Effect of Ascorbic Acid Dip Treatment on Frozen Storage of Squid (*Loligo duvaucelii*, Orbigny)

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Squid *(Loligo duvaucelii)* was treated with 0.5% ascorbic acid solution for 10 min and both treated and control samples were frozen at -40°C and stored at -20°C. The quality changes during frozen storage and shelf life were evaluated by following the physical, chemical, bacteriological and sensory characteristics. Ascorbic acid treatment was found to improve the quality and shelf life compared to control.

Several studies have been reported on the storage characteristics of iced and frozen stored squid. However limited work is done on the use of preservatives on improving the quality of these products during frozen storage. Treatment with ascorbic acid is found to improve quality of seafood (Bauernfeind *et al.*, 1951; Heen & Karsti, 1950; Greig, 1967; Greig *et al.*,1967; Jadhav & Magar, 1970; Deng, *et al.*, 1977 & 1978 and Ablette *et al.*, 1986). In the present study the possibility of using ascorbic acid as preservative for frozen squid is explored. Effect of ascorbic acid dip treatment on storage characteristics of frozen squid is assessed and the results reported.

Materials and Methods

Fresh squid *Loligo duvaucelii* procured from the fish landing center of Tuticorin fishing harbour was used in the present study. The dressed mantles were divided into two batches. One group was given 10 min dip treatment in 0.5% (w/v) ascorbic acid solution. The other batch was kept as control. The mantles were packed individually in 150 gauge polyethylene pouches and quick frozen at -40°C in contact plate freezer and stored at -20°C. Samples were drawn and analysed for physical, biochemical, microbiological and sensory characteristics at monthly intervals.

The thaw drip, weight loss on thawing and on cooking were determined by the methods given by Joseph *et al.* (1977). Moisture was estimated as per AOAC (1975) method. Quality characteristics like trimethylamine (TMA) and total volatile nitrogen (TVN) (Beatty & Gibbens, 1937), alpha amino nitrogen (Pope & Stevens, 1939), salt soluble nitrogen (SSN) (Dyer *et al.*, 1950), non protein nitrogen (NPN) (AOAC, 1975), peroxide value (PV) (Lea, 1952) and thiobarbituric acid value (TBA) (Woyewoda & Ke, 1979) were determined. The total plate count (TPC) was determined by pour-plate technique using nutrient agar medium (Anon, 1982). The sensory evaluations of the frozen samples and the cooked samples in triplicate were carried out. The cooked samples were prepared by boiling the thawed mantles in 2% brine for 10 min (Joseph *et al.*, 1985) and assessed for organoleptic qualities by six trained panelists on the basis of colour, appearance, texture and flavour using a five point hedonic scale (Excellent - 5, Good - 4, Fair and acceptable - 3, Poor and unacceptable - 2 and Spoiled -1).

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Results and Discussion

The physical changes in frozen squid mantles during frozen storage are presented in Table 1. The thaw drip, weight loss on thawing and on cooking increased gradually. This may be due to protein denaturation and consequent decrease of water holding capacity during frozen storage (Joseph *et al.*, 1985). The ascorbic acid treatment did not have significant effect on weight loss on thawing and cooking. Noguchi *et al.* (1977) noticed that ascorbic acid had little or no effect on freeze denaturation.

The changes in the biochemical, microbiological and sensory score in treated and control samples during frozen storage are presented in Tables 2 and 3 respectively. There was a gradual decrease in moisture content of the squid during frozen storage. The loss was less in ascorbic acid treated samples. TMA increased gradually in both the samples during frozen storage. Sastri (1981) observed an increase in TMA in frozen stored cuttle fish. The TVN also increased gradually during frozen storage and the control samples showed a value of 29.6 mg% at the end of 9 months storage.

α-amino nitrogen and SSN decreased during frozen storage. The decrease may be due to protein degradation and loss in thaw drip (Ablette *et al.*, 1986). The decrease was less in ascorbic acid treated samples than in control. NPN was found to decrease during frozen storage. The decrease in NPN may be due to loss of soluble nitrogen fractions in thaw drip. However the decrease was found to be less in treated samples than in control. This may be due to increased water holding capacity of the treated samples.

