Research Article

CHANGES IN QUALITY CHARACTERISTICS AND SELECTED CHEMICAL DECOMPOSITION INDICATORS DURING COLD STORAGE OF *MAYDELLIATHELPHUSA MASONIANA,* A FRESH WATER CRAB

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ARTICLE INFO	ABSTRACT

The present investigation was carried out to determine the deteriorative changes and nutritive quality of crab meat (*Maydelliathelphusa masoniana*) during storage at refrigerator temperature (4 ± 1^0C) for a period of one week. The parameters studied for the assessment are total proteins, lipid, ash, water, pH, TBA, FFA. The results indicate a significant increase in PH, FFA and TBA while total protein and lipid contents significantly decreased with the increase in the storage time. On the basis of the findings, it is recommended that the quality of crab meat is good upto three days and after that it becomes deteriorated.

INTRODUCTION

Sea food are rapidly deteriorating food so several preservation techniques are used for maintaining their nutritional components and delivering fresh to the consumer. The most commonly used is cooling technique and it is used commonly at the facilities and especially at the households (Varlik *et al*., 2007). Fish and fish products are highly perishable because of the high water content, the lipid oxidation, autolytic enzymes and later by microbial enzymes (Olafsdottir *et.al*., 1997).

Low temperature is important to retain the quality of fish and fish products (Jain and Pathore, 2007). Low temperature storage is one of the primary methods to maintain fish freshness, based on the reduction in the rates of microbiological, chemical, and biological changes (Chapman, 1990). Chilled storage is based on lowering temperature close to the freezing point of the products. Chilled storage is a useful technique that has been applied to extent the shelf life and fish products. The low temperature will reduce the activities of bacteria i.e. spoilage, enzyme activity and lipid oxidation reaction, so the fish and fish products remain edible longer. However, bacterial biomass and types of bacteria affect of storage (Chow, 1982).

Consumers usually buy fish in bulk and store in refrigerator. Deterioration of fish quality in refrigerator storage have great impact on the nutritious value of fish and the health of consumers. Considering the importance from consumer view point, this study was designed to analyse the efficiency of storage at low temperature (4 ± 1^0C) on shellfish quality.

MATERIALS AND METHODS

Crabs after being were collected from their natural habitat, at Gho-Manhasan stream, at a distance of about 12kms from University of Jammu, were brought to the laboratory. The animal was cleaned and their shell was removed, wet tissue was excised on absorbent paper and the weight was recorded on an electrical balance then it randomly divided into aliquots. One aliquot was freshly analyzed to determine the proximate and chemical changes. Second was kept at 4 ± 1^O C for seven days. The changes in the proximate and chemical parameters were noted after one day interval to assess the quality of meat. The following parameters were analyzed, pH (by Electrical pH meter, ash and water content (Standard method of AOAC, 1999), Total proteins (Lowry *et al*., 1951); Lipid (Folch *et al*., 1956), free fatty acid (Koniecko, 1979), TBA (Witte *et al*., 1970).

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Statistical analysis

The data was analyzed to the level of significance with the help of Microsoft Excel 2003 and SPSS (12.0 Version, Chicago, USA). The level of significance was tested by one way ANOVA, Duncan post multiple range comparisons.

RESULTS

Protein: Perusal of Table-1 and Fig. a revealed that at the beginning of the storage period (i.e. 0th day) the crude protein content values for crab meat were recorded as 17.91±0.55%. The value however, decreased to 11.86±0.43% on 7th day. A significant percental decrease was found in the protein content i.e. 4.61%, 11.78%, 16.25% and 23.87% on Ist, 3rd, 5th and 7th day of storage respectively (Table-2).

Fig.c Changes in the Moisture content of crab meat during storage at 4±1°C
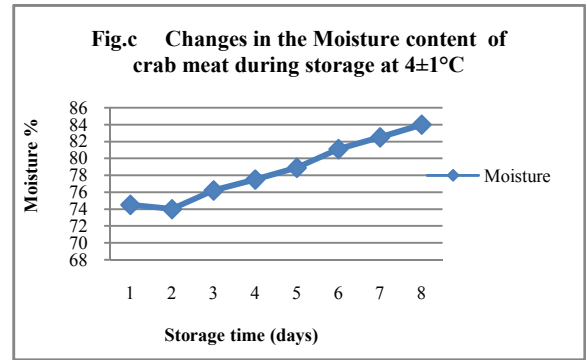
Table 1 Changes in the chemical constituents of crab meat during storage at 4±1°C. Data presented is the mean of three readings i.e. Mean±S.D

