STUDIES ON TECHNOLOGICAL PROBLEMS ASSOCIATED WITH THE PROCESSING OF COOKED FROZEN PRAWNS

I. PREPROCESS STORAGE CONDITIONS OF RAW MATERIAL IN RELATION TO QUALITY

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The chemical and organoleptic properties of prawn held in ice for different days prior to cooking and the changes after freezing and subsequent storage were studied with three different species of prawn viz. *Metapenaeus monoceros*, *Metapenaeus dobsoni* and *Parapeneopsis stylifera*. The optimum period for which the prawn can be kept under ideal conditions of icing prior to cooking has been worked out.

INTRODUCTION

Cooked frozen prawn forms an important item of India's export trade in frozen sea foods. Prawns of lower size grades belonging to *M. dobsoni*, *M. monoceros* and *P. stylifera* alone are generally used for the preparation of this item. Although known methods are followed by the trade to prepare products to suit the requirements of importing countries, precise data have been lacking on the technological aspects leading to process control. The present communication summarises part of the results of the investigations taken up in this direction.

MATERIALS AND METHODS

All the varieties of prawn used in this study except *M. monoceros* were collected from *'Fish Tech'* boat operated by the Institute. Immediately after catch, prawns of the same size grade and species were separated, washed thoroughly in sea water and packed in an insulated box with ice in the ratio 1:1. After reaching the laboratory, the prawns were again washed with potable water, a portion of it was separately peeled, cooked and frozen in a contact freezer at -40°C. The remaining prawns were kept in ice in the ratio 1:1 as whole, headless or PD forms as the case

may be. At definite intervals the prawns were removed from ice box and then cooked and frozen.

COOKING

Peeled prawns (except in the case of cooked and peeled varieties) were put in boiling water and cooked for 2 minutes after reboiling. After cooking, water was immediately drained off and the prawns immersed in cold water for 2 minutes, drained, packed in freezing trays in 450 g blocks and subjected to quick freezing.

M. monoceros were collected from the local market in almost live condition. On reaching the laboratory they were washed and preserved in ice as described above. Cooking and freezing were also done similarly.

Immediately after freezing one block of each lot was put in a watertight polythene bag and thawed in running water. The thawed material was cooked for 3 minutes in boiling water and the flavour was judged by a panel of experts. Scoring was done according to the following schedule.

Having characteristic flavour	= 10 marks.
Characteristic flavour obtained only on continued chewing	= 6 to 9 ,,
Absence of characteristic flavour but no unpleasant flavour.	= 5 ,,
Stale flavour	= 4 to 1 ,,
Off flavour	= 0 ,,

Samples scoring below 5 marks were regarded as organoleptically unacceptable. The remaining frozen material was stored at -20°C and analysed at regular intervals.

Total water soluble nitrogen, α amino nitrogen and nonprotein nitrogen were used as chemical indices of quality. 50 g of the thawed material was blended in a waring blender with 100 ml of distilled water. The mixture was made upto 200 ml and centrifuged for 30 minutes at 4000 r p.m., filtered, 10 ml of the filtrate was digested for the estimation of water soluble nitrogen according to Govindan (1962). Free α - amino nitrogen was estimated by the Pope and Stevens (1939) method using 50 ml of the filtrate and non protein nitrogen was estimated from 10 ml of the filtrate.

RESULTS

The flavour scores of the cooked frozen prawn represented by marks are given in table I, specieswise and typewise. The percentages of loss of WSPN, free α-amino N and non-protein nitrogen in the cooked frozen prawn due to ice storage of the raw material in the PD, HL and whole forms are given in Tables IIa, IIb and IIc whereas tables IIIa and IIIb give an account of the percentage losses in these indices due to frozen storage of the cooked material. Table IV gives results of a comparative study made between cooked peeled and peeled cooked prawns.

DISCUSSION

From Table I, it can be seen that peeled and deveined prawns can be preserved in ice for a maximum period of 5-6 days prior to cooking irrespective of species. Similarly whole and headless prawns can be preserved for 4-5 and 6-7 days respectively. From Tables IIa, b and c, it is evident that there is appreciable loss of nutritional constituents during ice storage. Twelve days of ice storage of the raw material in PD form make a loss of 40-45% of WSPN, 88-92% of α-amino N, and 72-76% of non-protein nitrogen in the cooked frozen material irrespective of species. In 4-5 days, which period has been taken as the maximum PD prawns can be preserved in ice prior to cooking, 28-30% of WSPN, 65-70% of α-amino N and 45-70% of NPN are lost