PV was found to increase gradually during frozen storage but the increase was less in treated samples than control. Deng *et al.* (1977) studied the effect of various antioxidants on rancidity development in frozen mullet fillets and found that ascorbic acid was more effective in retarding peroxidation.

The TBA values increased during frozen storage. The increase was less in treated

Table 1. *Physical changes in frozen squid mantles during storage*

Parameter	Storage period in months								
	1	2	3	4	5	6	7	8	9
Control									
Thaw drip, ml/100g	6.0	7.8	8.4	9.5	12.0	14.3	15.1	17.2	18.0
Weight loss on thawing, %	8.7	10.3	13.9	14.3	16.4	19.3	23.5	25.7	28.7
Weight loss on cooking, %	22.5	24.5	26.8	28.8	39.0	33.7	38.0	40.3	43.1
Ascorbic acid treated									
Thaw drip, ml/100g.	3.1	3.6	4.0	4.5	5.1	5.8	6.4	7.8	8.3
Weight loss on thawing, %	8.2	10.8	11.4	12.9	15.6	17.3	21.1	22.8	25.0
Weight loss on cooking, %	19.9	20.7	22.5	24.6	25.2	28.2	30.7	33.3	33.6

Table 2. *Biochemical and microbiological properties and sensory score of ascorbic acid treated squid during frozen storage at -20°C*

Paramater	Storage period, months									
	0	1	2	3	4	5	6	7	8	9
Moisture, %	82.9	82.8	82.0	81.1	79.8	78.5	76.3	75.8	75.4	75.6
Total nitrogen, g%	2.8	2.7	2.7	2.6	2.5	2.4	2.4	2.3	2.2	2.1
Trimethylamine, mg%	1.4	1.9	2.9	4.7	8.1	11.0	11.8	12.0	13.0	14.0
Total volatile nitrogen, mg%	3.5	8.0	12.7	16.4	19.3	21.0	22.0	23.1	24.8	21.3
α-amino nitrogen, mg%	238.00	218.4	185.5	167.6	146.0	117.6	106.3	101.3	94.2	91.8
Salt soluble nitrogen, g%	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3
Peroxide value, m.eq./kg fat	4.7	9.0	11.3	17.7	21.1	25.4	28.4	32.0	35.0	39.1
Thiobarbituric acid value, mg/1000 g meat	-	-	-	0.8	1.2	2.0	2.2	2.5	3.4	3.8
Total plate count, No.x 10^2/g	4.7	12.4	21.3	29.0	32.6	36.8	39.5	45.4	33.3	62.4
Mean score, Uncooked samples	5.0	5.0	4.9	4.9	4.7	4.4	4.1	3.8	3.5	3.4
Cooked samples	5.0	5.0	5.0	4.9	4.5	4.2	4.0	3.7	3.4	3.2

sample. The lower values of TBA in ascorbic acid treated samples indicated the preventive action of ascorbic acid on lipid oxidation in frozen stored squid. TPC showed very little change during frozen storage.

The sensory score decreased during frozen storage in all the samples. The control samples developed slight pink discolouration at the end of nine months storage. In the ascorbic acid treated sample, no discolouration was noticed even after 9 months storage. In control samples the texture was very soft and sticky in uncooked meat and it became tough after cooking, while the ascorbic acid treated samples had better qualities. The treated samples were acceptable after 9 months storage while the control was acceptable upto 6 months. Hence the ascorbic acid treatment improved the overall acceptance and shelf life of squid compared to the control during frozen storage.

