

PART II
SCIENTIFIC AND TECHNICAL

**TIME LAG BETWEEN CATCHING AND CURING OF FISH
AND ITS INFLUENCE ON THE FINISHED PRODUCT
I. MACKEREL**

T. S. UNNIKRISHNAN NAIR AND A. P. VALSAN
Central Institute of Fisheries Technology, Unit, Calicut-5

A study is made to determine the maximum permissible time lag both under iced and uniced storage conditions between the catching of mackerel (*Rastrelliger kanagurta*) and its curing, so that the quality of the finished product is within tolerable limits. Based on physical, chemical, bacteriological and taste panel studies the maximum time lag permissible is fixed as 8 hrs under uniced condition and 3 days under iced condition. Icing of fish is also found to affect the tasting qualities of the finished product.

INTRODUCTION

The quality and shelf life of cured fish are known to be intimately related to the initial freshness of the fish at the time of curing, inadequacy of which partially accounts for the poorer quality and shorter shelf life often observed in Indian cured products. There is a general tendency in the Indian fishing industry to dispose off as much fish as possible for fresh consumption. Huge stocks of fish may thus have to wait considerable lengths of time for their disposal, resulting inevitably in their quality deterioration. It is the latter type of unsold fish which usually find their way into the curing industry. Such raw material may have remained unpreserved for indefinite periods and consequently would be highly variable in their

degree of staleness and decomposition. Unless specific steps are taken for preservation, the freshly landed fish deteriorate beyond the standards of human consumption within a short period which varies according to prevailing climatic conditions and fish species. Obviously, it is imperative to determine and stipulate the maximum time lag that is permissible between the capture and actual curing of the fish in order to ensure good quality of the finished product. Studies on this subject are conducted at this research Unit with reference to the important commercial fishes of this region; viz; mackerel, sardine, shark and prawns. The details of these studies pertaining to mackerel are presented in this paper.

MATERIALS AND METHODS

150 numbers of absolutely fresh mackerel caught by boat seine nets very near to the shore were procured and immediately transported to the laboratory. The fish belonged to the size group 20.0-21.5 cm and averaged 10 numbers per kg. Immediate analyses of the fish for physical, chemical and bacteriological factors were carried out. The fish was divided into 2 lots for carrying out the investigations under iced and uniced (room temperature) conditions. In the case of the study of the spoilage of the fish under room temperature conditions, the lot of fish was further sub-divided into 8 portions and were kept in baskets exposed to atmospheric conditions in the laboratory itself. The room temperature and humidity were recorded at intervals of 2 hours. At the prefixed stages of spoilage, viz; 3, 5, 7, 8, 9, 10, 11, and 12 hrs. each of these portions was subjected to detailed analysis for the various factors as have been done for fresh sample and were then processed by the dry curing method of Pillai, *et al* (1956), which is the most common commercial method in this area for curing mackerel. A salt ratio of 1:5 was adopted. After the salting period, the samples were sun dried to uniform moisture levels.

In the study under the iced conditions, the fish was kept in an insulated box with drainholes, well mixed with crushed ice (1:1 ratio). The ice was periodically replenished throughout the course of this experiment and samples of 8 mackerel each were withdrawn at intervals of 24 hrs. They were analysed and cured in the same manner as the uniced samples. In both these sets of experiments, maximum efforts were made to emulate the practical trade conditions as far as possible. The finished products in both the sets of experiments were kept for storage study in glass containers. During storage, physical

observations of these samples were conducted at fortnightly intervals and chemical analyses at monthly intervals.

Physical observation of the samples at raw material stage consisted of (1) colour, (2) odour, (3) condition of gills, eyes and abdomen, (4) texture and (5) general appearance. During storage study, the colour, odour, onset of red and fungus and general appearance were noted at fortnightly intervals. Chemical analyses consisted of the following factors:

(1) Moisture: Determined by the method of A. O. A. C. (1955).

(2) Total Nitrogen: Determined by the A. O. A. C. method (*loc cit.*) using microkjeldahl distillation apparatus.

(3) Non-Protein Nitrogen: A suitable volume of protein-free filtrate from samples of known weight was digested and nitrogen determined as usual.

(4) Total Volatile Nitrogen: The Conway microdiffusion technique (1947) was employed.

(5) Trimethylamine: The Conway microdiffusion method (*loc cit.*) was adopted to determine this factor.

(6) The salt content of the fresh sample was also estimated as described in A. O. A. C. (*loc cit.*)

Bacteriological study comprised of the assessment of total count only. This was done by plating serial dilutions of the homogenates in sea water agar and incubating for 48 hrs. at room temperature.