TABLE I FLAVOUR CHANGES IN COOKED FROZEN PRAWNS

No. of months of frozen storage	Days of ice storage →	Flavour grade — Marks out of ten																									
		M. Dobsoni										M. Monoceros										P. Stylifera					
		1			3			5			7			9			1			3			5			7			9		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
0		10	9	9	9	8	7	8	7	6	3	5	5	1	4	3	10	9	9	9	8	7	6	6	6	4	5	4	2	3	2	9	9	8	8	8	6	5	7	5	3	5	4	2	3	2
2		8	8	7	8	7	6	7	6	5	6	5	5	1	3	3	9	8	7	8	7	5	5	6	5	3	4	3	2	2	1															
4		8	8	7	7	6	5	6	6	5	6	5	4	1	2	2	8	8	6	7	6	5	3	5	4	2	4	3	1	2	1															
6		7	7	6	6	6	5	6	5	5	2	4	4	1	2	2	7	8	6	7	6	5	2	5	4	1	4	3	1	2	1															

A = Whole. B = Headless. C = Peeled and deveined.

TABLE II a PERCENTAGE LOSS OF THE NITROGENOUS CONSTITUENTS IN THE COOKED FROZEN MATERIAL (EXPRESSED AS % OF ORIGINAL) DUE TO ICE STORAGE OF RAW MATERIAL IN PD FORM

Days of storage in ice	Water soluble nitrogen				Free ∝- amino nitrogen				Non protein nitrogen			
	A	B	C	D	A	B	C	D	A	B	C	D
3	23	25	26	24	43	44	48	62	35	37	37	44
5	28	29	30	31	64	65	68	63	47	50	51	51
7	36	33	35	34	72	74	72	66	67	65	60	66
9	37	35	40	42	85	84	89	85	69	70	70	71
12	39	38	42	45	89	86	91	92	72	72	75	76

A : M. Dobsoni B : M. Dobsoni C : M. Monoceros D : P.Stylifera

TABLE II b PERCENTAGE LOSS OF THE INDICES IN THE COOKED FROZEN MATERIAL (EXPRESSED AS % OF ORIGINAL) DUE TO ICE STORAGE OF THE RAW MATERIAL IN THE HEADLESS FORM

Days of storage in ice	Water soluble nitrogen			Free ∝- amino nitrogen			Non protien nitrogen		
	A	B	C	A	B	C	A	B	C
3	4	8	7	34	40	41	4	9	10
5	13	22	20	44	55	55	32	44	43
7	29	33	30	53	55	58	49	53	54
9	—	39	36	71	74	75	49	54	59
12	32	40	42	80	80	81	63	60	62

A : M. dobsoni B : M. monoceros C : P. stylifera

TABLE II c PERCENTAGE LOSS OF NITROGENOUS CONSTITUENTS (EXPRESSED AS % OF ORIGINAL) IN COOKED FROZEN MATERIAL DURING ICE STORAGE OF THE RAW MATERIAL IN THE ROUND FORM

Days of storage in ice	Water soluble nitrogen			∝- amino nitrogen			Non protein nitrogen		
	A	B	C	A	B	C	A	B	C
3	5	8	7	30	32	33	—	—	—
5	12	13	15	32	36	40	32	36	37
7	16	20	21	52	49	48	35	39	41
9	27	28	29	61	65	66	40	43	45

A : M. dobsoni B : M. monoceros C : P. stylifera

TABLE III a PERCENTAGE LOSS OF NITROGENOUS CONSTITUENTS DUE TO FROZEN STORAGE OF THE COOKED MATERIAL (SPECIES – *M. dobsoni*)

Type of storage in ice prior to cooking	Months of frozen storage	Days of storage in ice →	Water soulble nitrogen						∝-amino N						Non-protein nitrogen					
			1	3	5	7	9	12	1	3	5	7	9	12	1	3	5	7	9	12
Whole	2		4	7	9	11	27	—	3	8	18	26	—	—	4	8	12	13	—	—
	4		6	3	8	19	31	—	6	10	21	30	—	—	5	9	12	14	—	—
	6		10	16	20	24	34	—	10	25	30	36	—	—	7	11	20	20	—	—
HL	2		4	9	9	10	12	14	15	15	20	22	30	20	8	8	12	14	25	28
	4		10	11	11	12	14	16	15	20	26	28	30	35	10	11	15	18	28	31
	6		16	18	—	20	20	—	20	30	40	33	33	40	12	11	22	24	31	44
PD	2		8	9	10	10	11	13	8	18	—	18	22	25	10	15	13	16	17	20
	4		11	10	11	13	14	16	20	21	—	32	38	40	12	14	16	10	16	26
	6		12	13	—	14	20	24	28	30	—	40	45	48	14	16	14	20	22	32

