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EFFECT OF FROZEN STORAGE ON *PLEUROPLOCA TRAPEZIUM* MEAT

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ABSTRACT

The horse conch, *Pleuroploca trapezium* is a marine gastropod that is landed in huge amount as by-catch along Gulf of Mannar. Their beautiful shells and operculum are being used for ornamental and medicinal purposes. Even though the meat is not being used locally, small quantities are being exported to Southeast Asian countries like Taiwan. These basic data relating to nutritional quality emphasize the need of promotion of this underutilized gastropod meat on par with other sea foods. Normally the sea food is preserved at a low temperature to reduce the post harvest loss and quality deterioration during extended period of storage. The shelf life of frozen stored *Pleuroploca* meat as such and after dip treated with chemicals was determined. The meat without any pretreatment had a shelf life of 4 months, while the meat dip treated with Orthophosphoric acid and Potassium nitrate had a shelf life of 5 and 6 months respectively. Thus Potassium nitrate can be used for dip treatment to extend the storage life of the meat under frozen storage.

KEYWORDS: **Marine mollusk, Nutritional quality, analysis and storage**

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INTRODUCTION

Molluscs which are widely distributed throughout the world have many representatives in the marine and estuarine eco-systems[1]. Among the marine organisms the molluscs are one of the most successful forms of animal life and they have conquered almost every habitat and exist in all the oceans[2,3]. Fish and shellfish are relatively perishable and their quality degrades mainly by microbial spoilage and biochemical reactions occurring during handling and storage. Several spoilage indicators have commonly been used to assess the quality of stored seafood. Scientists have been constantly searching for improved methods to preserve or extend the shelf life of various aquatic food products. Their findings on seafood preservation and shelf life extension technology have been summarized in the reviews of Sikorski and Pan (1994)[4] and Ashia *et al* (1996)[5] Freezing has long been established as an excellent method for preserving the quality of food items.

Freezing preserves the taste, texture, and nutritional value of foods better than any other method and as a result extensive quantities of food are now frozen worldwide[6]. Freezing is having a lethal or inhibitory effect on microbial system and the microorganisms vary tremendously in their abilities to tolerate freezing. In general, tolerance of microorganisms to freezing increases as their optimum temperatures for growth decrease. In addition to that, the microbial growth is also retarded through antimicrobial agents or preservatives.

The problems concerning a limited storage life become more critical due to urbanization and the increasing time between harvest and consumption of food. Most frozen foods contain some proportion of lipid and are often susceptible to oxidative degradation and production of off-flavours during frozen storage. To control the generation of off-flavours, antioxidants are often used. Antioxidants are substances capable of delaying, retarding, or preventing the chemical and enzymatic reactions associated with lipid oxidation and a number of methods for applying antioxidants have arisen over the years. Before selecting and using an antioxidant, consideration should be given to the method of application, storing the product, and concentrations that may be applied legally. To aid in the dispersion of the antioxidant throughout the product it may be applied directly to the product before mixing or dissolved in an appropriate medium (i.e., water, oil or alcohol). A wealth of studies has been conducted on frozen foods to monitor the response to application of antioxidants and wide variation in response from activation to severe inhibition has been noted with many of the antioxidants[7]

Alblett *et al* (1986)[8] studied the influence of ascorbic acid and chelating agents on the quality of cooked mussels (*Mytilus edulis*). Jiang *et al.* (1979)[9] worked on freezing preservation of shucked oyster for reduction of drip loss by using pretreatment with tripolyphosphate and brine. Changes in chemical, bacteriological and organoleptic qualities of mussel during freezing and subsequent frozen storage in relation to pre-process iced storage and the effect of pre-process iced storage on the quality of cooked frozen mussel meat were studied by George and Nair (1976)[10]. The shelf life of fresh and ice stored edible portion of *Pleuroploca trapezium* was reported by Ramesh and Ayyakkannu (1992)[11] The present study reports the effects of a preservative Potassium nitrate, and an antioxidant – Orthophosphoric acid on the frozen storage quality of *Pleuroploca trapezium* meat.

MATERIALS AND METHODS

i) Dip Treatment and Storage

Fresh *Pleuroploca trapezium* meat was purchased from local shell and meat dealer and was brought to the laboratory immediately in an icebox. The meat was washed in potable water and scraped to remove adhering dirt and mucus. The meat was again thoroughly washed and then cut into thin slices. The slices were divided

into four lots and each one was dip treated separately with 0.3 and 0.5% Potassium nitrate and Orthophosphoric acid for five minutes and another lot of meat was kept as control without any chemical treatment.