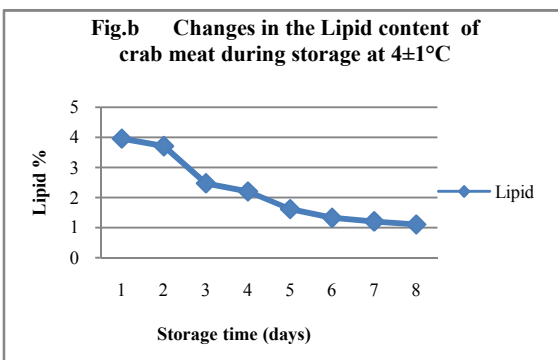| Storage time in days	pH (Mean±S.D)	Moisture (Mean±S.D)	Proteins (Mean±S.D)	Lipids (Mean±S.D)	Ash (Mean±S.D)	FFA (Mean±S.D)	TBA (Mean±S.D)
0	6.45±0.10^c	74.51±0.97^{cd}	17.91±0.55^a	3.96±0.39^a	6.71±0.40^a	0.65±0.04^h	0.42±0.03^f
1	6.75±0.16^{bc}	74.00±1.07^{cd}	16.85±0.40^b	3.71±0.41^a	6.35±0.37^{ab}	1.28±0.05^g	0.42±0.02^f
2	6.90±0.21^{bc}	76.21±1.22^{cd}	16.00±0.66^c	2.47±0.30^b	6.01±0.18^{bc}	2.15±0.07^f	0.58±0.05^{de}
3	7.21±0.12^b	77.51±1.16^{bc}	15.57±0.59^c	2.20±0.15^c	5.85±0.28^c	2.89±0.16^e	0.51±0.02^{ef}
4	7.67±0.18^a	78.90±1.08^b	14.27±0.24^d	1.61±0.20^{cd}	5.23±0.18^d	3.67±0.23^d	0.69±0.04^{cd}
5	7.50±0.16^a	81.11±1.12^b	13.31±0.58^e	1.32±0.10^{de}	4.91±0.22^d	4.61±0.21^c	0.75±0.02^{bc}
6	7.73±0.23^a	82.50±0.96^a	12.20±0.36^f	1.20±0.17^{de}	4.63±0.12^e	5.59±0.26^b	0.79±0.09^{ab}
7	7.99±0.19^a	84.00±1.15^a	11.86±0.43^f	1.10±0.09^e	4.13±0.15^f	6.98±0.32^a	0.86±0.11^a

- Data presented above is the mean of three readings i.e. Mean±S.D
- The values having same superscript in a column do not differ significantly P>0.05.

Fig. a Changes in the Protein content of crab meat during storage at 4±1°C
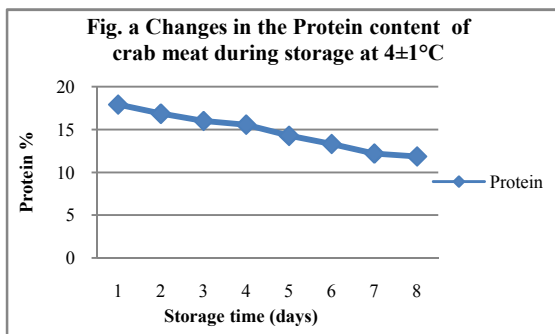
Moisture: From Table-1 and Fig. c, it is clearly evident that the initial moisture content value recorded on the 0th day of storage was 74.51±0.97% and it increased to 84.00±1.15% on 7th day of storage. A percental increase of 0.68% (1st day), 4.02% (3rd day), 8.85% (5th day), 12.73% (7th day) was recorded (Table-2).

Table 2 Percental decrease in proximate composition of crab meat during frozen storage at 4±1°C from 0 day to 7th day

Days	Protein (%)	Lipid (%)	Ash (%)	Moisture (%)
0-1	4.65	6.31	5.36	0.68
0-3	11.78	44.44	12.82	4.02
0-5	16.25	66.66	26.82	8.85
0-7	23.87	72.22	38.45	12.73

