HOME PRESERVATION OF FISH IN TROPICAL CLIMATES

By K. W. Anderson.

(Mr. Anderson visited the Territory as an Officer of the Food Preservation Division of C.S.I.R.O. to make a survey of fish preservation problems.)

THE intention in this article is to suggest some methods for the preservation of fish which may be useful to isolated European communities in New Guinea and Papua in smoothing out fluctuations in the availability of fresh fish.

Biochemical Basis of Fish Preservation.

Spoilage in fish is caused by :—

1. Bacterial Activity—

The flesh of newly caught, healthy fish contains no bacteria. However, the external surface, slime, gills and gut contain large numbers which invade the flesh soon after death. The rate at which they multiply increases with the atmospheric temperature. Bacteria attack the proteins giving rise to obnoxious breakdown products such as ammonia and sulphuretted hydrogen and also reduce a chemical substance, trimethylamine oxide, contained in the flesh of all salt water fish, to trimethylamine which is a gas and partly responsible for the particular smell of stale fish.

2. Enzymatic Activity—

Enzymes are non-living chemical ferments responsible for many biological processes. Those occurring in the gut of fish are particularly capable of the chemical breakdown and digestion of food. Shortly after death they begin to digest the flesh producing the typical softness.

3. Oxidation—

Oxygen of the air reacts with fats in the fish producing rancidity with its typical, bitter off odours and flavours.

The Methods Employed in Controlling this Spoilage are—

1. Temperature—

The use of heat, as in canning, to destroy bacteria and enzyme activity completely, or of cold, as in chilling, freezing and cold storage, to inhibit their development.

2. Chemical—

The use of salt, vinegar or smoke constituents which render the fish flesh, in varying degree, unsuited as a medium for bacterial growth and enzymatic activity.

3. Drying—

Bacteria cannot grow in foodstuffs with a moisture content less than 40 per cent. Some moulds can grow down to 16 per cent. water content.

Time Lag Between Catching and Processing.

In the light of the foregoing remarks it becomes fairly obvious that one of the most important phases in curing work is to obtain the fish as soon as possible after catching—before incipient spoilage has already set in. In the absence of ice it is

essential to thoroughly clean and wash the fish, scrubbing off blood and slime with a stiff brush immediately after capture, and to store it in as cool a place as possible if immediate processing is not possible. Rough handling and bruising of the fish should be avoided. The maximum permissible time lag between catching and application of a cure under tropical conditions is a few hours.

Curing.

The curing of fish can be divided into two distinct classes :—

1. A light cure where the initial characteristics, i.e. appearance, texture, flavour, is little changed by the treatment. In general such cures are suited to cool climates and the products have short storage lives unless kept under refrigeration.

2. Heavy cures where the rather drastic treatment considerably alters the former characteristics of the fish and lowers its palatability. The products may, however, have a life of some weeks or months even without cold storage and under tropical conditions.

Light Cures.

A. Brine Salting—

1. Preparation of Fish :—Small fish are split either down the back or belly and opened out so as to lie flat in one piece. Sometimes it is necessary to cut under the backbone and score the flesh at intervals of an inch or so, with the point of a knife, thus providing a greater area of cut flesh for penetration of salt into the tissue. The gills are removed from the split head, or the head removed completely. Large fish are split into two fillets removing the backbone but leaving the collarbone just below the gills to keep the flesh from falling apart during processing.

Reduce the fillets in size so that they will lie flat in the salting vessel and if necessary score the flesh longitudinally to a depth of $\frac{1}{2}$ inch at 1-2 inch intervals without piercing the backbone.

Thick skinned, spiny finned fish with large scales should be skinned and the fins removed by making a deep cut along each side of the fin and pulling it away by hand.

The fish are then thoroughly washed and scrubbed with a clean stiff brush in fresh water followed by soaking for 30 minutes in a dilute brine (a half-cup of salt per gallon of water) which helps to remove blood and cut slime from the fish.

2. Brining :—Rinse the fish quickly and place them into a brine containing 2-2$\frac{1}{2}$lb. of salt per gallon of water. The brining vessel should be watertight and of non-corrosive material. A small dugout canoe would probably be suitable. Cover the fish with a loosely fitting wooden cover weighted down so that they remain below the surface of the brine. The time required is dependent on the thickness of the fillets and number of layers of fish. For half-inch fillets in two or three layers one to three hours should be ample. For larger fish and larger quantities the time must be extended.

Remove the fish, drain them quickly and immediately place in shallow containers with good fitting lids in the refrigerator.