Ten grams each of meat was packed in LDPE pouches and stored at –18^{o}C in a deep freezer. The biochemical and microbiological characteristics of the treated and control samples were done monthly. In addition to that the sensory evaluation of the samples was also assessed and the optimum storage time was estimated for the treated and untreated meat at frozen storage conditions.

ii) Shelf life Studies

Trimethyl Amine Nitrogen (TMA-N) and Total Volatile Base Nitrogen (TVB-N) contents were estimated by Conway Microdiffusion method[12] and the Free Fatty Acids (FFA) was estimated by titrimetric method[13]. Enumeration of Total Plate Count (TPC) was done using Plate Count Agar and Total Fungal Count (TFC) using Potato Dextrose Agar[14]. Ten grams of meat was taken aseptically and homogenized with 90 ml of sterile saline (0.85% Nacl in distilled water). The homogenized meat was serially diluted using 9 ml saline and pour plated (1 ml) in respective media and incubated at 37^{0}C for 48h to enumerate TPC and for 5 days to determine the Total Fungal Count. *E.coli* and *Vibrio* sp. were enumerated by MPN technique of USFDA (1998)[15]. *Salmonella* sp. was enumerated by the pour plate method of USFDA (1998)[16]. Sensory evaluation was done by judging the color, texture and odour of the frozen sliced meat samples by panelists and was rated as - Very good, Good, Fair and Poor.

RESULTS AND DISCUSSION

Oxidation and hydrolysis of lipid in fishes during storage cause quality deterioration and lipid hydrolysis results in the formation of Free Fatty Acids (FFA)[17]. Regardless of the quantity of fat in a fish, degradation of this fat during storage can cause undesirable changes in flavour, odour and taste. The free fatty acid content of meat measures the first stage of lipid hydrolysis.

Extensive phospholipid hydrolysis in frozen fish, based on formation of free fatty acid and loss of phospholipid has been recognized for many years[18]. In the present study, the FFA value increased significantly with storage period in the untreated control sample. The increase was found to be lower in the treated samples with the least value of FFA in the samples treated with Orthophosphoric acid (Table 1). Increase in free fatty acid during frozen storage of Rawas (*Eleutheronema tetradactylus*), Spotted Seer and Ghol fillets have been reported by Garg and Stephen (1985)[19], Shenoy (1976)[20] and Garg *et al* (1982)[21] respectively. Fatty acid formation may contribute to texture toughening by influencing protein denaturation and flavour deterioration by enhancing lipid oxidation. Oxidation of lipids is a major cause of off-flavour and has also been implicated in texture change of frozen sea food[22].

Table 1
Biochemical characteristics of frozen Pleuroploca trapezium meat

Characteristics	Storage (days)	1	2	3	4	5
TMA-N (mg %)	0	0.32	0.32	0.32	0.32	0.32
	30	0.98	0.42	0.42	3.22	3.64
	60	2.43	2.72	3.3	3.71	4.80
	90	5.64	5.45	8.36	9.27	15.71
	120	8.40	7.00	14.00	18.2	26.60
	150	11.76	9.72	18.86	ND	ND
		14.36	12.02	ND	ND	ND
TVB-N (mg %)	0	0.62	0.62	0.62	0.62	0.62
	30	3.36	0.98	1.54	4.34	5.88
	60	7.03	6.95	7 .46	6.03	9.04
	90	10.54	7.92	15.32	14.57	25.65
	120	15.4	8.40	32.2	30.8	44.8
	150	20.52	10.46	ND	ND	ND
	180	26.48	12.65	ND	ND	ND
FFA (% Oleic acid)	0	0.023	0.023	0.023	0.023	0.023
	30	0.093	0.050	0.109	0.058	0.052
	60	1.225	2.209	3.02	2.115	3.065
	90	1.41	8.46	4.78	2.143	10.26
	120	1.672	14.75	6.88	2.180	18.48
	150	2.042	17.78	8.452	2.57	22.68
	180	3.761	22.34	10.23	3.884	25.75

1 – 0.3% Potassium Nitrate; 2 – 0.5% Potassium Nitrate; 3 – 0.3% Orthophosphoric acid; 4 – 0.5% Orthophosphoric acid; 5 – Control. DD - Not Determined.

