INFLUENCE OF ICE ON THE BACTERIOLOGICAL QUALITY OF THE PROCESSED FISHERY PRODUCTS

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The influence of ice on the bacteriological quality of the processed fishery products has been discussed. In almost all the cases ice has been traced to be a major source of contamination depending on the nature of water used for preparing it. The sources of contamination of ice and its remedies have been described.

INTRODUCTION

In the manufacture of frozen fishery products the material comes in contact with ice and water at various stages of processing. The raw material is generally packed in ice immediately after catch with a view to keep down the temperature and thus arrest bacterial spoilage. Icing is done again during transport of the material to the factory for the same reason. Ice is also added to cool the water used for glazing and reglazing operations. It is well known that plentiful use of water is very necessary for the production of high quality frozen fish material. On an average about 10–12 kg. of water will be required to produce 1 kg. of frozen prawn. This quantity includes the requirements for washing the raw material before and after dressing, and the requirements for glazing and reglazing.

Purity of ice and water is very important as washing and ice during meeting will carry away with it the surface bacteria and slime, thereby improving the bacterial quality. But if the bacterial quality of ice and water is poor material coming in contact with them will pick up bacteria. So, in addition to the increase in total plate count, contamination of faecal organisms may also take place, if polluted water is used. (Iyer *et al*, under publication) The presence of faecal organism in processed fishery products is not only objectionable but also will be regarded as 'not fit for human consumption' if goes above a certain limit though organoleptically the material may be sound. The Indian Standards Institution has framed quality tolerances for water for ice manufacture which insist that the total bacterial count of water used for ice manufacture should not exceed 100/ml and less than 1 of coliform from 100 ml of the sample (I. S., 1966). But inspite of all these, advantages of ice are so much that the processors are generally tempted to its quantity rather than its bacterial quality.

The rapid expansion of fish processing industry in India and other related factors have resulted in the decentralization of the entire industry. Primary processing like beheading, peeling, deveining etc. are done in interior villages near the landing places whereas the final stages of processing like grading, freezing, glazing etc. are carried out in freezing factories under the direct control of the management. After initial dressing the material is packed in ice and transported from the peeling shed to the processing factory. The ice not only keeps down the temperature of the fish but also increases its storage life by removing the slime or bacteria by the ice melt water. The leaching of the water soluble constituents that takes place by icing of fish will no doubt affect the organoleptic quality but at the same time it should be remembered that if the ice used for storage is not bacteriologically sound it will not only increase the total bacterial load of the material but also contribute faecal organisms. Studies carried out at this Institute during the past few years have shown that quality of ice plays a very important role at the different stages of processing. The sources of contamination and the effect of the contaminated ice on the raw material quality has been discussed in detail.

Materials and methods

The various processing factories and peeling sheds in and around Cochin were surveyed for this work.

The bacteriological platings are done according to the methods described earlier. (Iyer and Pillai, 1965)

Results and discussion

Table I shows that the bacterial load in the material can be maintained for a considerable length of time. But ice used for this purpose, if bacteriologically unsouud, will appreciably affect the quality of the material. Survey of raw materials carried out before and after transportation of the dressed material from the peeling shed to the freezing factories clearly indicate that the final quality of the transported material is influenced by the bacterial quality of the ice used during *transportation (Table II)*. From the table it is also evident that the contact time between the material and ice has also got a definite influence in the extent of contamination. If the initial bacterial load of the material is very high it is very difficult to control it in the final stage. Disinfectants are generally used to bring down the bacterial load. By washing the material with 10–15 ppm of chlorine, it is possible to bring down the counts by 70–80%. But table III represents a typical set of experiment where the ineffectiveness of the chlorine treatment is shown even though there is 70–80% reduction since the initial bacterial count is very high. One among the main sources of contamination of ice is the polluted water used for preparing it. Bacterial count of the ice samples prepared from potable and unpotable water is shown in table IV. This problem can be easily solved either by using chlorinated water (5–10 ppm) or by using potable water. Floors of the processing factories and peeling sheds where regular cleaning is not usually followed were found to contain very high bacterial load (Table V). In case ice is stored or dragged over such floor it becomes contaminated. In cases where there is no facility for refrigerated storage of ice, the ice blocks are covered with saw dust, gunny bag or tarpaulin which are not usually clean (Table VI). Extreme care should therefore be taken in handling ice and practices like dragging the ice over the floors should be prevented. Ice breaking machines should be installed

TABLE I SURFACE WASHING OF BACTERIA DURING ICING OF PRAWNS

Days in ice	Total bacterial count / g Expt. 1	Expt. 2	Expt. 3	Expt. 4	Expt. 5	Expt. 6	Organoleptic rating
1.	19000	24000	45000	15000	31120	35400	Good
2.	18000	23600	30010	11000	30020	30120	Fair
3.	17800	23000	28850	10000	29850	29600	Fair
4.	17000	21000	24300	9986	28520	27120	Fair to Poor
5.	16800	20000	21260	9890	25660	26340	-do-
6.	16100	19820	21300	9910	22380	24410	-do-

TABLE II INFLUENCE OF ICE AND CONTACT TIME ON RAW MATERIAL QUALITY

No.	Time taken for transport	Bactrial count of the material before transport			Bacterial court of the ice used			Bacterial count of the material after transportation		
		Total count/g	F.S./g	E. coli/g	Total count/g	F.S./g	E. coli/g	Total count/g	F.S./g	E. coli/g
1.	25 mins.	1.1×10^5	Nil	Nil	1900	26	18	6.6×10^5	80	25
2.	2 hrs.	6.1×10^4	Nil	Nil	3100	20	15	8.1×10^5	210	155
3.	4 hrs.	3.9×10^5	16	Nil	2900	20	10	9.9×10^6	320	180
4.	2 hrs.	6.1×10^4	Nil	Nil	8000	10	20	$8\ 1 \times 10^5$	120	35
5.	4 hrs.	6.7×10^5	Nil	Nil	7000	13	7	$9\ 6 \times 10^6$	380	45
6.	5 hrs.	6.9×10^5	Nil	Nil	7500	12	10	9.7×10^6	410	60
7.	5 hrs.	3.5×10^5	12	Nil	5800	10	10	7.6×10^6	690	310
8.	1 hr.	7.9×10^5	Nil	15	6700	20	20	3.1×10^6	Nil	20

