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Determination of Changes in Quality Characteristics During Cold Storage of (Macrobrachium Sps.)

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ABSTRACT

Presently an attempt was made to study the effect of low temperature on the quality changes in the prawn meat, Macrobrachium species. In fresh (unfrozen) samples, protein, fat, and ash content recorded to be the maximum, the values being 14.76±0.34%, 2.98±0.04% and 2.51±0.01% respectively. A significant total percental decrease ($p \leq 0.05$) in protein, lipid, and ash content was found. Rancidity development was measured by several biochemical parameters including Free Fatty Acids (FFA) and Thiobarbituric acid (TBA) besides pH.

KEYWORDS : prawn meat, nutritive quality, Macrobrachium

Literature review

Shellfish is highly perishable food and is susceptible to faster post-mortem deterioration (Ashie *et al.,* 1996). Deterioration in the quality of shell fishes is attributed to the highly sensitive proteins and fats present in aquatic organisms (Shahidi, 1994). The major deteriorative processes that affect the texture, colour, and flavor are microbial spoilage, autolysis (Chandrasekaran, 1994), polymerization, deamination, decarboxylation and biochemical reactions (Shahidi, 1994).

Crustaceans and other shell fishes spoil more rapidly compared with other fishes, mainly because they are smaller in size. Moreover since their guts are not removed immediately after harvesting, shellfishes are prone to early autolytic spoilage and therefore, the biological and chemical composition of the tissues accelerate rapid spoilage (Early and Strout, 1982).

The main problem with aquatic animals is that the fact that from the moment, they are caught or harvested, a change in their biochemical parameters gets initiated which continues until a state of spoilage is reached. Further, during handling and storage, quality deterioration of fresh fish occurs and limits the shelf life of the product (IFST, 1993) so various preservation techniques are used for maintaining their nutritional components and delivering the product fresh to the consumers. 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, lipid oxidation, and autolytic enzymatic activities 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) and is one of the primary method to maintain the freshness of fish as it reduces the rates of microbial, 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 of fish 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.

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

Materials and methods:

Prawns were collected from their natural habitat, and were brought to the laboratory. They were cleaned and their shell was removed, wet tissue was excised on absorbent paper and the weight was recorded on an electrical balance then it was randomly divided into two parts. One was freshly analyzed to determine the proximate and chemical changes and second part was stored at 4±1^0 C. The changes in the proximate and chemical parameters were estimated every alternate day for a period of one week to assess the quality of meat at chilling temperature (4±1^0 C). Various parameters were analyzed following standard techniques:

a) Proximate analysis:

i) Total proteins (Lowry *et al.,* 1951)

ii) Lipid (Folch *et al.,* 1956)

iii) Ash (Standard method of AOAC, 1999)

iv) Water content (Standard method of AOAC, 1999)

b) Chemical analysis:

i) pH (by Electrical pH meter)

ii) Free fatty acid (Koniecko, 1979),

iii) TBA (Witte *et al.,* 1970).

Results and Discussion

In this study, we note a slowly increase of the pH during storage time where the initial pH is 6.60 ± 0.02 (day 0), 6.93 ± 0.03 (day 2) and 6.47 ± 0.05 (day 4) (Table 1 and figs. i& ii). This increase may be explained by autolytic changes such as denaturation or breakdown of protein which provide an optimum condition for growth and reproduction of spoilage microflora (Parkin and Brown, 1983; Pedrosa-Menabrito and Regenstein, 1988). The decomposition of nitrogenous compounds leads to an increase in pH in the fish flesh (Shenderyuk and Bykowski, 1989).

The TBA value is an index which measures the malondialdehyde (MDA) content and is a widely used method for assessment of degree of lipid oxidation (Raharjo & Sofos, 1993 and Goulas and Kontominas, 2007). At the beginning of the storage period, the TBA values were 0.50±0.05 mg MA/Kg and at the end of the storage period of 7 days, the TBA values were obtained as 0.94±0.11 mg MA/Kg. The obtained were considerably lower than accepted limit human consumption of

5-8 mg MA/Kg. The present study showed a progressive increase in TBA value (secondary oxidation product) with increase in storage period under frozen conditions. The above results are in accordance with those of Ryder *et al.,* (1984), Zamir *et al.,* (1998), Mazorra Manzano *et al.,* (2000), Chijan *et al.,* (2006) and Kandeepan and Biswas (2007).

Production of FFA is measured to study the progress of lipid hydrolysis and has been used to establish the degree of deterioration of food products. FFA is a triacylglyceride product formed by either chemical or enzyme mediated hydrolysis (Barthet *et al.,* 2008). It was observed in the present studies that on day 0, FFA values were 0.83±0.01% and 6.73±0.07% on 7th day of storage(table-1 and figs. i& ii) The results thus clearly depicts, that there was a gradual increase in the FFA content with increasing storage time. Since the release of FFA content increased with time, as found in this study, it is reported that there is a relationship between FFA release and loss of freshness (Barassi, Pe`cora, Rolda´n, & Trucco, 1987; Ozogul *et al.,* 2005). These results are in accordance with Ozogul *et al.,* (2011) in *Solea solea*, and Gandotra *et al.,* 2012 in *Mystus*. At 4±1^0 C, the raw sample was found to be near acceptance limit 5.0% 6th day (4.61±0.16%). Rodriquez *et al.,* (2007) observed increasing FFA during frozen storage farmed Coho salmon (*Onchorhynchus kisutch*).

