Fish preserving by salting

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Salting of fish is a traditional processing method in most countries of the world. The presence of sufficient quantities of common salt (sodium chloride) in fish can prevent or drastically reduce bacterial action. There are three ways of fish salting: brining, dry-salting and pickle curing. Brining is the process of placing fish in a solution of salt (sodium chloride) in water for a period of sufficient length for the fish tissue to absorb the required amount of salt. Dry-salting is the process of mixing fish with dry salt and allowing the resultant brine (from dissolution of the salt in the water present in the fish) to drain away. Pickling or pickle curing is the process whereby fish is mixed with salt and is stored under the brine (pickle) which is formed when the salt dissolves in the water extracted from the fish tissue. Salt used to produce salted fish shall be clean, free from foreign matter and foreign crystals show no visible signs of contamination with dirt, oil, bilge or other extraneous materials. Sufficient salt levels in the final product are important for food safety, product preservation and consumer preferences.

Key words: fish, brining, dry salting, pickling, preservation

Introduction

About 15 % of the world fish catch is preserved by curing, i.e., salting, drying or smoking, or a combination of those treatments. Salting of fish is a traditional processing method in most countries of the world. The presence of sufficient quantities of common salt (sodium chloride) in fish can prevent, or drastically reduce, bacterial action. When fish are placed in a strong solution of salt (brine) which is stronger than the solution of salt in the fish tissue, water will pass from the tissue into the brine until the strength of the two solutions is equal. At the same time, salt will penetrate into the tissue. This phenomenon is known

...mosis. A concentration of between 6 – 10 % salt in the tissue will prevent ...ctivity of most spoilage bacteria and the removal of some water from the ... during the salting process will also reduce the activity of the spoilage ...eria.

...lting may be divided into salt preservation, as such, and ripening. ...ning, which is desirable for some fatty fish products, is a process that causes ...ges in the chemical and physical characteristics of fish flesh, generally by ... enzymatic process. The rate of ripening depends on the fish, the salt ...position employed, the temperature and the amount of salt absorbed by the ... tissues. These variables give rise to many different and uniquely ...acteristic products. Spoilage of fish is brought about chiefly by autolysis and ...obial decomposition. Most enzymes and micro-organisms are inactivated by ... salt concentrations, and the reduced moisture content of salted fish also ...lts in an unfavorable environment for the multiplication of micro-organisms. The salting process may be terminated when the fish have achieved the ...ired salinity and acquired the desired taste, consistency and odor.

Material and methods

Material

The choice of salt for salting depends on the method of salting, type of ...duct, the storage temperature of the product, the fish species, the method of ... etc. Bacteriological safety of the salt is important for the quality and safety ...fish and fish product.

Pure common salt is sodium chloride (NaCl) but almost all commercial salts ...ain varying levels of impurities depending on the source and method of ...duction.

Several factors which affect the rate at which salt is taken up and water is ...laced in fish are:

- the higher the fat content, the slower the salt uptake;
- the thicker the fish, the slower the penetration of salt to the centre;
- the fresher the fish, the more slowly salt will be taken up;
- the higher the temperature, the more rapid the salt uptake.

During subsequent drying the presence of salt has the following effects:

- the higher the salt concentration, the greater the replacement of water and, therefore, the less water that remains to be removed during drying;
- the higher the salt concentration, the less water that needs to be removed to produce a satisfactorily preserved product;
- the higher the salt concentration, the more slowly the fish dries;
- salt tends to absorb moisture from the air and at relative humidity of more than about 75 per cent during the drying process or during

subsequent storage, fish will not dry further; they may even absorb more moisture.

Salt used to produce salted fish shall be clean, free from foreign matter and foreign crystals show no visible signs of contamination with dirt, oil, bilge or other extraneous materials and comply with the requirements laid down in supplement 1 to the Code of Practice for Salted Fish (CAC/RCP 26-1979).

Methods of salting

There are three ways of fish salting: brining, dry-salting and pickle curing or a combination of these treatments, increasing the amount of salt in the fish substantially beyond that ordinarily found in the fresh product.

Results and discussion

Fish brining

Brining is the process of placing fish in a solution of salt (sodium chloride) in water for a period of sufficient length for the fish tissue to absorb the required amount of salt. Brine injection is the process for directly injecting brine into the fish flesh and is permitted as a part of the heavy salting process. With most brine salting techniques, a saturated brine solution is used. The presence of impurities may reduce the actual concentration of sodium chloride in solution and, in practice, the brine strength ranges between 80 - 100 %, which corresponds to 270 - 360 grams of salt to each litre of water. When fish are placed in saturated brine, the concentration of the brine begins to fall as soon as salt begins to penetrate the fish and water is removed. Unless plenty of brine is used and the fish are stirred frequently, the rate of salt penetration and water removal may be seriously reduced.

