

EFFECTS OF SALT AND ICE ON THE EXTENSION OF SHELF LIFE OF PUNTI FISH (*PUNTIUS STIGMA*, CUVIER AND VALENCIENNES 1844) DURING SHORT-TERM PRESERVATION

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Abstract

The present study has been carried out to investigate the effects of salt (NaCl) and ice on the extension of shelf life of *Puntius stigma* during short-term preservation in brine with addition of ice. The fish have been kept at different salt concentrations (0, 4, 10 and 15%) and at two different storage temperatures (12 and 30°C). The shelf life of the fish has been studied by measurement of TVN value and by sensory method. The fish kept at 0% salt concentration at 30°C has been found to have shelf life of 6.25 hours while at 15% salt concentration the fish have been found to have shelf life of 28 hours at the same storage temperature. Lowering the temperature to 12°C with the addition of ice the fish kept at 0% salt concentration have been found to have shelf life of 28 hours and at 15% salt concentration, the shelf life of the fish extended to 60 hours. Acceptable limit of the TVN value at 30°C was found to be 38 mg/100 g fish. No correlation between sensory score and TVN value was observed during the preservation of the fish at 12°C storage temperature. The present findings revealed that the increase of salt concentration and decrease of storage temperature during short-term preservation favors extension of shelf life of the fish.

Introduction

In Bangladesh like many other countries in the world, post harvest handling, processing and preservation of fish play a vital role in order to keep the fish in acceptable condition to the consumers. Fish as food has been playing an important role in the world food security including Bangladesh. Fish contributes about 80% of the total animal protein in the diet of people of Bangladesh.⁽¹⁾ Fish protein is highly digestible (85 - 95%) and all the dietary essential amino acids are present in fish muscle.⁽²⁾

From time memorial humans discovered the way of long-term preservation of fish for off season using by salting, drying and smoking. But preference for fresh fish is increasing with the advancement of civilization. As a result, wet and modern

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processed fish such as canned or frozen fisheries product are being produced. Currently keeping the quality of fish is one of the major problems in post harvest techniques in fisheries.⁽³⁾

The preservation of fish to retain its edibility and controlling its quality to the general level of acceptance by the consumers is mainly related with the inhibition of bacterial contamination and proliferation simultaneously with retardation autolysis which individually or in combination eventually make fish unmarketable, unedible and unacceptable for humans.⁽⁴⁾ Common salt (sodium chloride, commercial grade) is used to preserve fish by extracting water from fish tissues and penetrating into fish.⁽⁵⁾ Fish markets in Bangladesh, particularly in the urban areas, it was observed that fish sellers keep small indigenous fish in water adding some common salt and on ice in order to extend the shelf life of the fish during marketing to reduce economical and nutritional loss resulting from spoilage. Salt curing has been practiced as a long-term preservation method of fish all over the world⁽⁶⁻⁷⁾ and in Bangladesh it is the only technique for the preservation of Hilsa fish.^(1, 8)

Punti is abundantly available in shallow fresh waters of Bangladesh from June to September. The fish also distributed across India, Ceylon, Burma and Malaya.⁽⁹⁾ This fish is nutritionally enriched and is palatable to eat. A few published reports are available on the nutritional value of punti. However, information is not available on its shelf life during marketing in brine (salt solution) with or without ice particularly in urban areas. As a result, it was imperative to investigate the effectiveness of using salt and ice to increase the shelf life of punti fish (*Puntius stigma*) in laboratory. Therefore, an attempt was made to test salt and ice to increase shelf life of punti at fish technology laboratory of IFST, BCSIR, Dhaka.

Materials and Methods

The experimental fish was bought from different fish markets in Dhaka. To find out the effectiveness of the use of salt and ice for the extension of shelf life of punti fish (*Puntius stigma*) in laboratory condition salt, ice, water and raw punti fish have been used as raw materials during self-life study. The chemical parameter was total volatile nitrogen (TVN) of the fish muscle. Nine-point hedonic scale of acceptance was used as the physical parameter to determine the quality of fish.⁽¹⁰⁾ The average score 5 was considered as the borderline of acceptance.

According to Pearson and Muslimuddin⁽¹¹⁾ TVN has been widely used as an index of freshness of fish quality. Modified Conway micro diffusion technique was used to determine blood ammonia which was originally devised by Conway and Byrne.⁽¹²⁾ Pearson⁽¹³⁾ simplified this method by using boric acid solution instead of

standard acid in central compartment of the Conway dish, and was titrated by $N/70$ H_2SO_4 solution.