RESULTS AND DISCUSSION

In a general spoilage study like this, the importance of climatic conditions is well realised. However, on account of the impracticability of carrying out the entire investigation under different controlled temperature and humidity conditions, it has not been attempted. The tempera-

ture and humidity variations have been recorded throughout the study, which for practical purposes may be taken to represent tropical conditions.

The atmospheric temperature during the days of the experiment varied between 24°C and 31°C and humidity between 84% and 85%. During the period of the shelf life study of the finished products, the variation in temperatures were between 17°C and 36°C and humidity between 55% and 100%.

(a) *Spoilage at room temperature conditions:*

(i) *Effect on raw material:*

The data of physical observation on the raw material are presented in Table I. Based on the colour, odour, general appearance and the condition of the gills, eyes and abdomen and muscle tissue, it can be seen that the deterioration of the fish during the first 5 hrs. was very gradual and almost imperceptible. After this stage, the deterioration appears to have gained acceleration till a critical stage is reached at the 8th hour. Then onwards there was abrupt deterioration. These findings are fully substantiated by the chemical factors like TVN, TMA, NPN and total bacterial count depicted in figure 1.

(ii) *Effect on finished products*

The organoleptic qualities of the cured fish products prepared from materials from the different sub-samples are presented in Table II. These factors indicate a close relationship between the period of spoilage the raw material had undergone and the quality of the finished product. Accordingly, finished product obtained from raw material of upto 5 hrs of spoilage were adjudged to be good, based on odour, flavour, texture and colour characteristics. The products of 7 hrs and 8 hrs of spoilage were found to be just satisfactory. The finished product from more than 8 hrs

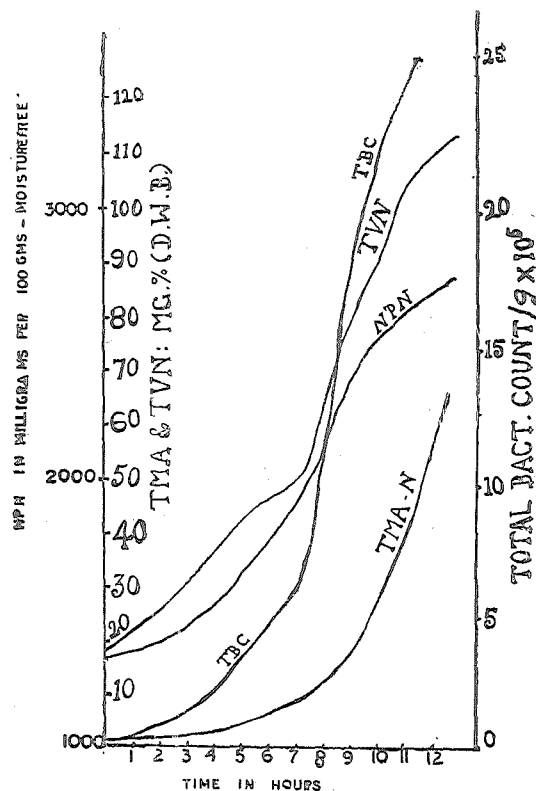


Fig 1 Changes in TMA, TVN, NPN and Total Bacterial count in mackerel stored at room temperature.

spoilage was found to be very poor in quality with perceptible off odour. Their texture also became very soft tending to be pasty and were unanimously unacceptable to the taste panel body.

The spilage indices of the finished products (fig 2) also indicate a direct relationship with the period of storage. This is true with respect to the initial values of these samples as well as when they are kept in storage for shelf life studies. Finished products from fresh raw material had a TMA value of just 1.3 mg % and TVN value of 37.5 mg %. These values steadily advanced almost proportional to the period of exposure to room temperature conditions and indicate that after the 8 hrs stage, the finished products in the initial stage itself was in a very poor condition and they further deteriorated when they were kept in storage.

TABLE I PHYSICAL OBSERVATIONS OF THE RAW MATERIAL AT ROOM TEMPERATURE BEFORE CURING

Sample No.	Details of samples	Odour	Colour	Gills	Eyes	Abdomen	Texture	General Appearance
I	Absolutely fresh	Natural fresh	Fresh	Red	Shining	Intact	Characteristic of fresh fish	Excellent
II	After 3 hrs.	Fresh	Almost as above	"	"	"	Almost as above	Very good
III	" 5 "	Almost fresh	Slightly tarnished	Slightly dark	"	"	Normal	Good
IV	" 7 "	No off	More tarnished	Slightly pale	Less shining	"	Slightly soft	Moderately good
V	" 8 "	Slightly off	Pale yellow	More pale	Slightly dull	Slightly loose	Softer	Satisfactory
VI	" 9 "	More off	More yellow	More pale	More dull	"	"	Below average
VII	" 10 "	"	Dirty yellow	Very pale	Dull	Loose flabby	More soft & loose	Below average
VIII	" 11 "	Very off	"	"	Very dull	Belly bursting	"	Stale
IX	" 12 "	Putrid	Very intense yellow	"	"	More belly bursting	Extremely soft & loose	"

