# HIGH TEMPERATURE SALTING OF FISH MINCE

by

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## ABSTRACT

Freshly caught miscellaneous fish were transported to the laboratory, gutted and washed before mechanical separation into bone and mince. Seven batches of the mince were then treated with seven different concentrations (Wt/Wt) of sodium chloride before cooking. The cooked mince was divided into two groups, pressed and unpressed. Percentage residual salt of the salted cooked mince, cooked water and salted pressed mince was determined. Also, the moisture content of the salted cooked mince and salted pressed cake was determined.

The moisture content of both the salted cooked mince and salted press cake decreased with percentage added salt and an equibirium was reached around 20% level of added salt. However, the moisture content of the pressed cake was lower than that of the cooked mince after 10% level of added salt. It is interesting to note that the residual salt in both the cooked and pressed mince increased with increase in added salt up to 20% where there was an equibirium in the pressed mince. Furthermore, there was a direct relationship between percentage residual salt in salted cooked mince and percentage salt in the cooked water.

## INTRODUCTION

There is an abundant potential of small sized fish species which are under-utilized in most parts of the world, the extent of which is estimated at over 6,000,000 metric tonnes, but most of these fishes are mostly regarded as trash. Because of the need to increase the protein consumption of the developing countries such as Nigeria, it is necessary to examine ways of utilizing these so-called trash fish.

Fish is an important nutrient as it is high in proteins, lipids, minerals and vitamins. However, these nutrients vary with species. Because fish deteriorates quite rapidly, unlike meat, it is necessary to prevent various stages of deterioration so as to make it available for human consumption. Preservation techniques that are designed to prevent deteriorative processes include icing, freezing, canning, drying, smoking and solutes particularly salt.

Solutes are used to reduce the water activity of fish tissue. Scott (1953; 1955 & 1957) introduced the concept of water activity as a quantitative approach to the influence of water on microbial proliferation in foods. Essentially, the solutes must be compounds that have good solubility in water and must be able to exhibit very large negative deviation from Raoulth Law (Benmergui et al, 1979). Benmergui et al (1979) have also shown that many compounds including calcium chloride, magnessuim chloride, calcium iodide, sodium chloride, potassium acetate and sodium formate are all able to exhibit negative deviations from Raoult Law thereby, depressing water activity. However, these workers pointed out that no single electrolyte can provide adequate depressions of water activity when applied at a level that is organoleptically acceptable.

Inspite of this theoretical consideration, it is possible to use sodium chloride at low levels to inhibit bacterial growth and at high levels to prevent their growth. The mechanisms of the action of salt as a preservative are more complex and there appears to be a conflicting understanding of the process involved. However, Scott (1957) reported that salt acts by lowering the available water to micro-organisms. It has been observed that halphilic bacteria are able to survive high salt concentration because they need sodium chloride to maintain the stability of their cell walls (Moht and Lorsen, 1963).

Duer and Dyer (1952) revealed that the myosim fractions of fish muscle proteins were denatured when a critical salt concentration of approximately 8 - 10% was reached and that the rapid denaturation was accompanied by a sudden increase in salt uptake and moisture loss. Thus in practice, it is necessary to use levels above 10% salt to lower the water activity of fish as a means of preservation.

Penetration of fish muscle by salt cannot be over emphasised. Thus, high temperature has been employed in salting process of fish mince and muscle because the penetration of sodium chloride into and the removal of water from fish mince have been found to be faster (Taylor, 1922; Dyer, 1942; Talabi, 1982). These workers revealed that the critical salt concentration was reached in a much shorter time at higher temperatures. Furthermore, Kroemer and Knumbholz (1931) observed that the maximum salt concentrations in which growth occurs is greater at lower temperatures.

Because the underutilized fish are generally thrown away, we have attempted in this laboratory to develop a process whereby these fish can be fully utilized and made available for human consumption but the various properties of products from this process using high temperature, salting and pressing have not been elucidated. Thus, the specific objective of this work was to make a preliminary investigation into the effects of high temperature salting on the moisture and residual salt contents of the mechanically separated fish meat in the fully understanding that the amount of salt retained by the products and their moisture content can be used to predict to a large extent the keeping quality of these product.

## MATERIALS AND METHODS

Fresh miscellaneous fish caught off Lagos area coastal water using Federal Argonaught were washed with seawater and stored in ice before transporting to Nigerian Institute for Oceanography and Marine Research (NIOMR)'s processing room. The fish were gutted and washed before being mechanically deboned using Boader 694 separator. The mince was collected and divided into seven batches which were mixed thoroughly with different salt levels (0, 5, 10, 15, 20, 25, 30, and 35% wt/wt).

Each batch of salted mince was passed through a cooker/press system with facilities for collecting:-

(a) the free at 80°C water produced during cooking, and

(b) the press water.

The cooked mince was divided into two groups. One group was not pressed (cooked mince) while the other group was pressed into cakes (salted preseed cake: SPC). Liquid samples were collected when salted mince was steaming, when it was cooked and the cooked mince was being expressed and finally when mechanical pressure was applied to the cooked mince. The cooked and pressed mince were put in polythene bags, while all water samples were put in vials and stored in the refrigerator for salt and moisture analysis.

## Determination of Sodium Chloride

The salt content of the salted cooked mince (SCM), SPC and cooked water was determined by a modified A.O.A.C. (1975) silver nitrate titremetic method.

## Determination of Moisture Content

The moisture contents of the SCM and SPC were determined by direct distillation (A.O.A.C., 1975).