Fish dry - salting

Dry-salting is the process of mixing fish with dry salt and allowing the resultant brine (from dissolution of the salt in the water present in the fish) to drain away. Dry -salting results in a rapid loss of the weight of the fish. Dry salting is the process of mixing fish with suitable food grade salt and stacking the fish in such a manner that the excess of the resulting brine drains away. Dry or kench salting cannot be recommended for general use in the tropics as the fish are not covered by the brine or pickle and are, therefore, more susceptible to spoilage and insect attack. Exposure to the air and the presence of salt also encourages the rate of fat oxidation which gives rise to discoloration and the

characteristic rancid flavours. Fish should be covered with a saturated brine or pickle as rapidly as possible and kept covered until salting is completed.

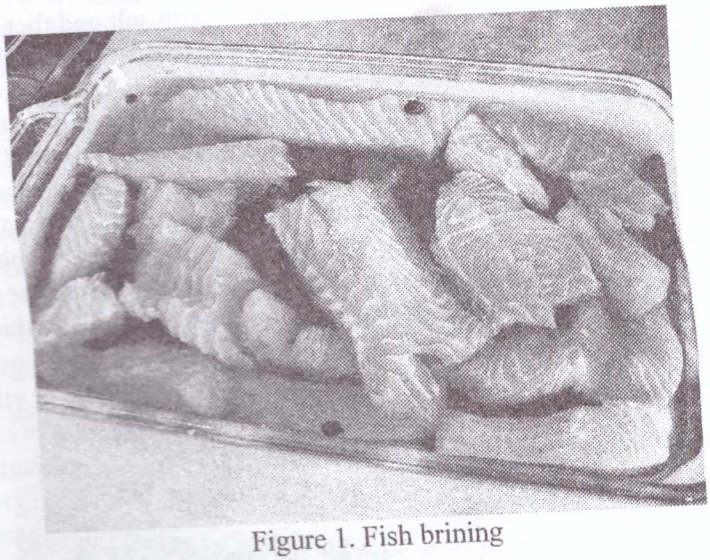

Figure 1. Fish brining

Figure 2. Fish dry - salting

Figure 3. Salted dry fish

Fish pickle curing

Pickling or pickle curing is the process whereby fish is mixed with salt and is stored under the brine (pickle) which is formed when the salt dissolves in the water extracted from the fish tissue. Fish flesh contains 75-80% water (very fatty fish 60-65 %), and this water can be replaced partly by salt in the preparation of salted fish, water diffusing from the fish becomes saturated with the surrounding salt and is termed "pickle". Wet salting (pickling) is the process whereby fish is mixed with suitable food grade salt and stored in watertight

containers under the resultant brine (pickle) which forms by solution of salt in the water extracted from the fish tissue. Brine may be added to the container. The fish is subsequently removed from the container and stacked so that the brine drains away. Pickle salting - fish are covered with salt and then packed in water-tight containers in layers with salt sprinkled between each layer. The pickle which forms covers the fish and if the fish are not completely covered in 3 - 4 hours, saturated brine is normally added to completely immerse them. A cover should be placed on top of the fish to hold them below the surface of the pickle. During pickle curing, the fish are surrounded by granular salt which, initially, dissolves in the surface moisture of the fish. Sufficient salt is then available to go into solution and maintain the pickle at saturation point as salt penetrates the fish and water is removed. The water extracted from the fish also contains blood and other compounds that help to reduce the rate at which fat in the fish is oxidised.

Figure 4. Pickled fish

The various chemical and physical effects of using salt on fish were discussed. Several of these are apparently contradictory and in commercial salted fish production a compromise may have to be reached to resolve the various factors. The rate of salt penetration of the flesh increases as the temperature rises. Increasing the temperature also increases the rate of spoilage. If fish are salted at a reduced temperature, e.g., +5°C, although the rate of salt penetration is reduced, the rate of spoilage is more drastically reduced and it may be possible to salt the fish to the centre before any serious spoilage occurs. Similarly, salt penetration is slower in fresh fish than it is in partly spoiled fish but it is impossible to make a good salt fish product from spoiled fish. In many

...ries, large fish are split before salting because this increases the surface area ...lso reduces the depth of flesh that the salt has to penetrate.

...ooden and plastic barrels are suitable for brine or pickle curing fish. The ...iner should be of a size and shape which allows the largest fish normally ...ded to be laid flat. Cement-lined vats or tanks are suitable for larger ...ities of fish and the vats should be able to hold one days' catch with an ...al depth of one metre. Wooden lids fitting internally to the tanks which can ...eighted down to hold the fish beneath the brine should be provided. Vats ...bs should be situated in the shade to keep the fish as cool as possible.