Results and Discussion

The fresh quality of the *Puntius stigma* has been determined by chemical and physical parameters i.e., by estimating the TVN values at different salt concentrations and by sensory score judgment as assessed by panel of judges and at 30 and 12°C has been represented in Figs. 1, 2 and 3. It is evident from Figs. 1 and 2 that the increase of TVN value gives an inverse relation with the result obtained by sensory method (30°C). With the progress of preservation period, the TVN value has been found to be increased while the sensory score value has been found to be decreased. It is observed that TVN value and sensory score values have got inverse relationship with each other. The TVN value is considered to be a measure of spoilage change of fish that is with the increase of storage period the TVN value of the fish increases with the concomitant decrease of salt concentration. The fairly increase of TVN value with the increase of storage time had also been observed by Pearson and Muslemuddin.⁽¹¹⁾

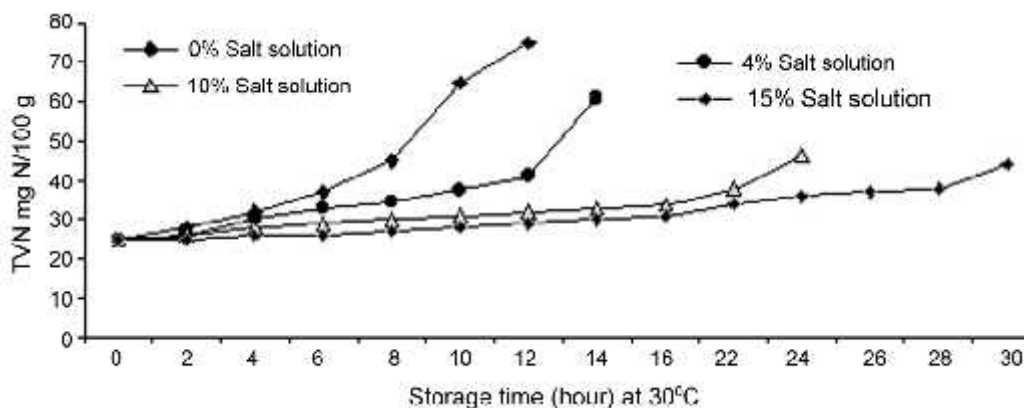


Fig. 1. TVN value of punti fish at different salt concentrations during short-term preservation in brine at 30°C.

However, the TVN value in fish muscle kept at 12°C (Fig. 2) did not show any increase with the progress of preservation period in brine, rather it was found to decrease. In other words at this lower storage temperature with the addition of ice in salt solution, the TVN value did not show any correlation with the result obtained by sensory method as observed in case of fish studied at 30°C. The lower TVN value at this lower storage temperature (12°C) might be due to the leaching out of soluble nitrogenous substances formed as a result of spoilage at slower rate in brine solution.

This trend of observation have got similarities with the findings of Muslemuddin *et al.*⁽¹⁴⁾ who also reported that though the production of TVN increased with the progress of storage period in ice, it did not show the rise with time due to leaching action of melt water. However, at 30°C, the rate of formation of TVN must have superceded the leaching action, thus showing an increase of the TVN value with the length of storage time. The above finding led to the suggestion that during spoilage change investigation in lower temperature (12°C) the use of chemical parameter does not give any clear index of spoilage change. In that case sensory method should be followed very carefully.

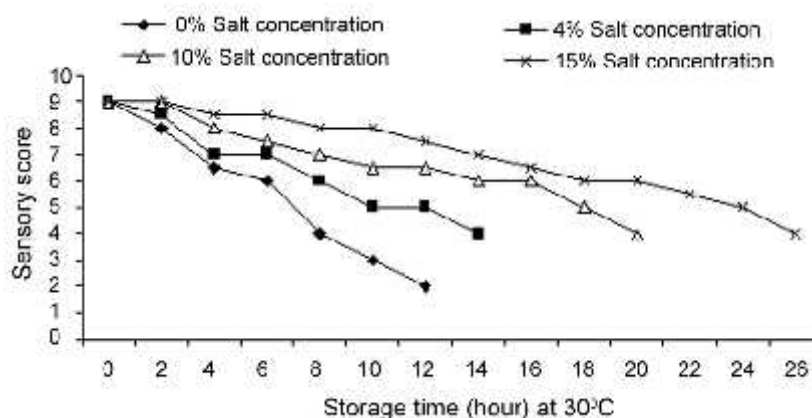


Fig. 2. Sensory score value of punti fish muscle at different salt concentrations during short-term preservation in brine at 30°C.

The shelf life of punti fish (*Puntius stigma*) as determined by sensory method at different salt concentrations and at different storage temperatures 30 and 12°C (the lower temperature is maintained by addition of ice in brine solution) has been represented in histogram (Fig. 3). It has been observed from the histogram that the length of shelf life is directly proportional to the increase of salt concentration in brine and it is inversely proportional to the temperature of the brine. The shelf life of the fish becomes more and more lengthy with the decrease of temperature as for example, the fish kept at 0% salt concentration without adding any salt to it become unacceptable to the panel members of the sensory score evaluation judges after only 6.25 hours at 30°C, but at 15% salt concentration it remained acceptable even up to 28 hours at the same storage temperature. This trend of observation of extending shelf life with the treatment of salt with increasing concentration, has got similarities with the findings of several others like Tresler and Lemon,⁽¹⁵⁾ Cutting and Waterman⁽⁶⁾ who held the view that the main feature of salting is the removal of sufficient water from the fish tissue by partial replacement with salt. As a result a condition is arrived when spoilage activities are slowed down.