Table 2
Microbial changes of frozen stored raw P. trapezium meat

Parameter	Storage days	1	2	3	4	5
TPC (CFU/g)	0	5×10^3	5×10^3	5×10^3	5×10^3	5×10^3
	30	44×10^3	10×10^3	20×10^4	8×10^4	24×10^4
	60	28×10^4	137×10^4	117×10^3	42×10^3	46×10^3
	90	30×10^4	106×10^4	98×10^4	46×10^4	37×10^3
	120	32×10^4	85×10^4	89×10^4	47×10^4	97×10^4
	150	28×10^4	60×10^4	74×10^4	38×10^4	68×10^4
	180	25×10^4	31×10^4	55×10^4	34×10^4	45×10^4
TFC (CFU/g)	0	1×10^4	1×10^4	1×10^4	1×10^4	1×10^4
	30	2×10^4	1×10^4	1×10^4	1×10^4	1×10^4
	60	1×10^4	1×10^4	1×10^4	1×10^4	1×10^4
	90	2×10^3	nil	2×10^3	2×10^3	1×10^3
	120	1×10^3	1×10^4	2×10^3	nil	4×10^3
	150	1×10^3	1×10^3	2×10^3	1×10^3	1×10^3
	180	1×10^3	1×10^3	1×10^3	1×10^3	1×10^3

1 – 0.3% Potassium Nitrate; 2 – 0.5% Potassium Nitrate; 3 – 0.3% Orthophosphoric acid; 4 – 0.5% Orthophosphoric acid; 5 – Control.

Table 3
Organoleptic analysis of raw Pleuroploca trapezium meat using frozen storage

Parameter	Storage days	1	2	3	4	5
Colour	0	Very good	Very good	Very good	Very good	Very good
	30	Very good	Very good	Very good	Very good	Good
	60	Good	Good	Good	Good	Good
	90	Good	Good	Good	Good	Fair
	120	Good	Good	Fair	Fair	Fair
	150	Fair	Good	Fair	Fair	Poor
	180	Fair	Fair	Poor	Poor	Poor
Odour	0	Very good	Very good	Very good	Very good	Very good
	30	Very good	Very good	Very good	Very good	Good
	60	Good	Good	Good	Good	Good
	90	Good	Good	Good	Good	Good
	120	Good	Good	Fair	Fair	Fair
	150	Fair	Fair	Fair	Fair	Poor
	180	Fair	Fair	Poor	Poor	Poor
Texture	0	Very good	Very good	Very good	Very good	Very good
	30	Good	Good	Good	Good	Good
	60	Good	Good	Good	Good	Good
	90	Good	Good	Good	Good	Fair
	120	Good	Good	Fair	Fair	Fair
	150	Fair	Fair	Fair	Fair	Poor
	180	Fair	Fair	Poor	Poor	Poor

1 – 0.3% Potassium Nitrate; 2 – 0.5% Potassium Nitrate; 3 – 0.3% Orthophosphoric acid; 4 – 0.5% Orthophosphoric acid; 5 – Control.

TMA-N is often used as an index to assess the keeping quality and shelf life of seafood products[23]. In the present study, the TMA-N contents of the meat showed an increasing trend in all the samples. The TMA-N values reached unacceptable levels in the control sample and sample treated with 0.5% Orthophosphoric acid in 4 months and for 0.3% Orthophosphoric acid treated sample in 5 months. The extent of increase in TMA-N values was much higher in untreated control sample than that of the treated sample (Table 1). In the case of samples treated with 0.3 and 0.5% Potassium nitrate, the values were lower and the level was well within the acceptability limit of 15mg/100g[24] of meat even after 6 months of frozen storage. This may be due to lower bacterial load in the samples by the inhibitory effect of Potassium nitrate over the growth of bacteria. Similar observations were reported for frozen stored blanched mussel meat (*Perna viridis*) treated with tripolyphosphate[25]. In the microbial analysis, Total Plate Count was high in control samples followed by Orthophosphoric acid and Potassium nitrate treated samples. After 180 days of frozen storage, the counts decreased considerably in the treated samples than in the untreated samples (Table 2). For determining the aerobic plate count shelf life, the sanitation standard of 3×10^6 for frozen seafood was used[26]. In the present study, in all the treated samples, the Total Plate Count was within the acceptable limit in two to three months of frozen storage. But the Total Fungal count was found to have an overall increase during storage and it has been reported that yeasts are not susceptible to cold shock[27]. Change in microbial population is a traditional quality index of fresh fish[26] and there are numerous reports on the microbiological quality of marine animals[28,29].

In the present study, the sensory measurement and the objective tests were found to complement each other, but the organoleptic shelf life was found to be slightly more than the objective shelf life (Table 3). Rancidity was not detected in frozen minced trout or frozen fish flakes when sensory methods were used to judge the quality. Chemical measurements, however, were able to differentiate antioxidant and non antioxidant treated samples. Since ultimately it is consumers who evaluate the final stored product, sensory measurements conducted properly should be the truest measure. In the frozen storage of raw *Pleuroploca trapezium* meat, the Potassium nitrate treated and Orthophosphoric acid treated samples were acceptable for more than 5 and 6 months respectively inspite of the control which is acceptable only up to 4 months organoleptically and 3 months objectively. The Potassium nitrate treatment improved the overall acceptance and shelf life of *P. trapezium* meat and therefore it can be used for dip treatment of the meat to improve their shelf life under frozen storage.

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