F. S. Faecal Streptococci.

TABLE III REDUCTION IN COLIFORM COUNT BY CHLORINE TREATMENT

Chlorine dose ppm	Sample with low bact. count Before treatment	After treatment	% reduction	Sample with high bact. count Before treatment	After treatment	% reduction
5	50	Nil	100	1000	900	10
5	30	Nil	100	1100	1000	10
10	25	Nil	100	3000	1800	40
20	40	Nil	100	2500	1500	40
30	35	Nil	100	1900	1330	30
50	125	25	80	3000	600	80
50	50	Nil	100	2800	700	75
100	200	20	90	6000	1200	80
100	240	20	91	5600	560	90
100	120	10	91	6500	560	90

TABLE IV INFLUENCE OF WATER ON THE BACTERIOLOGICAL QUALITY OF THE ICE PREPARED FROM IT

Non potable water						Potable water					
Bacteriological quality of water used for preparing ice			Bacteriological quality of ice prepared			Bacteriological quality of water used for preparing ice			Bacteriological quality of ice prepared		
A	B	C	A	B	C	A	B	C	A	B	C
610	12	10	1100	8	5	19	Nil	Nil	20	Nil	Nil
800	10	15	780	3	6	20	Nil	Nil	35	Nil	Nil
720	5	12	600	4	4	10	Nil	Nil	35	Nil	Nil

A : Total count/ml
E : Faecal streptococci/ml
C : E. coli/ml

TABLE V BACTERIAL COUNT ON THE FLOORS OF PROCESSING HALL

Factory	Total count per sq. cm	Faecal streptococci/sq. cm	E. coli Type I/sq. cm
A	3.1x10^5 — 6.1x10^7	300 — 1100	200 — 600
B	1.8x10^5 — 8.1x10^7	30 — 300	39 — 400
C	1.5x10^5 — 5.9x10^6	Nil — 10	Nil — 40
D	6.1x10^5 — 7.7x10^6	50 — 790	Nil — 300
E	3.3x10^5 — 8.3x10^6	10 — 120	30 — 90
F	6.6x10^5 — 1.9x10^8	220 — 590	110 — 1800
G	2.1x10^5 — 3.1x10^7	360 — 790	290 — 2000

TABLE VI BACTERIA LOAD ASSOCIATED WITH SAW DUST, GUNNY BAG, TARPAULIN ETC.

Factory	Article	Total count	Faecal streptococci	E. coli
A	San dust/g	1.1x10^4 — 3.1x10^5	Nil — 20	50 —600
B	-do-	3 0x10^5 — 9.6x10^5	Nil — 100	80 —260
C	-do-	3.2x10^5 — 6.1x10^5	25 — 75	40 —210
A	Gunny bag sq. cm	5.2x10^5 — 6.6x10^6	Nil — 95	20 — 90
B	-do-	4.1x10^5 — 8.2x10^5	20 — 100	30 —160
A	Tarpaulin sq. cm	1.1x10^5 — 3 0x10^5	60 — 85	50 — 80
B	-do-	6.1x10^5 — 8.1x10^5	20 — 110	40 —110

TABLE VII EXTENT OF CONTAMINATION OF ICE DURING TRANSPORTATION

Before transportation			After transportation		
Total count/ml	FS/ml	E. coli/ml	Total count/ml	FS/ml	E. coli/ml
800	Nil	Nil	6600	13	16
700	Nil	Nil	3100	16	20
1100	Nil	Nil	5100	25	20

TABLE VIII EFFECT OF WASHING THE CONTAMINATED ICE WITH CHLORINE WATER (5—10 ppm.)

Bact. Count of contaminated ice/ml			Bact. count of contminated ice/ml after washing with chlorinated water		
Total count	FS	E. coli	Total count	FS	E. coli
$7.1x10^3$	15	10	$1.3x10^3$	Nil	Nil
$7.3x10^3$	125	20	$1.1x10^3$	Nil	Nil
$8.1x10^3$	109	15	$1.8x10^3$	Nil	Nil
$6.1x10^3$	220	10	$1.5x10^3$	Nil	Nil

near ice storage rooms where ice can be crushed and taken in tubs on trolley to the processing tables as and whenever required. In the storage rooms itself ice should be kept on wooden plat forms 6″ above the grounds having slight slopes so that water does not accumulate inside. Where there are no ice cracking machines, wooden boxes (approx. 4′ × 2′ × 1′) lined with aluminium sheet may be used for breaking the ice blocks. In many cases it has been seen that ice of bacteriologically sound quality becomes highly contaminated while it reaches the peeling shed, (Table VII) due to unhygienic methods of handling during transportation. However the bacteriological quality of such variety of ice can be improved by washing the ice blocks with chlorinated water (Table VIII) having 5–10 ppm of available chlorine.

General recommendations

1. The ice should be prepared from potable water or from chlorinated water.

2. Dragging of ice blocks over the unclean surfaces of the factory should be avoided.

3. It is not advisable to cover the ice blocks with unclean gunny or saw dust.

4. Cracking machines or box for cracking the ice should be used.

5. All precautionary measures 1;3 should be taken to avoid the contamination of ice during transporation.

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