B. Marinating—Curing with Vinegar, Salt, Sugar and Spices—

1. Preparation and cleaning is the same as for brine salting.

2. Marinating :—About 10 lb. of fillets are immersed in a solution prepared as follows—Distilled White Vinegar, 1 gallon; Salt, 1 lb. After 24-36 hours in the pickle the fillets are washed, drained and trimmed, arranged closely together on a flat surface skin side down and the following spice mixture spread evenly over their surface at the rate of a-half ounce per one pound of fish—Whole Allspice, 10 parts; Whole White Pepper, 8 parts; Whole Mustard Seed, 4 parts; Whole Cloves, 1 part; Bay Leaves, 1 part; Ginger, 1 part. Roll the fillets from the tail, if desired around a small piece of dill pickle or an onion, and fasten with a tooth-pick. Pack them tightly in wide-mouth glass jars. Metal covers should have a protective disc to prevent corrosion of the metal by acid sauce. Onion slices, lemon or pimento can be added if required.

The jars are then filled with the following sauce, making sure that the fillets are completely covered—Distilled White Vinegar, 4½ pints; Salt, ½ lb.; Sugar, 5 oz.; Water, 3 pints. Seal and store the jars in a refrigerator.

White distilled vinegar is preferable to brown and fruit vinegars which contain tannin and may produce off flavours. The selection of spices and garnishings are left to the consumers preference and their availability. Whilst the fish can be eaten immediately a " cured " flavour develops after one to two weeks.

C. Smoking—

Light smoke curing, whilst imparting a desirable flavour to fish, is difficult to control and apply in tropical climates.

1. Preparation of the fish and cleaning is as before.

2. A preliminary brining in which the fish are soaked for a half-hour in a brine containing 2 lb. of salt per gallon of water. After removal from this brine bath they are rinsed in a dilute brine (half-cup of salt per gallon of water) and allowed to drain. The fillets are then placed on wire trays or preferably suspended from hooks inside a simple smokehouse so that they do not touch.

3. It will probably be necessary to hot smoke the fish at 130°-150° F. for at least five hours.

A smokehouse of limited capabilities can be constructed from a large wooden box, metal or wooden barrel with the ends out. It is placed over a pit about two feet deep which at the side opposite the door extends beyond the smoker to form a firepit. The firepit has a cover to control the fire and force the draught with the smoke into the smokehouse. The top of the smoker is covered, with the exception of an adjustable crack to permit escape of smoke and maintain flow through the system.

Sawdust is preferable because of its tendency to smoulder without bursting into flame but wood chips can be used. The best woods are non-resinous soft-woods and some hardwoods. Green coconut husks are satisfactory.

Allow the fish to cool and store, without stacking or wrapping, in the refrigerator.

D. Pickling.—Combined Cooking and Marinating—

Pickled Eels.

Clean and skin the eels and cut into pieces about a-half inch thick. Wash, drain, and dredge in fine salt, allow to stand one hour. Rinse off the salt, wipe the pieces dry, and rub with a cut clove or garlic or onion. Brush with melted butter or salad oil and broil until the surface is light brown. Place the pieces of eel on absorbent paper and when cool pack them in layers in a crock with a scattering of spliced onion and spices between layers of fish. Weigh

the mixture down to keep it compressed and store in a refrigerator for 24 hours. Then cover with distilled white vinegar. Seal the crock tightly and store in the refrigerator. Allow to stand 48 hours before using.

Typical quantities for 10 lb. of eels are as follows :—Distilled White Vinegar, 2 quarts; Allspice, 1 oz.; Bay Leaves, 1 oz.; Mustard Seed, ½ oz.; Cloves, ½ oz.; Black Peppers, ½ oz.; Mace, ½ oz.

Pickled Clams, Oysters, Mussels.

Clean the shells and steam to open. Save the liquor or nectar. Remove the meat from the shells—cool meat and nectar separately. When cool, pack the meats into sterilized (boiled) jars with a few bay leaves and whole cloves. Add a slice or two of lemon to each jar.

Strain the nectar obtained in steaming. To each quart of this add—Distilled White Vinegar, ¾ pint; Cloves, teaspoon; Allspice, ½ teaspoon; Red Peppers, ½ teaspoon; Cracked, Whole Mace, 1 teaspoon. Simmer for 45 minutes.

When cool pour into the jars and seal. Store in the refrigerator. Note that these products become dark in colour when exposed to the light.

Pickled Shrimp-Prawns.