## RESULTS

The effect of varying levels of salt on the moisture content of the cooked mince and the pressed cake are presented in Figure 1. Between 0 and 5% added salt, the cooked and pressed cake produced did not show much difference in their residual moisture since approximately the same levels of moisture was observed. At a level of 10% added salt, the residual moisture content of the pressed cake fell to a level (70%) that was lower than that of cooked mince (75.25%). In general, between 0 and 10% added salt, the effect of salting can be said to be directly related to a gradual loss of water with increasing addition of salt to the raw mince. Between 10 and 20% added salt, there was a drastic drop in the residual moisture level of the cooked mince and pressed cake after which equilibrium appeared to be attained. It is, however, interesting to point out that the residual moisture levels in the SPC beyond the 5% level of added salt were consistently lower than in the cooked mince. This appears to be due to the effect of pressing and it seems that the effect appeared to be taking place beyond 15% added salt.

The effects of salting on residual salt in cooked mince and pressed cake are shown in Figure 2. The variation of added salt with the residual salt in the cooked mince was up to the level of 20% added salt. Between 20% and 35% added salt, there was a step-wise increase in the residual salt content. Almost a linear relationship similar to what was observed in the cooked mince was also noticed in the pressed cake between 0 and 20% added salt. Beyond 20% salt, there was an equilibrium in the residual salt content of the pressed cake. The salt levels were consistently lower in the pressed cake than in cooked mince and the effect of pressing appeared to be fairly constant until 25% salt was added to the mince. At this point and beyond, the effect of pressing became significantly pronounced. The shaded portion in Figure 2 represents the effect of pressing.

While 20% appeared to represent the equilibrium in pressed cake in respect of residual moisture and salt (Figure 3), the moisture and salt equilibrium in respect of the cooked mince material seemed to be less well defined. For instance, the moisture equilibrium point was 20% whereas, in the salt, two equilibrium points (20% and 30%) appeared to have given rise to the step-wise curve in Figure 2.

The repression curve (Figure 4) shows that there was a direct relationship between residual salt in the cooked mince and the residual salt in the cooked water.

## DISCUSSION AND CONCLUSION

Salt as a preservative has been widely used for several years. Unfortunately, with the development of refrigerative technology, research efforts for food preservation has continued to decline. This is even true of the tropical third world countries which can least afford the luxury of refrigeration. In the preliminary work of Del Valle and Nickeson (1968), the equilibrium consideration relevant to fish mince were examined in respect of ambient temperature and considerable fundamental knowledge were established which were later applied in products development studies (Bellos and Pigott, 1979; Young et al, 1979). Salting of fi at room temperature facilitates an energy efficient removal of water from fish muscle thereby lowering the water activity and the susceptibility of such product to microbial damage. Duerr and

Dyer (1952) observed that salt dematuration point of cod protein was at 10% and this corresponded to the point at which high moisture loss began during salting.

There has been a few publications on the application of these concepts by Del Valle et al (1973) at fairly elevated temperature. The most notable of these publications was by Talabi (1981) in which meat analogues were salted at high temperture and which resulted in a reduction to traditional ambients temperature salting time when compared to traditional ambient temperature salting. The approach has now been adapted to the salting of mechanically separated fish mince and forms the basis of this study.

Results presented in Figure 2 clearly shows that an almost linear relationship exists between the amount of salt added and the residual salt that could be obtained when such a mince is subjected to cooking. The ensuing product is, however, considered fairly wet since it still contains a high moisture content when a high level of salt (35%) is added (Figure 1). Such a material containing a high level of salt (over 20%) would contain a minimum of 13% salt as Figure 2 shows. However, it is felt in this study that it will be possible to remove part of the moisture by a process of pressing in order to remove the possibility of the microbial damage. When pressing was carried out on the cooked minces in Figure 2, some degree of loss of salt was experienced and the shaded protein shows the effect of the application of pressing. The technological significance of pressing is that it enables a reduction in the amount of moisture that is available for microbial growth so that the salt level that will be required to prevent such growth will become considerably reduced. The overview of Figures 1 and 2 i.e. Figure 3, clearly shows that because equilibrium is attained with pressure at 20%, it seems logical to suppose that at that level of salt, increasing the pressure on the pressing equilibrium may result in a lower level of moisture. But this was not investigated in this study. It is apparent from this results, however, that the cooked mince has a maximum capacity of salt and water relation (subject to the pressing conditions which for the salt was 11% and for moisture 15%).

Theoretically, this salt level (20%) will still have not saturated the residual moisture of 51% and as such, the product may not be stable to some microorganisms. It appeared from Figure 3 that theoretical saturation has been achieved only in the cooked mince at a level above 30% added salt which corresponded to 16.8% salt and 55% moisture. The theoretical saturation point of sodium chloride (salt) used is 26.6% at 20%. This condition allows a salt saturation of sodium chloride in water at 20°C. Theoretically, this condition will adequately prevent bacterial growth.

Under the condition prevailing in the equipment used in this study, it was not possible to produce pressed cake of micro-biologically free quality, since it would not be possible to saturate the residual moisture in pressed cake with salt. It is, therefore, felt that the pressure may be increased for improved product.

However, it is possible to produce a microbiologically stable cooked mince by the addition of a minimum of 30% sodium chloride prior to cooking. Alternatively, it should be possible by direct addition of salt to the pressed cake to increase the salt level to a level that will prevent microbial growth. Further work is being contemplated along this direction.

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