OBSERVATIONS ON SOME ASPECTS OF SPOILAGE IN FRESH AND FROZEN PRAWNS

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Introduction

The prawn freezing factories in Cochin receive their supplies of raw materials from all over the West Coast. Some factories have separate peeling centres in most of these places and the prawns collected from nearby fishing villages are peeled and deveined or beheaded and deveined as the case may be, cleaned and packed in ice at these centres before transporting to the factories. It often happens that the material thus transported takes more than 24 hours to reach the factories. Icing of the material at the peeling site helps in preventing bacterial spoilage during the long period of transport. But the success of icing will largely depend on the amount of ice used and how it is applied. If the requisite quantity of ice is not used the material will not only be not cooled to the desired level but its temperature will rise up during the long trip to the factory creating favourable conditions for normal spoilage processes to continue.

Supplies arrive at the factories at all times. Those that are received late in the evening will be kept in chill storages at temperatures ranging from 30–35° F. until taken up for further processing. Although this will help in keeping down bacterial multiplication a lot of other biochemical changes can proceed uninterrupted (Shewan, 1949). There is in addition the inevitable delay during the various stages of processing like washing, grading, packing and freezing. During all these stages the material is likely to undergo spoilage if sufficient care is not taken to keep down its temperature to around 32° F. and to minimise the time taken for each process.

The present communication deals with the results of an enquiry into the changes taking place in the chemical and bacteriological characteristics of prawns during the various stages of processing. A correct knowledge of these changes is highly essential in judging the quality of the final product as well as in establishing control measures to improve the quality of frozen prawn products.

Experimental

The experiments were carried out with the co-operation of some of the leading prawn freezing factories in Cochin. Samples were collected from different lots of raw materials as they arrived at the factories. As far as possible care was taken to follow the same lots through different stages of processing until finally frozen. Side by side with this a study was also made on the changes taking place in fresh prawn samples collected from landing places during spoilage at room temperatures. This was found necessary for the proper interpretation of the results obtained with the factory samples. All the samples were tested for their chemical and bacteriological characteristics. The changes in the pH, trimethylamine, total volatile nitrogen, non-protein nitrogen, *a*-amino nitrogen and viable bacterial count of fresh prawn during spoilage under laboratory conditions are presented in Table I. Table II gives the data collected on ' headless ' prawns during different stages of processing while the corresponding figures for peeled, deveined and frozen prawns are presented in Table III. The changes in the quality of three different packs of frozen prawns, *viz.*, headless, peeled and deveined and cooked frozen, during storage for a period of 13 weeks have also been studied and the results are given in Table IV. The variations in the pH of a few

Table I

Changes in the chemical and bacteriological characteristics of prawn during spoilage at room temperatures

Description of sample	Period of storage	T.M.A. mg. N%	T.V.N. mg. %	*a*-amino N mg. %	pH	Non-protein N mg. %	$HgCl_2$ test	Viable bacterial count/gm.
Metapenaeus monoceros	2 hours	2·8	13·27	277·0	6·50	..	−ve	$8·8 \times 10^4$
	5 hours	2·8	13·27	275·4	6·50	..	−ve	$5·3 \times 10^5$
Palaemon sp.	Fresh	Nil	8·40	226·8	6·60	..	−ve	$4·0 \times 10^3$
	5 hours	1·36	12·88	261·1	6·71	..	−ve	$1·0 \times 10^4$
	24 hours	..	.	..	7·45	..	+ve	$8·0 \times 10^7$
Parapenaeopsis stylifera	4 hours	2·65	8·41	155·2	6·60	..	Doubtful	..
	8 hours	3·40	12·92	170·1	6·70	618·4	+ve	..
Metapenaeus dobsoni	6 hours	2·05	20·54	117·5	6·80	502·5	+ve	$2·4 \times 10^6$
	10 hours	10·29	31·57	109·1	7·70	703·0	+ve	$1·6 \times 10^8$

TABLE II

Changes in the chemical and bacteriological characteristics of 'headless' prawns during different stages of processing

Description of sample	T.M.A. mg. N%	T.V.N. mg. %	*a*-amino N mg. %	Non-protein N mg. %	Bacterial count/gm.
Series I*					
Initial ..	2·8	11·9	97·05	728·0	$1·0\times10^{7}$
Stored in chill room for 18 hours ..	2·8	10·5	107·40	616·0	$1·3\times10^{6}$
After freezing ..	5·6	15·4	97·05	1,008·0	$3·6\times10^{4}$
Series II					
Initial ..	3·2	13·6	..	..	$3·2\times10^{5}$
Stored in chill room for 14 hours	2·8	11·2	..	..	$1·7\times10^{5}$
After washing ..	2·8	11·2	..	..	$7·5\times10^{4}$
After freezing ..	..	..	..	..	$3·8\times10^{4}$
Series III					
Initial ..	2·1	11·9	..	..	$4·1\times10^{5}$
After washing ..	2·1	9·8	..	..	$7·0\times10^{4}$
After freezing ..	1·4	6·3	..	..	$1·4\times10^{4}$

* All the samples belonged to the *Palaemon* sp.

