ICED AND FROZEN STORAGE OF SQUID *(LOLIGO SP)*

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The iced and frozen storage characteristics of squid (*Loligo sp.*) are discussed. Squid can be kept in ice in an acceptable condition for a maximum period of 2 days. Frozen squid can be stored for a maximum period of 15 weeks at -18°C, which can be extended upto 19 weeks by suitable treatment.

INTRODUCTION

Squid (*Loligo* sp.) has a world wide distribution in the warmer seas. They are caught in fairly large quantities in the waters of Gulf of Mannar. They are netted in great quantities in spring and early summer. The approximate composition of squid meat is moisture 83%, protein 15-16% and fat less than 1%. Varela, Pujol and Moreiras (1962) reported the biological value of squid proteins to be 82 compared to 83.7 for octopus and 74.8 for shrimp. Pandit and Magar (1972) have found that squid meat is rich in calcium, phosphorus, iron and contains moderate amounts of B group vitamins. In spite of the high nutritive value of squid, it has not been utilised properly in our country. It is necessary to have a better understanding of the processing and storage characteristics of squid in its proper utilisation.

This paper deals with the changes occurring in squid during iced and frozen storages in relation to the organoleptic qualities.

MATERIALS AND METHODS

Fresh squid (*Loligo* sp.) of average weight 100g. were obtained from the trawl nets operated by the Research Centre. They were immediately iced and brought to the laboratory. Guts, skin etc. were removed and the meat was washed thoroughly in potable water. A portion of the meat was kept under ice in an ice box having drip holes. Samples were drawn daily and analysed for the changes in biochemical, bacteriological and organoleptic qualities.

For freezing studies the meat was treated as follows: (1) control (2) treated with 10% sodium chloride solution for 30 minutes and (3) treated with 10% sodium polyphosphate solution for 5 minutes. All the above three samples were packed in polythene bags, approximately 250 g. in each, quick frozen at -30°C in a contact

TABLE I

BIOCHEMICAL AND BACTERIOLOGICAL CHANGES IN SQUID MEAT DURING ICED STORAGE

No. of days in ice	TN %	NPN mg./100g.	SSN %	Myosin %	Alpha amino nitrogen mg./100g.	TVN mg./100g.	Moisture %	Faecal Streptococci/g.	Total count g.
0	2.615	682.3	2.092	1.392	78.21	3.210	83.42	62	4.025×10^5
1	2.539	602.3	1.859	0.9021	66.59	5.666	83.35	58	2.197×10^5
2	2.332	320.4	1.064	0.6521	21.28	11.75	85.42	51	3.45×10^5
3	2.143	162.1	0.8322	0.3954	14.02	11.56	85.27	43	5.212×10^5
5	1.945	103.0	0.7128	0.4539	8.002	15.33	85.39	30	6.305×10^5
6	1.803	135.6	0.6135	0.4251	4.211	18.21	85.67	25	7.6×10^5

E. Coli and coagulase +ve staphylococci were absent throughout the period of study.

TABLE II

ORGANOLEPTIC CHANGES DURING ICED STORAGE

Days in ice	Colour	Flavour	Texture
0	very good	very good	very good
1	very good	very good	very good
2	Good	Good, Fair	Slightly rubbery and hard to chew
3	Fair	Fair, Poor	Rubbery
5	Poor	Poor	Rubbery
6	Poor	very poor	Rubbery

plate freezer and stored at -18°C. Samples were drawn periodically and analysed for biochemical, bacteriological and organoleptic changes.

Moisture was determined by AOAC (1960) method, total nitrogen (TN) and non-protein nitrogen (NPN) by micro kjeldhal method, salt soluble nitrogen (SSN) by the method of Dyer (1950), alpha-amino nitrogen from the trichloro acetic acid extract by the method of Pope and Steven (1939), total volatile nitrogen (TVN) by the micro diffusion method of Conway (1947) and myosin by the method of Dyer, French and Snow (1950). Frozen samples were thawed in running water at room temperature (25± 2°C) after sealing them in polythene bags. The drip was collected and the volume measured. TN in the drip was estimated. Samples for the bacteriological test were drawn prior to thawing. Total bacterial count was estimated by the pour plate method using Tryptone glucose agar, *E. coli* using Desoxycholate agar, Coagulase +ve Staphylococci using Chapman Stone medium and faecal Streptococci using KF agar. The organoleptic tests were carried out on the squid muscle boiled in 2% brine for 5 minutes.