TABLE II ORGANOLEPTIC DATA OF THE FINISHED PRODUCTS FROM SAMPLES SPOILED AT ROOM TEMPERATURE, JUST AFTER CURING

Sample No.	Odour	Taste & Flavour	Texture	Overall Grading
I	Good	Good	Firm	Good
II	"	"	"	"
III	"	"	"	"
IV	Satisfactory	Satisfactory	"	Satisfactory
V	"	"	"	"
VI	Slight off	Poor	Soft	Below average
VII	More off	Very poor	More soft	Putrid and unacceptable

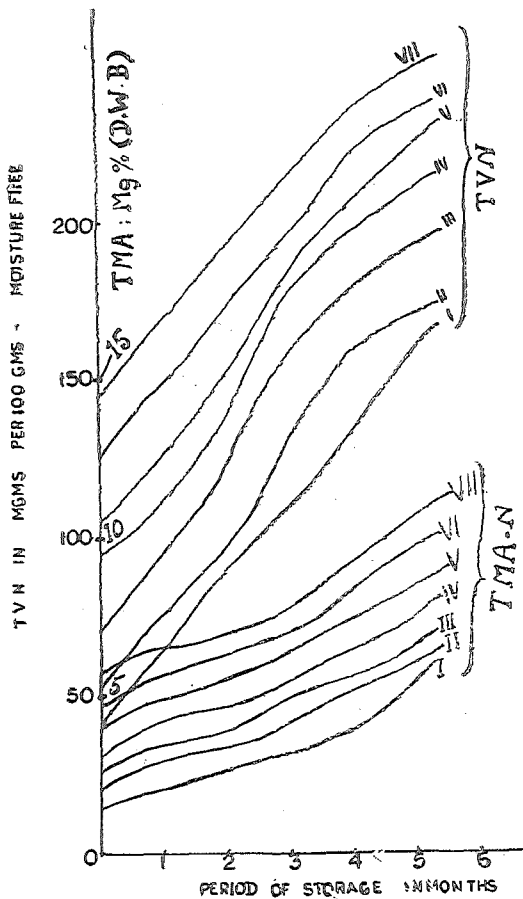


Fig 2 Changes TMA and TVN in mackerel cured from samples held at room temperature during storage.

(b) Storage under iced conditions
(i) Raw material

The data on the organoleptic condition of the fish presented in Table III indicate that the fish kept in ice storage for 3 days remained in good condition, after which they deteriorated rapidly. This observation is fully corroborated

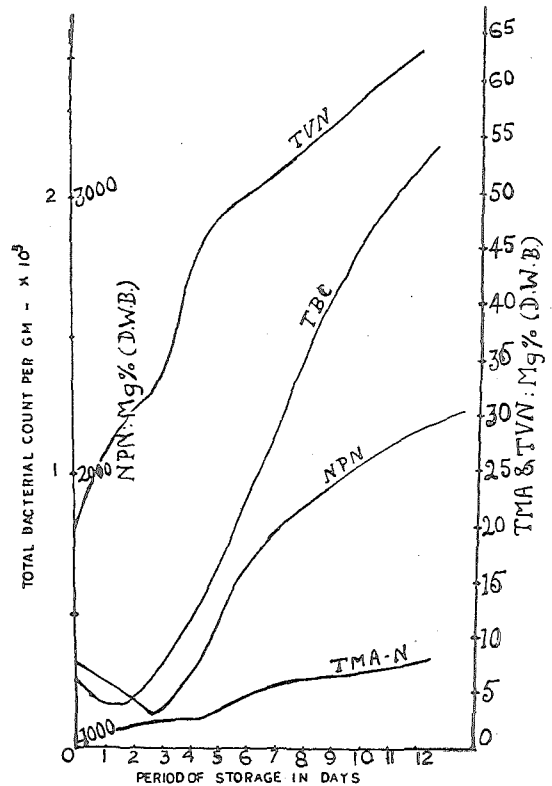


Fig 3 Changes in TMA, TVN, NPN and Total Bacterial count in mackerel stored in ice.

by chemical and bacteriological data presented in fig 3. It may also be noted that compared to samples at room temperature conditions, some of these chemical factors recorded lesser values. This may partly be due to the leaching out of these water soluble constituents during iced condition.