Peel the shrimp or prawns and wash them well. Make a pickle as follows—Water, 7¼ pints; Salt, ½ cup; Distilled White Vinegar, 1¼ pints; Red Peppers, 1 tablespoon; White Peppers, ½ tablespoon; Allspice, ½ tablespoon; Mustard Seed, ½ tablespoon; Bay Leaves, 6 leaves. Simmer the pickle slowly for a-half hour, then bring to the boiling point, add the shrimp or prawns and bring back to the boil. Cook for five minutes. Remove them from the brine and allow to cool. Pack in sterilized jars with a few fresh spices and a slice of lemon in each jar.

Fill the jar with a solution made from—Distilled White Vinegar, 2 pints; Water, 1¼ pints; Sugar, 1 tablespoon. Seal the jars and store in the refrigerator.

Storage Life of Light Cures.

Under the conditions of temperature normally found in household refrigerators (35°-45° F.) these light cures, if properly applied, should yield storage lives of from several weeks to months.

Reconstitution of Light Cures.

Reconstruction is accomplished by soaking in several cold waters until the required degree of leaching is obtained. The fish can then be cooked in any conventional manner. Note that hot smoke and pickle cures are already cooked. Some people prefer not to leach marinated, spiced fish.

Spiced Fish.

Sun drying to a low moisture content is not feasible in tropical climates and fire drying is hard to control, generally leading to a product of poor texture and palatability.

Dry Salting.

Preparation and cleaning of the fish is the same as for brine salting.

The split or filleted fish are then dredged in a box of curing salt, picked up with as much salt as will stick to them and stacked in layers skin side down in a non-corrosive, watertight container. A thin layer of salt is placed along the bottom of the salting vessel and between each layer of fish. No two pieces of fish should touch and each layer is laid at right angles to the preceding one. The amount of salt necessary will be approximately 30 per cent. of the weight of fish. The top layer of fish is packed skin side up and weighted down with boards to

prevent the fish floating in the brine that subsequently forms. For small batches (20 lb. of fish) at least 24 hours will be required for sufficient cure. Thicker fish and larger quantities may need seven days or longer.

Rinse the fish in a fresh dilute brine ($\frac{1}{2}$ lb. salt per 5 gallons of water) to remove adhering salt and place them on a wire-framed drying rack preferably in a breezy, shaded location as sunlight accelerates oxidation of the fats.

Air dry the fish until there is no further sign of surface moisture, nor any visible, when pressure is applied with the palm of the hand. The time required will depend on weather conditions and may vary from a few hours to days. In periods of rain and at night (when the relative humidity of the atmosphere rises), the racks should be removed to a sheltered spot and covered with a tarpaulin.

If desired the salted air dried fish can be smoked in some simple kiln as previously described. It is permissible to use much lower smoke temperatures with this heavily salted product thus avoiding further tendency to toughen the flesh.

This product can be stored without refrigeration and should keep at least several weeks. It will develop surface moisture but this cannot be avoided. An occasional redrying or packing of the fish in dry salt is suggested.

Reconstitution is as for light cures. Subsequent cooking should be brief as the effect of the heavy salting is to toughen the flesh.

Some Notes.

1. The higher the quality of the curing agents the better the product. Salt should be at least 98-99 per cent. pure, clean and dry as possible and of fine crystal size for dry salting. An excellent salt is " Flossy " curing salt—a product of the Cheetham Co., Geelong. Approximate price, Sydney, 20s. per 186 lb. bag.

2. One of the commonest sources of spoilage in salt fish is due to halophilic bacteria—organisms which can grow in concentrated salt solutions. It occurs as pink or red brown stains on the fish accompanied by softening and putrefaction. If it is encountered, all equipment and benches should be disinfected and the salt roasted in shallow trays over a fire to sterilize it. Salt obtained from the sea by solar evaporation is often contaminated with these bacteria.

3. Many of the spice mixtures and garnishings described can be used to advantage in flavouring salted or fresh fish during cooking.

4. Where commercial, low temperature refrigeration is available a simple and efficient preservation of fresh fish can be obtained by placing the cleaned fillets into a cut down kerosene tin, covering with water and freezing to a solid block of ice.

5. Australian and English white distilled vinegar is usually, unless otherwise labelled, 16 grain strength—4 per cent. acetic acid. Quantities have been calculated on this basis. Some American white vinegars are 100 grain strength—10 per cent. acetic acid. The American " grain " unit differs from the English.

Bibliography.

Information on Marinating was gathered from—Progress Reports of the Pacific Coast Stations—Canada 58, p. 20 (1944) ; Progress Reports of the Atlantic Coast Stations—Canada 48, p. 12 (1950).

Information on Pickling is contained in : Home Preservation of Fishery Products—Jarvis ; U.S.A. Dept. of Interior, Fish and Wildlife. Fishery Leaflet 18 (1943).