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Table 3. *Biochemical and microbiological properties and sensory score of frozen squid mantles (control) during storage at -20°C*

Parameter	Storage period in months									
	0	1	2	3	4	5	6	7	8	9
Moisture, %	82.9	80.0	78.4	76.4	76.0	75.3	75.0	74.4	73.6	73.2
Total nitrogen, g%	2.8	2.7	2.6	2.5	2.4	2.3	2.1	2.1	1.9	1.8
Trimethylamine N, mg%	1.4	2.0	4.0	7.8	9.9	13.0	14.0	14.9	15.9	17.0
Total volatile nitrogen, mg%	3.5	9.8	13.9	18.4	21.7	26.0	26.5	26.8	27.8	29.6
α -amino nitrogen, mg%	238.0	212.9	188.7	152.0	132.5	106.4	100.8	94.6	89.0	83.1
Salt soluble nitrogen, g%	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2
Non protein nitrogen, g%	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2
Peroxide value m.eq./kg fact	4.7	12.4	21.3	29.0	32.6	36.8	39.5	45.4	53.3	62.4
Thiobarbituric acid value, mg/1000g meat	-	-	-	2.8	3.2	5.4	6.9	8.6	9.8	11.3
Total plate count, no x 10^2/g	5.3	4.0	3.6	6.9	7.1	9.4	10.0	10.6	11.3	12.0
Mean score										
Uncooked samples	5.0	4.9	4.4	3.9	3.5	3.3	3.0	2.6	2.1	1.2
Cooked samples		5.0	4.9	4.7	4.7	4.0	3.5	3.0	2.3	2.0

References

Ablett, F.R., Gould, P.S. & Sherwood, A.D. (1986) *J.Fd Sci.* **51**, 1118

Anon (1982) *The Oxoid Manual of cultural Media, Ingredients and other Laboratory Services.* 5th edn., Basingstokg, U.K.

AOAC (1975) *Official Methods of Analyses,* 12th edn. Association of Official Analytical Chemists, Washington, D.C.

Bauernfeind, J.C., Smith, E.G., Batcher, D. & Siemens, G.F. (1951) *Fd Technol.* **5**, 254

Beatty, S.A. & Gibbons, N.E. (1937) *J.Biol.Bd Can.***3**, 77

Deng, J.C., Mathews, R.F. & Watson, C.M. (1977) *J. Fd. Sci.* **42**, 344

Deng, J.C., Watson, M., Bates, R.P. & Schroeder, E. (1978) *J.Fd Sci.* **43**, 457

Dyer, W.J., French, H.V. & Snow, J.M. (1950) *J.Fish.Res. Bd Can.* **13**, 129

Greig, R.A. (1967) *Fish.Ind.Res.* **4**, 45

Greig, R.A., Emerson, J.A. & Flichman, C.W. (1967) *Fish.Ind.Res.* **3**, 1

Heen, E. & Karsti, D. (1950) *Fish as Food*

Vol.IV. (Borgstrom G., Ed.) p.335. Academic Press, New York

Jadhav, M.G. & Magar, N.G. (1970) *Fish. Technol.* **7**, 146

Joseph J., Varma, P.R.G. & Venkataraman, R. (1977) *Fish. Technol.* **14**, 13

Joseph J., Perigreen, P.A. & Nair, M.R. (1985) in *Proceedings of Int.Conference on Storage Lives of Chilled and Frozen Fish and Fish products*, I.I.F. - I.I.R. Commissions C_2 and D_3. Aberdeen (U.K) p.83

Lea, C.H. (1952) *J.Sci. Fd Agri. 3, 586*

Noguchi, S., Ooswa, K. & Matsumoto J.J. (1977)*Bull.Jap. Soc. Sci. Fish.* **43**, 77

Pope, C.G. & Stevens, M.F. (1939) *Biochem.J.* **33**, 1070

Sastry, C. (1981) *Biochemicals changes in cuttle fish (Sepia aculeata) during iced and frozen storage*, M.F.Sc. Thesis. The University of Agricultural Sciences, Bangalore.

Woyowoda, A.D. & Ke, P.J. (1979) *Quality assessment of fatty fish by the thiobarbituric acid distillation method.* Fisheries and Oceans Canada. Technology Branch, Halifax Lab. New Series Circular No.63