TABLE IV COMPARATIVE ADVANTAGE OF COOKED AND

No. of months of frozen storage	Days of storage in ice →	Flavour grade — Marks out of 10										Water soluble nitrogen mg%									
		1		3		5		7		9		1		3		5		7		9	
		CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC
0		9	8	8	7	7	6	6	5	3	2	630	550	560	480	380	310	300	220	280	200
2		9	8		5	6	5	5	3	2	1	610	540	550	460	370	300	290	210	270	190
4		8	7		5	5	3	5	3	2	1	580	520	540	410	360	290	285	200	270	200
6		7	6		4	5	3	5	2	2	1	550	500	540	420	345	260	290	200	—	210

TABLE III b PERCENTAGE LOSS OF NITROGENOUS CONSTITUENTS DUE TO FROZEN STORAGE OF THE COOKED MATERIAL (SPECIES - *M. Monoceros*)

Type of storage in ice prior to cooking	Months of frozen storage	Days of storage in ice →	Water soulble nitrogen 1 3 5 7 9	∝-amino N 1 3 5 7 9	Non-protein nitrogen 1 3 5 7 9
Whole	2		1 3 8 12 —	2 8 15 20 —	9 12 18 20 —
	4		4 6 12 16 —	8 10 20 29 —	12 18 20 25 —
	6		7 10 18 21 —	10 20 30 35 —	15 25 28 32 —
HL	2		2 3 10 14 13	10 20 29 28 20	13 — 20 23 23
	4		10 11 14 20 19	12 28 34 40 38	20 24 32 40 49
	6		18 16 28 33 26	16 30 50 50 50	28 38 32 45 50
PD	2		2 9 10 — 14	10 16 22 33 —	15 18 28 30 40
	4		10 15 20 24 28	15 21 34 42 —	18 22 30 40 46
	6		16 20 32 38 —	20 33 56 60 —	26 32 35 45 50

PEELED FORM OVER PEELED AND COOKED FORM

Non- protein nitrogen mg %										Free ∝-amino nitrogen mg %									
1		3		5		7		9		1		3		5		7		9	
CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC	CP	PC
390	280	320	250	300	200	250	200	200	150	80	40	70	40	60	30	50	25	20	20
380	280	310	240	290	190	240	180	200	140	70	30	62	30	60	28	45	20	18	10
390	270	300	240	280	190	250	170	190	130	70	40	68	35	55	25	40	18	15	7
376	270	300	230	275	185	240	160	180	110	65	38	62	35	55	25	38	18	15	6

CP : Cooked and Peeled. PC : Peeled and Cooked.

in the cooked frozen prawns, independent of the species of prawn used.

Similarly twelve days of ice storage of the raw material in HL form causes 32–42% loss in WSPN, 80–81% loss in free ∝-amino N and 60 – 63% loss in NPN in the cooked frozen material. If the material is kept in the round form, the losses of WSPN, ∝-amino N and NPN in the the cooked material amount to about 27–29%, 61–66% and 40–45% respectively in nine days. Only 25% of WSPN, 52–58% of free ∝-amino N and 40–45% of NPN are lost in cooked material is 6 – 7 days if the prawn is kept in HL form or on the contrary 12 – 15% of WSPN, 30–40% of free ∝-amino N and 32–37% of NPN are lost in 3 – 4 days if kept in round form for the same period. It is also evident from the table that the loss of nutritional constituents during longer storage in ice is almost identical irrespective of the type of storage (Round, HL or PD). The percentage loss of constituents during ice storage is in the order of *M. dobsoni* < *M. monoceros* < *P. stylifera*. The difference in the percentage losses between the three species is low but significant in all the series conducted.

It can be seen from tables III a and III b that loss of constituents during ice storage for 12 days is more than the loss taking place during frozen storage of the material for 6 months at -20°C. PD prawns have the maximum storage life in ice, but they lose their nutritive constituents more easily than do the headless or whole prawns. The latter finding is in agreement with earliar reports (GOVINDAN *loc cit.*) Headless and whole prawns retain the flavour for longer days compared to peeled and deveined prawns, but they easily become unacceptable due to black-spots and discolouration. Table IV shows the relative superiority of cooked and peeled prawns over peeled and cooked variety with regard to flavour and nutritional constituents. The organoleptic and chemical qualities of the cooked and peeled material were found to be superior in all the casses throughout the experiment. But the peeled and cooked prawns create further problems in maintaining the sanitary quality of the processed product which has been discussed in detail elsewhere.

CONCLUSIONS

Based on the foregoing study the maximum number of days recommended for keeping different forms of prawns (whole HL and PD) in ice under ideal conditions of icing to prepare cooked frozen prawn are: PD: 5-6, HL: 6-7 and whole: 4-5 irrespective of species.

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