By lowering the temperature of the brine solution, the shelf life of experimental fish has been found to be increased further. At 0% salt the shelf life increased from 6.25 to 28 hours at 12°C and at 15% salt concentration the shelf life of the fish increased from 28 hours at 30°C to 60 hours at 12°C. This finding shows that the combination use of salt in the brine solution and lowering of temperature by addition of ice is the

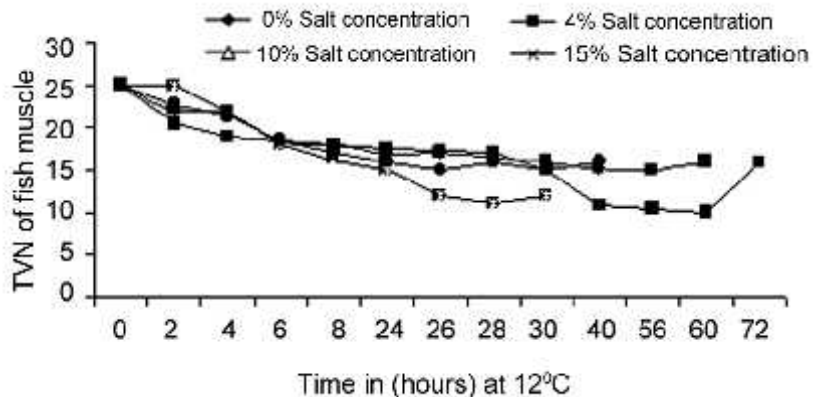


Fig. 3. Changes in TVN value of punti fish during short-term preservation at 12°C in brine.

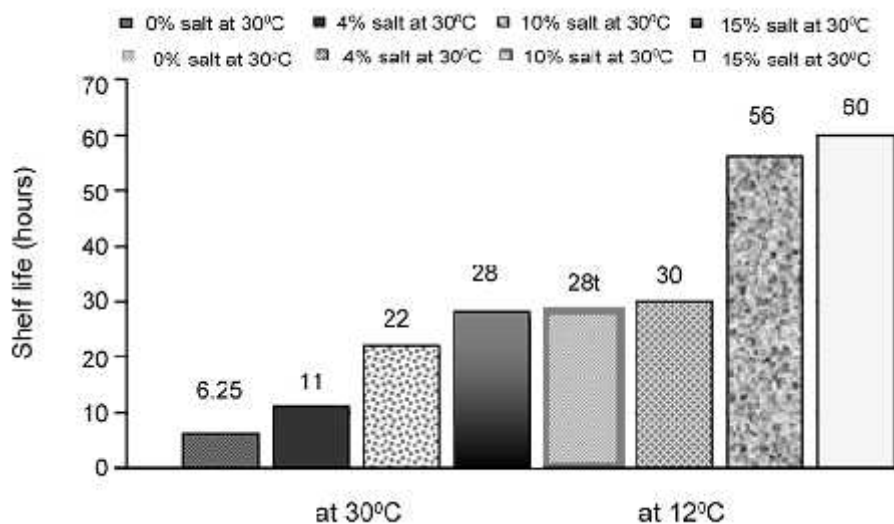


Fig. 4. Variation in shelf life of the punti fish due to variation in salt effect and temperature effect during its short-term preservation in brine.

most effective method of extending shelf life in this short-term preservation method. Thus the effect of lowering temperature has further increased the keeping quality of the fish in addition to the salting action of retarding spoilage in this method. And the

slower rate of spoilage, which leads to the longer shelf life of the punti fish, is due to further retardation of bacterial and enzymic activity at lower storage temperature (12°C).⁽¹⁵⁾ This sort of slow rate of spoilage change has also been advocated by Schille and Messterff⁽¹⁶⁻¹⁷⁾ who held the view that the bacterial action is delayed by chilling the fish in ice. Hess⁽¹⁸⁾ made a thorough study on the influence of temperature within the range of - 1 to + 2°C and concluded that a lowering of temperature becomes more and more effective in retarding bacterial decomposition thereby increasing the shelf life of the fish.

The overall findings of the present investigation suggests that the shelf life or the keeping quality of the small variety of fish could be extended by keeping the fish in water with the addition of common salt which has got preservative action.

Addition of ice in brine solution has got preservative action by lowering the temperature where the fish has been kept for short-term preservation in laboratory condition and can further extend the shelf life of the fish. Thus the use of salt and ice in brine solution in proportionate amount for short-term preservation of small variety of fish have been found to be effective in extending the keeping quality or shelf life of the fish. In other words the effectiveness of the use of salt and ice in brine solution, where the fish is kept in laboratory condition during the present study has been found to be correct and effective. It is therefore, concluded that the combination use of salt and ice in brine solution in proportionate amount is helpful in prolonging the keeping quality or shelf life of the small variety of fish which in turn will be beneficial for both the fish seller and the consumers while marketing the fish.

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