

RECENT DEVELOPMENTS IN FISH PROCESSING AND PRESERVATION

V. K. PILLAI

Central Institute of Fisheries Technology, Ernakulam.

A review of the literature on fish processing will reveal that most of the important developments have taken place during the last twenty years. Sustained work by teams of scientists in different parts of the world has not only contributed much to our knowledge of the chemistry and technology of fish but also resulted in revolutionary changes in the methods of preservation and processing of fishery products.

The primary aim of research in the field of fish preservation was to maintain fresh fish quality during storage for long periods. The real breakthrough in this field took place with the finding that sodium nitrite is very effective in prolonging the shelf life of fish (Tarr, 1941). It was however soon realised that this compound although effective in arresting oxidative changes in fresh fish to some extent, was not the ideal preservative. In spite of this the use of nitrites has been practised on a large scale in countries like Canada and Norway.

The search for a complete preservative continued and in this the scientists had to deal with all the different types of spoilage occurring in fish, namely microbiological,

enzymatic, oxidative and hydrolytic changes. Several substances were tried in experiments to combat the above spoilage agencies. These included penicillic acid, sulphur drugs, streptomycin, tetracycline compounds like CTC, OTC etc. The immense possibilities of CTC as a fresh fish preservative was established beyond doubt (Boyd, *et. al.* 1953). Low concentrations were found to enhance the shelf-life of iced fish by considerably long periods. This prompted large scale trials and research in many countries on a variety of commercially important fish and shell fish. The informations collected on the subject are enormous and are of much value to the fish processing industry. The initial fears of danger through oral intake of CTC to public health have been discounted and most of the major fish producing countries have now legalised the use of this antibiotic in fresh fish preservation. In India too a good deal of work has been done on this subject. There are indications that use of this antibiotic may turn out to be beneficial to the prawn processing industry in certain specific fields like pre-process preservation and long distance transport of raw materials.

CTC, although outstanding in its

performance, however has not provided the complete answer to the problem of fish preservation. The success of CTC treatment has been found to depend on various factors such as the freshness of the raw material, the type of fish used, the extent of initial bacterial contamination, contamination with metal surfaces, possibility of degradation products from fish to combine with the CTC thus nullifying its effect etc. It is effective only against certain types of micro-organisms (mainly gram negative types) while the other organisms and the enzymes continue their action unabated. The specificity of the antibiotic to gram negative organisms also brings in the additional question of certain species predominating in the product and creating an imbalance of the natural flora of the material, which may or may not have ill effects.

In recent years there have been renewed efforts to find out better preservative materials for fishery products. A new product called Myverol is undergoing extensive tests as a preservative. The antibiotic Tylosin lactate at 2.3 ppm has been found to prevent growth of anaerobic bacteria for over one year (Anon, 1963). Effectiveness of the antibiotic on low acid, thermophilic and flat sour organisms have already been investigated. The enzyme is a fermentation product of *streptomyces*. It has a lactone ring structure with a molecular weight of approximately 900. Almost complete inhibitory effect on gram positive organisms has been found. It also appears that the antibiotic is specific in inhibiting the vegetative cells of the causative agent for botulinum intoxication. Studies with this enzyme have shown that no strain of spore formers could withstand a concentration more than 4 ppm. The possibility of using this compound in conjunction with CTC, which is specific only to gram negative organisms, as an effective inhibitor against all types of

micro-organisms in fish is worth investigating.

Work on the esters of p-hydroxybenzoic acid as anti-bacterial agents has been encouraging. Methyl through Octyl esters have been found to exhibit pronounced preserving activity potential. Lower chain length members are very effective against gram negative organisms while increase in the alkyl chain length is marked by increase in their activity towards gram positive organisms.

Extracts from natural vegetable material have been found to possess very good antioxidant properties. Hot water extracts from onion tops, green pepper seeds, potato peels etc. are found to contain antioxidant properties in foods having fat and water. The activity has been traced to flavonoides and related compounds present in these extracts.

Vitamin K₅, which has shown indications as a preservative, increases the sensitivity of a number of bacterial strains to irradiation. This will permit radiation sterilization to be accomplished at lower levels. This incidentally brings us to the recent developments in pasteurization and radiation sterilization techniques for the preservation of fishery products.