RESULTS AND DISCUSSION

Iced storage characteristics

Table I illustrates the changes in the biochemical characteristics while Table II illustrates the changes in the organoleptic characteristics during iced storage. Total nitrogen showed considerable decrease during storage. This can be attributed to the leaching out of water soluble proteins. According to Matsumoto (1958), 77-85% of the total proteins of squid is water soluble. Similarly the non-protein nitrogen also showed a sharp decrease. It was noticed that squid meat contained high percentage of NPN which is in full agreement with the earlier findings of Japanese scientists (Borgstrom, 1965).

The salt soluble nitrogen and myosin which occur in very high quantities in the fresh meat decreased gradually during

TABLE III

BIOCHEMICAL CHANGES DURING FROZEN STORAGE

	CONTROL				SALT TREATED				POLYPHOSPHATE TREATED			
Weeks of storge	Moisture %	TN %	SSN %	TVN mg./100g.	Moisture %	TN %	SSN %	TVN mg./100g.	Moisture %	TN %	SSN %	TVN %
0	83.75	2.412	1.691	3.2	82.42	2.157	1.402	5.3	82,62	2.374	1.689	4.6
1	82.21	2.469	1.393	4.1	82.11	2.069	1.3111	7.2	82.24	2.283	1.41	4.9
7	81.77	2.380	1.021	3.9	81.36	1,950	1.082	9.1	82.23	2.212	1.21	5.2
12	81.42	2.311	0,9120	4.8	81.32	1.921	0.9112	8.2	81.11	2.281	0.82	6.5
15	81.32	2.28	0.7180	6.7	81.36	1.892	0.8236	10.12	81.29	2.121	0.7283	7.8
19	80.98	2.123	0.6662	7.2	81.17	1.937	0,7213	12.8	80.69	2.098	0.6821	9.2

TABLE IV

ORGANOLEPTIC CHANGES DURING FROZEN STORAGE

Weeks of	CONTROL			SALT TREATED			POLYPHOSPHATE TREATED		
storage	Colour	Flavour	Texture	Colour	Flavour	Texture	Colour	Flavour	Texture
0	Very good	Very good	Very good	Very good	Very good	Very good	Very good	Very good	Very good
1	Very good	Very good	Very good	Very good	Very good	Very good	Very good	Very good	Very good
7	Good	Good	Good	Good	Good	Good	Good	Good	Good
12	Good	Fair	Fair	Good	Good	Good	Good	Good	Good
15	Fair	Fair-poor	Poor	Good	Good	Fair	Good	Good	Fair
19	Fair-poor	Poor	Poor	Fair	Fair	Fair-poor	Fair	Fair	Fair

ice storage. Matsumoto (1958) has also reported high myosin fraction in the squid protein. The alpha amino nitrogen content became very low after two days storage. Organoleptic characteristics also showed marked changes after two days (Table II). This is in full agreement with the findings of Simido and Takeda (1952) who also found the mono amino nitrogen to be abundant in squid so long as the meat taste remained sweetish. The total volatile nitrogen increased steadily. The moisture content remained constant for one day and from second day it showed considerable increase. This also reflects changes in the meat after one days' storage. There was no significant change in the total bacterial count of the meat throughout the 6 days' ice storage thereby indicating that there is no appreciable bacterial spoilage during this storage period. But significant changes were observed in the organoleptic tests of the cooked meat. However, based on biochemical and organoleptic changes it could be seen that squid meat cannot be kept in ice, in prime condition, for more than two days.