Fig.b Changes in the Lipid content of crab meat during storage at 4±1°C

Fig.d Changes in the Ash content crab meat during storage at 4±1°C

Lipid: Inquisitive study of Table-1 and Fig. b reveals that the initial lipid content was recorded to be 3.96±0.39% (on 0th day) and it decreased to 1.10±0.09 % on the 7th day of storage. A significant decrease of 6.31%, 44.44%, 66.66% and 72.22% was recorded on 1st, 3rd, 5th and 7th respectively (Table-2).
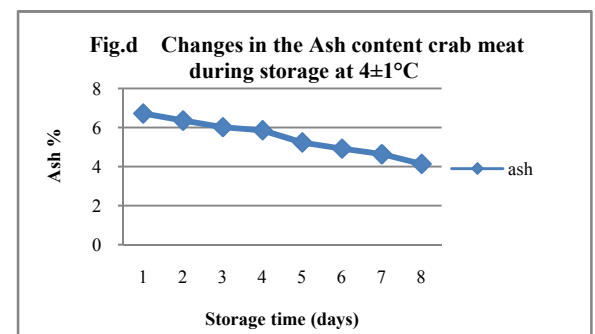
Ash: At the beginning of the storage period (i.e. 0th day) the ash content values for crab meat were determined as 6.71±0.40%. It however, decreased to 4.13±0.15% on 7th day (Table-1 and Fig. d). A significant percental decrease in the ash
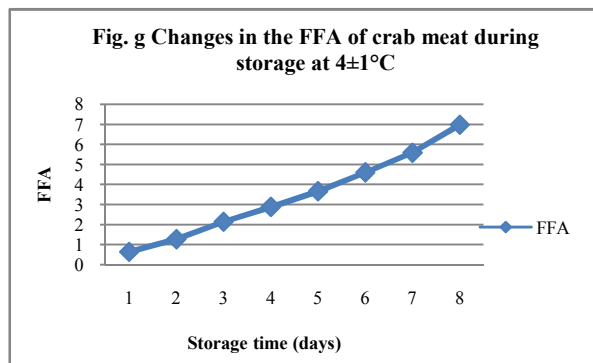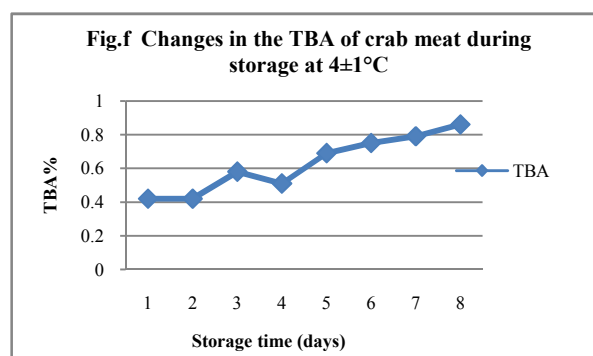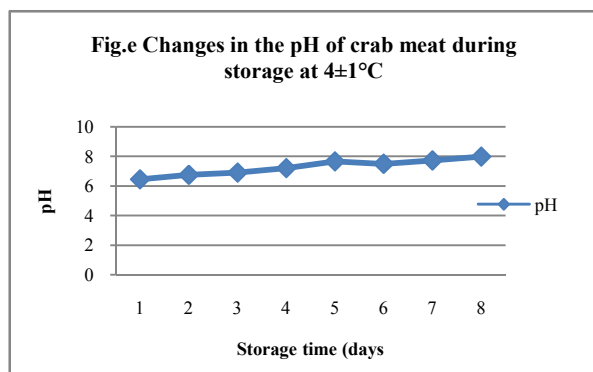
content i.e. 5.36%, 12.81%, 26.82%,and 38.45% was recorded on Ist, 3rd, 5th and 7th day respectively (table- 2).

Chemical indicators i.e. pH, TBA, FFA:

pH: At the beginning of storage period, pH values for the fresh samples were determined as 6.45±0.05. At the end of 7 days of storage period, pH was recorded to be 7.99±0.23.

FFA: It was observed in the present studies that on day 0, FFA values were 0.65±0.01% and 6.58±0.07% on 7th day of storage. At 4±1[0] C, the raw sample was found to be near acceptance limit 5.0% on 6th day (4.61±0.16%).

TBA: At the beginning of the storage period, the TBA values were 0.42±0.05 mg MA/Kg. At the end of the storage period of 7 days, the TBA values were obtained as 0.68±0.11 mg MA/Kg. All the chemical indicators remain in good quality upto 3 days. It is however, acceptable upto 5th day as all the chemical indicators are well within the acceptable limits. After it, the sample is unfit for human consumption (Table- 1 and Fig. e, f, g).

