrasion resistance. The core of aluminium foil is used to give the laminate the necessary water, gas, odour and other barrier properties. The primary function of polypropylene inner ply is to give good heat seals and product resistance. The polypropylene ply also protects the aluminium foil and contributes to the overall pack strength. Now flexible pouches are manufactured in India employing the configuration developed by CIFT and this opened the way for commercialization of heat processed fish curry in flexible pouches. The pouch packed fish products have a shelf life of at least one year at ambient conditions. Mackerel in curry processed on a pilot scale in flexible pouch using an over pressure autoclave was test marketed in the importing countries. The product had good acceptability and there is a good demand for fish curry in flexible pouches.

Details of retort pouch processing:

Retortable flexible containers are laminate structures that are thermally processed like a can, are shelf stable and have the convenience of frozen boil in the bag products. The material for flexible containers must provide superior barrier properties for a long shelf life, seal integrity, toughness and puncture resistance and must also withstand the rigors of thermal processing. Retortable flexible containers may be retort pouches or semi rigid containers.

Composition of the pouch:

The most common form of pouch consists of a 3 ply laminated material. Generally it is polyester / aluminium foil / cast polypropylene. The outer polyester film is 12 micron thick. It serves to protect the foil and to provide the laminate with strength and abrasion resistance. The core of aluminium foil is used to give the laminate the necessary water, gas, odour and light barrier properties. The foil thickness is normally 12 micron although 7, 9 and 15-micron foils are also used. The primary function of the polypropylene inner ply is to provide the strong heat seals

and good product resistance required in the retort pouch. This layer also helps to protect the foil and contributes to overall pack strength. The thickness of the cast polypropylene layer will depend to some extent on the nature of the product being packed. For soft liquid containing products 50-micron polypropylene is normally used. This is increased to 70 micron for hard products. Whilst it is possible that any of the three pouch components could contain an imperfection such as a pinhole, the probability that these would be coincident in the laminate is very remote. The three layers of the retortable material are combined by adhesive lamination. Conventional polyurathane adhesives, cured by tolyolidene-di-isocyanate based catalysts, were originally used in this process and are still used for the polyester bond. Doubts about the safety of this type of adhesive for the polypropylene bond led to the problems in obtaining USFDA approval of the retort pouch material. The situation has now been resolved by the developments of two alternative bonding systems. One of these is a polyurathane adhesive which is cured by an aliphatic isocyanate, the other (morprime) is based on a dispersion of micronised polypropylene the process does not require any adhesive at all.

There are a few basic requirements for retort pouch film. The most important from a marketability and total packaging system viewpoint, as well as essential from a strictly functional viewpoint are;

- Low gas (Oxygen) permeability:
- Low water vapour transmission rate:
- Resistance to temperature from below 0 °C to at least 121 °C to cover possible storage condition exposures and the minimum sterilisation level for low acid products.
- Inertness in terms of resistance to penetration by food components and low migration of film components in conformity with food and drug regulations.
- Heat sealability and capability of being handled on automatic fabricating and filling equipment.
- Good aging properties.
- Physical strength to resist any handling abuse during manufacturing and during distribution cycles.

The first step in the manufacture of laminate for pouches involves printing the polyester film. Excellent print quality, multiple colour registration, repeat length and long run economy are associated with gravure printing which is usually employed. The printed polyester film can be adhesive laminated to the aluminium foil and then laminated to the polypropylene or the printed polyester film can be laminated to a premounted, foil polypropylene base laminate. In either case the adhesive is applied to a substrate and then passed through an oven which sets the adhesive, the combining of the two webs is done on a heated roller by employing pressure. The manufacture of retort pouch packs involves a series of lengthy operations.

Pouch Packing Process:

Filling:

Filling the pouches with raw material is the first step in the process. Filling systems range from manual to automatic with variations and combinations of both. The essential requirement is that the pouch seal be kept free from contamination with product since this could impair sterility, either by spoilage or resultant leakage at the seam. Systems capable of dispensing product components of various types including fresh food pieces, slices and sauces are available. Liquids and liquid-

solid mixes can be dispensed using rotary valve piston dosers. Solids can be dispensed using dry fillers. Where the product has to be arranged in the pack with fishes like sardine, mackerel etc there is alternative to hand filling.

Air removal

Removal of air from the filled pouch is done before they are sealed. Removal of air from the filled pouch is normally effected on an automatic line and is necessary for several reasons.

- to ensure product stability
- to avoid pouch bursting during retorting
- to assist uniform heat transfer
- to allow detection of spoilage (swelling)
- to facilitate cartoning.

If too much air is left in the pouch there is a danger that it will inflate and burst during sterlisation or reheating. Inflation of the pouch during sterilisation will also impair heat transfer to the pouch contents. The residual air should be less than 2% of the volume of the pouch contents. For liquid products it is possible to exclude much of the air by squeezing the pack, so as to raise the liquid level to just below the line of seal during sealing operation. Packs containing solid prodcuts can be vacuum-sealed using chamber machines. Injecting steam into the packs to displace the air prior to sealing can also produce effective vacuum packs. Here saturated or superheated steam is injected into the filled pouch just prior to making the top seal. Condensation of water vapour minimises the amount of headspace gas when cooled. Super heated steam is less effective than saturated steam, but superheated steam is often used because it causes less moisture condensation in the seal area.

Sealing

Hot bar sealing is preferable to impulse sealing. If impulse sealing is used it should provide two sides heating and the sealing elements should be 6 mm wide rather than the normal 3 mm. The pouch should be double sealed to reduce the risk of seal defects. The over seal should extend over the mouth of the pouch to prevent mould growth in any product contamination above the closure seal.

Traying

After the pouches are sealed it is transferred to a retort rack or tray on which each pouch is accommodated in a separate compartment or slot. This ensures that the flexible pouches present similar dimensions with uniform exposure to the heating medium. Ideally these trays should be pocketed to prevent pouch movement and super imposition during retorting. An additional mesh restraint over the retort trays can be used to restrict pouch inflation and distortion in the retort.

Processing

The pouches are then heat processed in an over pressure autoclave at 121 °C for a specific time. The processing conditions are standardized based on the heat penetration data obtained during thermal processing. The processing is given so that the product is safe to eat and also acceptable to consumers. CIFT has also standardized different recipes suitable for different regions of India.

FLOW DIAGRAM FOR PROCESSING FISH CURRY IN RETORTABLE POUCH