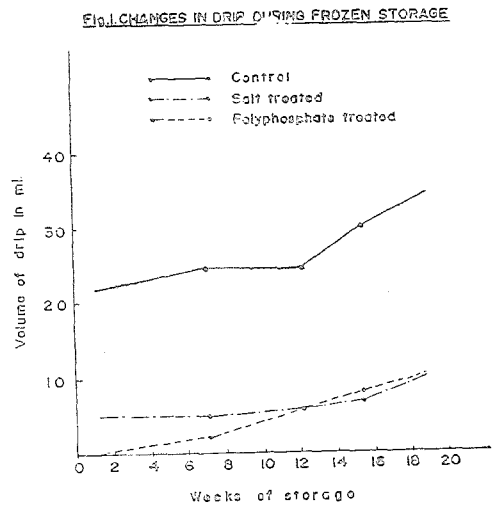

Fig. 1

Frozen storage

The changes in the frozen squid meat during storage are given in Table III and IV and figures 1 to 3. Table III gives a comparative picture of the biochemical changes in the squid meat, both control and treated. Moisture content decreased steadily during the storage in all the three

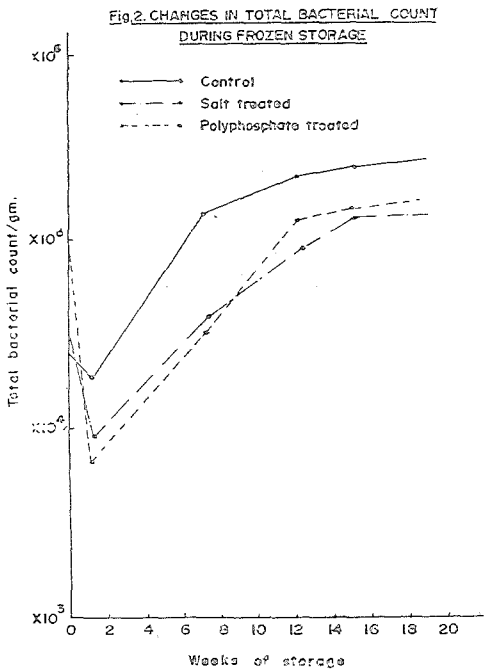

Fig. 2

samples. The loss in moisture is very well accounted for by the increase in the volume of drip as shown in Fig. 1. The decrease in moisture was more in the control sample than in the treated ones and consequently the drip was also more in the control sample.

Total nitrogen decreased in all the three cases. With the increase in duration of frozen storage there was a sharp decrease in the salt soluble nitrogen. This is due to the denaturation of protein during

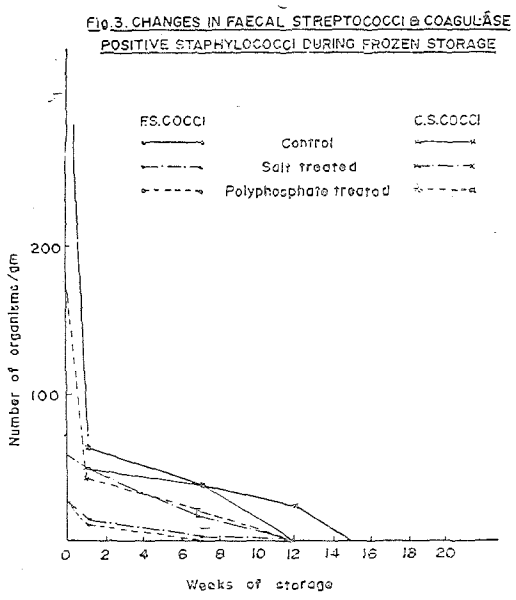

Fig. 3

storage. Similar results were obtained by Shenoy and Pillai (1971) and Radhakrishnan, Solanki and Venkataraman (1973) in sardine and Bombay duck, respectively. The decrease in SSN was more in the control. The total volatile nitrogen showed increase in all the three cases.

Figure 1 gives the changes in the volume of drip during the frozen storage. The volume is considerably more in the control than in the treated samples. Among the treated samples rate of increase of drip during storage was more in the salt treated sample than in the polyphosphate treated sample.

Table IV shows the changes in the organoleptic qualities of the squid during frozen storage. It is seen from the Table that the control sample became unacceptable after 15 weeks of storage whereas the treated samples remained in good condition upto 19 weeks.

Figures 2 and 3 show the changes in the bacterial flora during storage. The total count showed gradual increase whereas the counts of faecal Streptococci and Coagulase positive Staphylococci showed gradual decrease. The faecal Streptococci count dropped to nil, after 12 weeks' storage in the case of control and salt treated samples and after seven weeks in the case of phosphate treated samples. Coagulase positive Staphylococci count dropped to nil after storage for 12 weeks in the case of the treated samples and 15 weeks in the case of control sample.

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