...e quantity of salt used depends upon the type of cure required, the type of ...nd the method used. For a strongly cured product, approximately 30 kg of ...er 100 kg of fish is required. Although salt prevents the growth of spoilage ...eria, other micro-organisms are not so affected by the presence of salt. ...ro-organisms can be conveniently divided into three groups by their ...itivity to salt:

- Low tolerance - growth is stopped, or the organism is killed, by the presence of low concentrations of salt. Most of the normal spoilage organisms fall within this group and a salt content of a few per cent will prevent growth.
- High tolerance - organisms which can tolerate high concentrations of salt although the rate of growth is usually reduced, or stopped, at very high salt concentrations.
- Halophiles - those organisms which cannot grow without salt.

...ith dry salted fish, the salt-tolerant and halophile organisms can continue to ...w but they cannot do so in pickle-cured products: most of them are aerobic ...anisms and the fish and brine of pickle-cured fish contains very little, or no, ...gen.

...ost enzymes activity is stopped in heavily salted fish but, with lighter cures, ...e fish may develop characteristic flavors as a result of enzymes activity and the ...wth of certain salt-tolerant organisms. If the salt levels and fermentations are ...t carefully controlled, putrefactive spoilage may occur.

...raditional processes used in the preparation of salted fish in various regions ...ve been described. According Ah-Weng et al. (1985), almost 30% of the fish ...ught in Southeast Asia is preserved by curing (salting, drying or smoking).

...annenbaum et al. (1985) noted that in South China salting is done in ...ooden vats, and the fish are arranged in alternate layers with coarse rock salt. ...fter a few days, the fish are immersed in brine and weights (often large stones ...aced on top of grass mats) are placed on the surface to prevent the fish from ...oating. The length of salting ranges 1 - 5 days, after which the fish are taken ...t to dry in direct sunlight, usually spread on woven grass mats. They are

turned every few hours and left out for one to seven days, depending on the s of the fish and the weather.

According Armstrong and Eng (1983) in Malaysia, most fish for salting a sprinkled and stuffed with crude sea salt and placed in a tank. When the tank full, the fish are covered and compressed with bricks or stones. After 2 - 3 da of pickling, the fish are either smoked or left as is and put to dry in the sun. T more expensive varieties of salted fish are sometimes marinated in jars cooking before dispatch to market.

In Tunisia, salted anchovies and sardines are prepared by alternating layers salt and fish in glass or earthenware containers, which are then sealed and sto for up to three years. The fish is used mainly in salads (Hubert, 1984).

In Egypt, sand-salted fish is prepared by covering the gills and body of fi with salt, wrapping it in canvas and burying it in sand for 15-30 days. Tin-salte fish is made by covering the gills and body with salt and then leaving the fish fo several hours in the sun until the body has swollen. The salt is then renewed, an the fish is arranged in alternate layers with salt in a special tin or barrel. Treate fish is consumed after at least 10 days' storage (Elmossalami and Sedik, 1972).

Conclusion

Salt can be an important method of preserving smoked fish and controllin bacteria that are capable of causing food borne illness. However, the use of sal in fish to import desirable flavors often varies according to taste preferences and generally over the years has changed to a lighter salting.

The combination of refrigeration temperatures and prescribed salt levels offe a high degree of assurance that bacterial growth will be retarded. High sal concentrations result in the osmotic transfer of water out of, and salt transfe into, the fish. The removal of water appears to limit bacterial growth and enzym activity.

The most commonly used methods of salting fish are liquid brining and dry - salting. In each case, the amount and rate of salt absorption are affected by a variety of factors. Fish absorbs salt faster from higher salt brine concentrations. Strong brines with short brining periods, however, may not allow for an even distribution of salt.

Thicker pieces of fish also make it difficult to obtain a proportionate salt distribution. For instance, when the flesh thickness doubles, the time required to achieve an even distribution of salt may require a brining period that is three times longer. Loading arrangements should also be considered to have the proper salt exposure. Even though fish will absorb salt faster as the brining temperature increases, it is best to standardize brining at a cool temperature 1 -

C. Besides discouraging bacterial growth, this will help achieve consistent and dictable results.

Tough or firm - textured fish and fish with a high fat content will absorb salt wer than soft - textured fish or low fat fish. Fish containing more fat, wever, needless salt to obtain the desired WPS content. It is also notable that viously frozen fish or low quality fish have flesh characteristics which rease the rate of salt absorption.

Sufficient salt levels in the final product are important for food safety, oduct preservation and consumer preferences. Due to the many variables it is tical to develop a processing formula for each species of fish and to ensure t it is rigidly followed. Regular salt level testing of the final product should be integral part of the process.

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