TABLE III

Changes in the chemical and bacteriological characteristics of peeled and deveined prawns during different stages of processing

Description of sample	T.M.A. mg. N%	T.V.N. mg. %	*a*-amino N mg. %	Non-protein N mg. %	Bacterial count/gm.
Series I					
Initial ..	2·1	16·1	117·90	532·0	$1·4\times10^{6}$
Stored in chill room for 14 hours	2·1	9·1	34·65	252·0	$8·2\times10^{6}$
After freezing ..	2·1	5·6	34·65	364·0	$1·9\times10^{5}$
Series II					
Initial ..	1·3	9·8	..	..	$2·6\times10^{5}$
Stored in chill room for 14 hours	0·7	4·9	69·31	322·0	$3·3\times10^{5}$
After washing ..	4·9	13·3	..	..	$4·3\times10^{5}$
After freezing ..	..	..	..	..	$1·0\times10^{4}$
Series III (small size)					
Initial ..	4·0	9·6	107·40	644·0	$3·7\times10^{6}$
Stored in chill room for 14 hours	2·8	9·1	38·13	588·0	$6·0\times10^{6}$

TABLE IV

Changes in the quality of frozen prawn during storage

Description of sample	Period of storage	T.M.A. mg. N%	T.V.N. mg. %	Bacterial count/gm.
Headless—fresh frozen	Initial	.	..	$3 \cdot 8 \times 10^4$
	1 week	0·70	14·7	$4 \cdot 0 \times 10^4$
	6 weeks	2·10	11·9	$2 \cdot 0 \times 10^4$
	13 ,,	0·70	14·0	$0 \cdot 6 \times 10^3$
P and D—fresh frozen	Initial	..	..	$1 \cdot 0 \times 10^4$
	1 week	2·80	9·1	$3 \cdot 1 \times 10^4$
	6 weeks	2·10	9·8	$2 \cdot 0 \times 10^5$
	13 ,,	0·70	14·0	$1 \cdot 9 \times 10^4$
Cooked frozen	Initial	..	..	$1 \cdot 4 \times 10^4$
	1 week	nil	7·0	$1 \cdot 0 \times 10^4$
	6 weeks	1·4	6·3	$5 \cdot 0 \times 10^5$
	13 ,,	nil	5·6	$3 \cdot 2 \times 10^5$

species of prawn of commercial importance have been followed during spoilage at room temperature. The values obtained are presented in Table V.

TABLE V

Changes in the pH during spoilage of prawn at room temperature*

Sample	Initial	After 5 hours	After 24 hours
Metapenaeus monoceros ..	6·60	6·70	7·45
Do. ..	6·60	6·95	8·05
Parapenaeopsis styliferus ..	6·80	7·20	..
Metapenaeus dobsoni ..	6·54	6·80	7·50

* Each figure recorded is the average of 15 estimations.

DISCUSSION AND CONCLUSIONS

It may be seen from Table I that the T.M.A. content of fresh prawn varied from almost nil to about 3·0 mg. N%. The variation in the T.M.A.

content during the initial period of spoilage up to 5 hours is almost negligible. This is also true in the case of T.V.N., the change becoming significant only after 8 hours of spoilage under room temperature. The data on non-protein nitrogen is too meagre to draw any conclusions while no appreciable variation is noticed in the case of *a*-amino nitrogen content. The pH of the flesh also does not vary significantly during the initial stages of spoilage as indicated by Tables I and V. The variation in the pH within the course of 24 hours is only of the order of one unit. These clearly show that pH value cannot be considered as an index of spoilage in prawn especially during the early stages of spoilage. This is in full agreement with the findings of other workers in regard to fish and shell fish (Elliot, 1947; Kondrup, 1948; Fieger, Novak and Bailey, 1956). However Iyengar *et al.* (1960) observe that pH of the meat together with its bacterial count would be useful as an index of spoilage in ice-stored shrimp.

The data collected on the bacterial load of fresh prawns indicate that the flesh of fresh prawn is not sterile. There is also a steady increase in the total bacterial count during spoilage and as such these figures become very significant in assessing the overall quality of the prawn. Recently Velankar *et al.* (1961 *a* and *b*) have proposed the volatile acid number as a useful index to assess the spoilage of prawn both at room temperature and in ice storage.

The data presented in Tables II and III indicate that the raw material, both headless and peeled and deveined, are in a fairly advanced stage of spoilage judged from the bacterial counts. The bacterial counts are much more than that of fresh prawn examined in the laboratory. The initial load of $1 \cdot 0 \times 10^7$ observed in the case of one sample of ' headless ' prawn (Series I in Table II) is nearly equal to that observed in flesh of the same species after incipient spoilage. This very high bacterial count of the raw material is only indicative of the fact that some spoilage has taken place either at the peeling centres or during transport. It is however noteworthy that the bacterial load or the other chemical factors do not increase much when once the materials reach the factory. Washing and cleaning do not appear to have any effect in leaching out the water-soluble volatile compounds. However there is a certain amount of reduction in the bacterial count as a result of these operations. But this reduction is not so significant as has been reported by Sreenivasan (1959). The difference may be due to the fact that while the surface bacteria are leached out during the washing process the inherent bacteria will continue to multiply as the washing and cleaning operations generally take more than 30 minutes under factory conditions. In regard to T.V.N. contents there is reduction observed in the final product.

This may probably be due to the further leaching of the volatile constituents during thawing. These figures of T.V.N., therefore, are not likely to present the true picture of the quality of the frozen product.

The T.V.N., non-protein N and *a*-amino nitrogen values of the peeled and deveined samples show a decrease after being in the chill room and after freezing (Table III). This again can be explained as due to the leaching effect. In the case of peeled and deveined material the leaching of these constituents are likely to be more because of the fact that larger flesh surface is in contact with the ice and water. Similar observations have been made by Velankar and Govindan (1958) in the case of *a*-amino nitrogen in ice-stored whole prawns. Quite contrary to this the ' headless ' samples do not show any significant changes in the above constituents either after storage in chill room or after freezing.

The data presented in Table IV clearly indicate that the frozen samples do not undergo much change during frozen storage for a period of 13 weeks.

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