(ii) Effect on finished products

The data on organoleptic and taste panel studies presented in Table IV

TABLE III PHYSICAL OBSERVATION DATA OF THE RAW MATERIAL UNDER ICE STORAGE BEFORE CURING

Sample no.	Details	Colour	Odour	Gills	Eyes	Abdomen	Texture	General Appearance
I	1 day's icing	Not faded	Almost fresh	Very slightly pale	Alright fairly bright	Intact	Normal	Good
II	"	"	"	"	"	"	"	"
III	"	Slightly faded	No off	Slightly pale	"	"	Slightly soft	Satisfactory
IV	"	General fading of colour	Slight off	Paler	Slightly dull	"	Softer flesh	Below average
V	"	More fading	More off	"	Dull	"	"	"
VI	"	Much tarnished	"	Very pale	"	"	Very soft	Stale
VII	"	Very dim	Intense off	"	Very dull	Belly bursting started	Extremely soft	"
VIII	"	"	"	"	"	Belly bursting intense	"	"

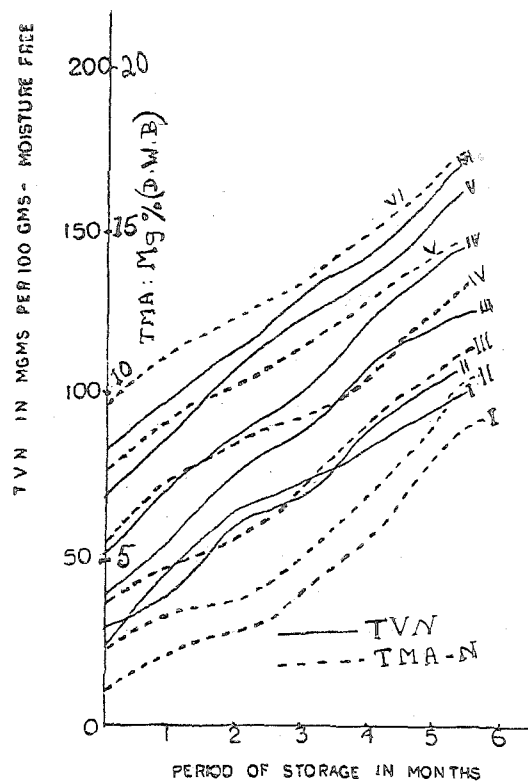


Fig 4 Changes in TMA and TVN in mackerel cured from samples held in ice during storage.

revealed that the finished products from raw material of upto 3 days icing were acceptable and satisfactory. However, the tasting qualities were found to be poor in the case of all the iced samples probably due to leaching out of water soluble flavour and taste components. The chemical data of the important spoilage factors of the finished product at the initial and during the different stages of storage are presented graphically in fig 4. The general trend of variation of these factors were almost of the same pattern as in the case of samples prepared from raw material under room temperature conditions.

CONCLUSIONS

- (1) Under room temperature conditions, the maximum permissible delay between the catching of the fish and its curing is to be limited to 8 hrs.
- (2) Although the 8 hrs held raw material

TABLE IV ORGANOLEPTIC DATA OF THE FINISHED PRODUCTS FROM SAMPLES HELD IN ICE STORAGE, JUST AFTER CURING

Sample No.	Odour	Taste & Flavour	Texture	Overall Grading
I	Good	Satisfactory	Firin	Satisfactory
II	"	"	"	"
III	Slightly rancid	"	"	"
IV	More rancid & slightly off	Below average	Below average	Below average
V	"	"	"	"
VI	Poor	Poor	Poor	Poor
VII	"	"	"	"

gave reasonably satisfactory and acceptable finished products, their shelf life and tasting quality decreased proportionately as the period of spoilage prior to curing advanced.

- (3) With 1:1 icing, the curing of mackerel may be delayed upto 3 days without unduly undermining the quality of the finished product. Only very little difference could be detected in the finished product prepared from raw material upto 3 days in ice after which symptoms of spoilage were more pronounced.

ACKNOWLEDGEMENT

The authors are indebted to Drs.

A. N. Bose and V. K. Pillai for their keen interest in this study and for many helpful suggestions. Thanks are also due to Shri P. Sadanandan and other laboratory staff for their valuable assistance during the course of this study.

REFERENCES

- A. O. A. C., 1955, *Official Methods of Analysis*, (Association of Official Agricultural chemists), 8th Edition.
 Conway, E. J., 1947, *Microdiffusion Analysis and Volumetric error*, Crosby Lockwood and sons, London.
 Pillai V. Krishna; Valsan A. P. and Nair M. Rajendranathan 1956, *Indian J. Fish*, 3, 44.