Fig.e Changes in the pH of crab meat during storage at 4±1°C

Fig.f Changes in the TBA of crab meat during storage at 4±1°C

Fig. g Changes in the FFA of crab meat during storage at 4±1°C

DISCUSSION

Protein analysis results

At the beginning of the storage period, the crude protein values of muscles of *M. masoniana* were found to be 17.91%. At the end of storage period, it decreased to 12.87%. Our results are in good agreement with those reported by Kolodziejska *et al.*, (1987) who have observed that low temperature, the rate of denaturation and autolysis of fish protein was markable. The autolysis helps the bacteria to invade the tissue rapidly, the free aminoacids and water soluble protein content of tissue serve as an excellent source for their growth and as a result of which not only the quality but also the quantity of protein is decreased. Siddiqui and Ali (1979) reported that decrease in protein content of prawn content of prawn during ice storage is due to the leaching effects i.e., the amino acids and water soluble proteins leach out with melting ice.

Lipid analysis results

Changes in the total lipid during storage at 4±1[0]C is presented in Table-1. In fresh sample total lipid was estimated to be 3.96%. It was recorded that a linear decrease in the lipid content was recorded with the increase of storage time. It was found to be 3.71 and 2.47% on the first and second day of storage. On 7th day, it reached to a value of 1.10%. The major factor responsible for the deterioration of fish and shellfish is oxidation of lipid. A significant decrease in total lipid content (50 to 70%) at 0[0] was noted by Gibson and Worthington (1977) and Riaz and Qadri (1990). Agnihotri (1988) reported that the deterioration in lipid took place due to intermediary activities of endogenous meat enzymes leading to hydrolysis of fat. Zamir *et al.*, 1988 attributed the loss in lipid levels of crab meat stored at refrigerator temperature 7±2[0]C for one week due to the oxidative rancidity.

Water content analysis

The water content in fresh tissue of crab was recorded to be 74.51% and it increased with the increase of storage time. It was recorded to be 84.0% after 7 day of storage period. Such changes may be attributed to the reaction between formaldehyde or malanoaldehyde (break down product of TMA and total lipid) and tissue protein accompanied with the release of water (William et al., 1983). It shows a positive correlation with TBA and FFA and negative correlation was observed with total proteins, lipids and ash content of crab tissue. Similar correlations were reported by Leblanc *et al.*, 1988 in cold tissue during storage at low temperature.

Ash content analysis

The ash content in the crab muscle at 0 day of storage at 4±1[0]C was found to be 6.71% and the final value on 7th day was found to be 4.03%. Okeyo *et al.*, 2009 observed that the ash content of the frozen raw Nile perch decreases with storage time and a percental decrease of 12.69% was recorded after 22 days of cold storage. However, Kandeepan and Biswas (2007) registered 14.87% decrease in chiller and 20.66% decrease in freezer after 7 days of storage.

pH analysis results

According to literature, pH is about 6.0-6.5 for fresh flesh and it increases during storage. The limit of acceptability is usually

6.8-7.0 (Ludroff and Meyer, 1973). However, post mortem pH can vary considerably depending on the season, the species and other factors (Simeonidou *et al*., 1998). pH depends on several physical and chemical factors such as buffering capacity and ionic composition of crab meat. Bhobc and Pai (1986) reported that rise in pH of shrimp (*Metapeneus dohsani*) during low temperature storage is primarily due to the formation of amines through bacterial reduction of TMAO to TMA, decomposition of tissue protein and deamination process. The change in the hydrogen ion concentration of meat is used as an indicator for the assessment of quality of correlation with water but negative correlation with protein and lipid during seven days storage at $4 \pm 1^0 C$. Our results showed that quality of fresh caught crab meat prime upto 6 days of storage and acceptable on 7th day of storage.

TBA analysis results

The TBA values are a widely used indicator for the assessment of degree of lipid oxidation (Calki *et al*., 2006). A progressive linear increase in the TBA content was recorded with the increasing storage time. The values obtained were considerably lower than accepted limit human consumption of 5-8 mg MA/Kg.

FFA analysis results

Rodriquez *et al*., (2007) observed increasing FFA during frozen storage farmed coho salmon (*Onchorhynchus kisutch*). According to Pacheo Aguillar *et al.,* 2000 during post mortem period, lipid (glycerol-fatty acids esters) present in the fish muscle undergo hydrolysis, resulting in the release of fatty acids. This is also supported by Okeyo *et al*., 2009, who stated that the accumulation of FFA could be due lipases and photolipases activity in digestive organs in muscle of Nile perch.

CONCLUSION

This study reveals that as the storage period increases, there occurs degrading changes in biochemical and bacteriological composition that has direct effect on shelf life and market value of the fish. Freezing of fish creates unfavourable environmental conditions which slow the bacterial growth and biochemical composition of crab muscle, thereby increasing the shelf life.

Acknowledgements

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