The Processing of Fish and other Marine Resources

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(A) Fresh Fish

The preservation of freshness in fish (commonly referred to as fish handling) and the conversion of fresh fish into other products can both be considered as methods of processing. In commercial practice, however, the term " processing " is confined to the conversion of fresh fish into other products. Let us first consider the preservation of freshness in fish.

Deterioration in the quality of fresh fish is due firstly to enzymatic action within the tissues of the fish which causes autolysis or self-dissolution. Enzymes in a living fish assist both the building-up as well as the breaking-down reactions of normal metabolism. After death, building-up reactions cease but breaking-down reactions continue, finally breaking down the tissues. Secondly, deterioration is due to bacterial action. The tissues of a healthy living fish are sterile while the surfaces in contact with the environment are contaminated with bacteria. While the fish is alive, the bacteria are continuously removed by the flow of slime, movement of water through the gills and the passage of food along the alimentary tract. On death, all movement ceases, the bacteria stagnate and multiply on skin, gills and intestines and then penetrate the flesh using arteries and veins as roadways. Finally, the presence or absence of oxygen (air) influences the course of certain reactions, the growth of certain bacteria and the rancidity of oils in the fish.

The first step in reducing the rate of deterioration is by cleaning (called dressing) the fish. This involves washing off slime, removing gills and intestines which also contain bacteria, removing easily decomposable material such as blood, roe and fat layers and separating out stable, edible portions such as fillets. In the case of small fish, it is uneconomic to dress each individual fish so they are merely washed in bulk; in addition, if the cleaning process takes a long time and the fish are not cooled, they can deteriorate due to exposure to high room temperatures. Therefore, dressing fish is applicable only when it can be done quickly, i.e., when fish are large and there are sufficient workmen.

After dressing, the next stage is to cool the fish as the rate of all reactions (enzymatic and bacterial) are reduced by cooling. When ice is used, fish can be cooled to just above 32°F (0°C) but the water (juices) in the fish will not freeze as it does so only at 28°F (-2°C). Storage time on ice is counted in days, usually 8-12. There are no flavour changes due to icing but flavour changes will take place due to slow deterioration with time. Fish without ice will deteriorate much faster as they are at a higher temperature.

Frozen fish has been cooled below its freezing point (28°F) and so the water inside the fish is in the form of ice. Freezing is done by a blast of cold air or by contact with a cold surface which brings down the temperature rapidly. Rapid freezing is necessary to prevent fractional crystallisation and the formation of new combinations among dissolved constituents which causes flavour changes and to prevent the formation of large crystals whose expansion while freezing may break down cell walls and cause oozing or drip on thawing. Frozen fish are stored at low temperatures (-5°F to -10°F) (-20° to -23°C) and keep in good condition for months or even years.

Quality in a fish continuously deteriorates from time of death. All preservative methods merely slow down these changes and are not able to stop them completely still less to reverse them. The point at which the fish is to be judged as unfit for consumption is very arbitrary and is related to market conditions and consumer acceptance. This judgment is independent of bacteriological tests for suspected infection. Fish found contaminated with disease-causing bacteria must be condemned as unfit irrespective of the state or quality of the fish.

Laboratory tests for quality (chemical or physical) are unsatisfactory as they deduce quality by evaluating a single component and the tests become even more unreliable when applied to catches in tropical waters which usually consist of numerous varieties of fish in different stages of maturity. Therefore, testing for quality is best done by human judges who test many aspects of the fish (appearance, touch, smell, etc.) and also know the quality acceptable to the local market.

The following conditions must be satisfied for fish to be sold in the fresh form:

(i) they must be of varieties acceptable to the market;

(ii) they must be whole or filleted and not crushed or in scraps;

(iii) they must be maintained iced or frozen to preserve their quality.

It is, therefore, seen that there are specific conditions to satisfy before fish can be sold in the fresh form. This makes it necessary to convert fish which cannot be sold fresh into other products. The necessity for conversion arises through the following circumstances:—

(*a*) lack of facilities for handling fresh fish;

(*b*) fresh fish in excess of facilities available for handling in the fresh state;

(*c*) large quantities of a particular variety all of which cannot be sold fresh;

(*d*) crushed or damaged fish which have lost their market appeal;

(*e*) inferior varieties of fish which have limited or no sale in the fresh form;

(*f*) unused portions after cleaning or trimming;

(*g*) portions of special value such as fish livers which can be processed for oil.

(B) Processed Fish

Processing makes possible the full use of a resource. It does not enhance quality for a deteriorated product cannot be improved. However, it may change an unpalatable product to a more palatable one or extract an usable product from discards. Processing often concentrates the food value of a product. For example, dried fish has 40-50% protein compared to about 20% for fresh fish. Extracted fish liver oil is a more concentrated and stable form of Vitamin A than the entire liver or the entire fish. Processed fish is more stable and easier to handle than fresh fish. The value of a resource is greatly increased by extending its distribution. Processing of fish makes it easier to distribute this resource throughout the population and also easier to export to other countries.