Experiments carried out on shell fish like lobster and crabs have shown that normal pasteurization procedures will be very effective in arresting deteriorative changes in these materials during long storage. Heat treatment at 70 to 75°C for periods not exceeding 15 minutes either at a stretch or at intervals followed by immediate chilling and storage has been found to preserve the original flavour of the material for a longer period. The technique however has not gained much attention so far although it offers the possibility of further evaluation. As

against this the technique of radiation pasteurization has evinced the interest of fish technologists to a greater extent in the last few years. Attempts carried out in many countries show the great potentialities of this technique. At an irradiation level of 0.2 megarad using a Cobalt-60 irradiator it has been possible to increase the shelf life of king crab meat to fourfold at a storage temperature of 0°C. Raw shrimp irradiated at 0.5 to 0.75 megarads with 5 ppm CTC added kept well for over 10 weeks at a temperature a little over 0°C. The technique has however been found to have several disadvantages particularly when applied to fish foods having high fat content. Deep penetration radiation split up the moisture into oxygen and hydrogen. These nascent gases exhibit very high oxidising and reducing properties. Their action starts a series of changes to the fat and other components of the fish resulting in undesirable changes in flavour and odour of the material.

The most important development in the field of fish processing is the discovery of the now well known 'Accelerated Freeze Drying' technique. This technique promises to become a major food processing method. It provides savings to the consumers without compromising quality. Both pilot scale and batch type Plants have already been put in the market for commercial use; and the present attempts are to design continuous type accelerated freeze drying Plants. Side by side with the development of machinery for this process research is also being continued with vigour both in India and in foreign countries to find out the suitability of the process to different varieties of fish products, the reconstitution properties of the processed material and its quality *vis-a-vis* the quality of the original raw material. Answers to many of these are yet to be found. However it

is hoped that time and continued efforts will provide these vital informations.

In the field of canning the conventional batch type thermal processes using still or agitating retorts are giving place to more efficient methods. Continuous methods involving rotary cookers, hydro-matic cookers, hot air sterilizer systems of Swedish origin, gas flame heating process of French origin or HTST (high temperature short time) process are gaining ground, atleast for the mere reason that the sterilization time is much shortened. The HTST process is the shortest of all these processes. The rotary cooker has found much favour in recent years with the industry as sterilization is over in three to four minutes.

Another process that is fast gaining ground is the Fluidized Bed Processing Method (Pigott, 1963). This process uses a heated bed of fluidized solids for sterilization purpose. The heated particles quickly transfer heat to the cans. Inert solid particles of 50 to 120 mesh range like sand can be used.

In the field of freezing of fish recent studies have shown that frozen fish keep better after an initial immersion in a solution of phosphate salts. Gels formed from sodium chloride and dextrose and from sodium alginate in presence of salts of sodium and calcium are also being used extensively in freezing operations. Alginate jelly has been found extremely useful in reducing drip, preventing rancidity of fat and other deteriorative changes. Organoleptic evaluation of fish and prawn coated with alginate jelly has indicated that the fresh fish characteristics are retained during freezing and storage for long periods.

One of the recent developments in the fish freezing industry is the application of

the principle of fast blast at -45.5°C . This is found not only to accelerate freezing (freezing takes place in 15 seconds) but also seals the flavour and prevents moisture losses completely. The air velocity is such that it literally offsets more than nine tenths of the weight of the material making it float through the freezing tunnel so that cooling is uniform on all the sides of the block. Still more recent is the use of liquid nitrogen in freezing (Kurzynski, 1965) and refrigeration of fresh and frozen perishable goods including fishery products in transit. This new system has demonstrated several advantages including operating efficiency over mechanical refrigeration systems although it is considered somewhat more expensive than the conventional freezing processes. Portable Polarstream refrigeration units are now available for use in trucks. With the availability of liquid nitrogen at cheaper rates this process may turn out to be successful and competitive even in India where internal distribution of fish is yet to develop.

The foregoing is only an outline of the major developments that have taken place in the fish preservation and processing fields. Many of these can profitably be applied to the prawn processing industry. Competition in the world market for the conventional types of frozen and canned products is on the increase and only top quality at lesser price will be able to sustain the industry. Better avenues of utilizing the product will have to be found

out, which means development of newer products capable of meeting the demands of the consumers. Consumer type packs of individually frozen prawn in aluminium lined polythene bags, boilable plastic bags, breaded prawn products etc. are becoming increasingly popular in the Western countries. Considering the potentialities of our prawn processing industry it is only justifiable that we start work on these lines without delay. We have also to find immediate solution to important problems like discolouration in dried prawn pulp, belly bursting in ice stored and frozen sardines etc. Of course it has to be remembered that a great deal of basic research is needed before perfecting a technique, developing a new product or solving a technological problem. It is gratifying to note that most of these are being tackled by the Central Institute of Fisheries Technology with encouraging results.

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