(1) *Products similar to fresh fish.*—In canning, fish and flavouring ingredients are sealed in a tin and the tin is heated to a temperature at which the contents are cooked and sterilised. Canning is an useful method of dealing with inferior varieties of fish or those caught in large quantities. Canned fish replace fresh fish at table and do not need special facilities for transport or storage. However, the initial cost is high due to the cost of the can and the cooking process.

Fish sticks and fish cutlets are made of ground fish flesh and pastry, and so make use of inferior varieties and trimmings. They are to be regarded as a form of fresh fish and need icing or freezing for storage.

Fish can be dried by the dehydrating action of salt or by heat. Dried fish does not need to be iced or frozen and, being about half the weight of fresh fish, can be transported at less cost. When the fish are unfermented, they can be substituted for fresh fish when cooked.

Unfortunately, fermentative flavours develop readily and, in Ceylon, have become an accepted characteristic of dried fish. Fermentation adds pungent flavours and changes the fish from a food product towards a condiment.

(2) *Products of the condiment type.*—These products are highly flavoured and so can be used only in limited amounts, more as a condiment than a food. Local dried fish (karavala) through lack of control in processing, develops inadvertent fermentation flavours. However, in the preparation of pickled fish (jardi) fermentation flavours are deliberately sought and encouraged by adding flavouring ingredients such as goraka, tamarind and vinegar and using barrels of particular woods for curing.

Smoking is another method of adding flavour. Lightly smoked, lightly dried fish can be used in the same way as fresh fish, but heavily smoked, hard dried fish will be of the condiment type, chief of which is maldive fish which is fish which has been boiled, smoked and hard dried.

Another product, fish sauce, is a fully fermented fish product which yields an aromatic liquid to be used as a sauce.

Any variety of fish can be made into karavala, jardi, maldive fish or sauce, each variety lending its own flavour to the product. All these processes reduce the weight of the fish. Conversion of 10 lb. of fresh fish to karavala or jardi will yield about 4 lb. (varying from 3 to 8); conversion to sauce will give 3-4 lb. liquid, while you can prepare only 2 lb. of maldive fish from 10 lb. of fresh fish. It is, therefore, uneconomic to process any fish that can be sold fresh.

(C) Special Products

(1) *Fish Meal.*—Fish is boiled, dehydrated, defatted and ground up to yield about one-fifth its weight of coarse powder of high protein content (40-70%) to be used for animal food. If well prepared in special apparatus, the material can be used for human consumption as an additive to flour from grain. Local conversion into animal meal is done with crushed fish, unsold fish and varieties unpopular either in fresh or dried form.

(2) *Fish Liver Oil.*—Livers of fish are chopped up and steamed in the absence of air to give a vitamin-rich oil. This oil is locally produced mainly from shark, but livers from other big fish are also used in the extraction process. Fish liver oils vary in their vitamin content and are blended with a vegetable oil (e.g. groundnut oil) to produce a mixed oil of standard Vitamin A content. Standardisation is necessary to recommend a fixed dosage and the blending makes the oil more palatable.

(3) *Agar.*—This can be obtained from red seaweeds (*Gracilaria* spp.) which are commercially abundant off Trincomalee where they occur in depths upto 4 fathoms. These seaweeds are collected during July to October and about 100 tons per season are exported to Japan by private traders. The possibility of manufacturing crude or purified agar in Ceylon is under consideration. Agar forms a jelly which is popular as a sweetmeat and which has technical uses in bacteriology and medicine.

(4) *Alginic Acid.*—This can be obtained from brown seaweeds (*Sargassum* spp.) which are commercially abundant off the South-West coast (from Beruwela to Hambantota). In this region the beds extend upto 400 metres from the shore and are estimated to be able to yield about 130 tons per season (October to January). These weeds are not exploited so far as brown seaweeds are of world-wide distribution (unlike the tropical reds) and there does not appear to be an export market for them. Alginic acid is an emulsifying agent with a wide variety of uses in food products (ice cream, cordials, etc.) and technical industries such as textiles and paper.

(5) *Other Marine Products.*—These include pearl oysters (for pearls); chanks (for shells); window pane oysters (for pearls and shell material); beche de mer (boiled and dried holothuria for food); shark fins (cartilaginous rays used in soups); isinglass (gelatinous extract from fish air-bladders); fish oil (separated in preparation of fish meal) and stearin (separated out from liver oils and used for water proofing boats, etc.).

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