Proximate analysis results:

Protein analysis results:

At the beginning of the storage period, the crude protein values of muscles of *Macrobrachium* were found to be 14.76%, at the end of storage period, it is decreased to 11.21%. A percental decrease of 4.45%, 8.26%, 14.43% and 24.05% in the protein content was recorded on 1st, 2nd, 3rd and 4th day respectively (table-2). Perusal of table-1 and figs. i & ii reveal that the loss in the total protein content from its fresh value was not markable during initial period of storage (1-3days) in prawn meat (i.e., 14.76 to 13.85). After then, it gradually decreased to 11.26% on 7th day of storage. Our results are in good agreement with those reported by French *et al.,* 1988 and Kolodziejska *et al.,* (1987) who have observed that at low temperature, the rate of denaturation and autolysis of fish protein was markable.

Total lipids

Changes in the total lipid during storage at 4±1^{0}C are presented in Table 1 and figs. i & ii. In freshly caught total lipids were estimated to be 2.98%. it significantly falls during seven days storage period. On the first and second day of storage it was 2.72 and 2.02%. Results indicate that total lipid decreased gradually with the increase of storage time. On 7th day it reached to a value of 0.91%. Oxidation of lipid is the major factor for the deterioration of fish and shellfish. A percental decrease of 18.79%, 39.26%, 54.02%and 69.46% was recorded on 1st, 2nd, 3rd and 4th day respectively (table-2). A significant decrease in total lipid content (50 to 70%) at 0^{0}C 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 in fresh tissue of prawn was 74.51%. It increased with the increase of storage time. After 7 day it reached to the value of 85.01% (table- 1 and figs. i & ii. The changes that occurred in the water content during storage at 4±1^{0}C may be due to the loss of water holding capacity of muscle or due to 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). Our results are supported by the findings of Zamir *et al.,* (1988) in crab, Bao *et al.,* (2007) in Artic Charr (*Salvelinus alpines*) and Siddiqui *et al.,* (2011) in *Puntius* sps. who recorded an increasing trend in moisture content.

It shows positive correlation with TBA and FFA and negative with total protein, lipid and ash content of crab meat. Similar correlations were reported by Leblane *et al.,* 1988 in cold tissue during storage at low temperature

Ash content analysis

The ash content in the prawn muscle at 0 day of storage at 4±1^{0}C was found to be 2.51% and the final value on 7th day was found to be 0.88 %. The overall decrease found to be highly significant P≤0.01. Okeyo *et al.,* 2009 observed that the ash content of the frozen raw Nile perch decreases with storage time. They calculated 12.69% decrease after 22 days of ice storage. However, Kandeepan and Biswas (2007) registered 14.87% decrease in chiller and 20.66% decrease in freezer after 7 days of storage. According to Arannilewa *et al.,* 2005, the ash content remains almost the same throughout the sixty days frozen storage of Tilapia. It changed from 26.13±2.20 (recorded on 0 day) to 26.80±1.44 (recorded on 60th day)(table-1 and figs. i & ii).

Conclusion

The main objective of this study was to record changes in the nutritional and biochemical characteristics in *Macrobrachium* that has been stored in refrigerator conditions. As a result of the study it was observed that the prawn meat is of good quality upto 2 days but in terms of chemical indicators like pH, TBA and FFA, it is however acceptable upto 4 days of refrigerator storage (4±1^{0}C) beyond which all the above mentioned chemical indicators exceed their acceptability limit and make it unfit for human consumption. Thus it can be concluded that low temperature storage method does not kill the microorganisms but reduces the microbial metabolism which is responsible for spoilage (Ashi *et al*., 1996)

STORAGE TIME IN DAYS	P H	WATER	TOTAL PROTEINS	TOTAL LIPIDS	ASH	FFA	TBA
0	6.60	79.41±0.56	14.76±0.59	2.98±0.32	2.51±0.19	0.83±0.11	0.50±0.05
1	6.83	79.97±0.75	14.11±0.52	2.42±0.25	2.01±0.16	1.18±0.15	0.67±0.09
2	6.98	80.63±0.98	13.85±0.44	2.02±0.21	1.83±0.17	2.17±0.21	0.79±0.08
3	7.16	81.71±1.10	13.54±0.36	1.81±0.20	1.69±0.16	3.70±0.25	0.84±0.11
4	7.87	82.56±1.21	12.98±0.27	1.59±0.16	1.53±0.11	3.99±0.24	1.01±0.18
5	7.99	83.98±1.23	12.63±0.21	1.37±0.11	1.27±0.10	4.98±0.32	1.21±0.21
6	8.01	84.81±1.42	11.86±0.21	1.11±0.12	1.11±0.05	5.77±0.39	1.41±0.23
7	8.11	85.01±1.68	11.21±0.18	0.91±0.09	0.88±0.05	6.73±0.45	1.63±0.27

Table 1: Changes in the chemical constituents of Prawn meat during storage at 4±1^{0}C

Days	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
0-1	0.70	4.40	18.79	19.92
0-3	2.89	8.26	39.26	32.66
0-5	5.75	14.43	54.02	49.40
0-7	7.04	24.05	69.46	64.94

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

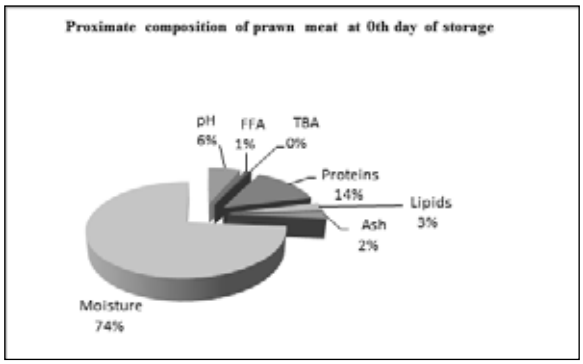

Figure 1

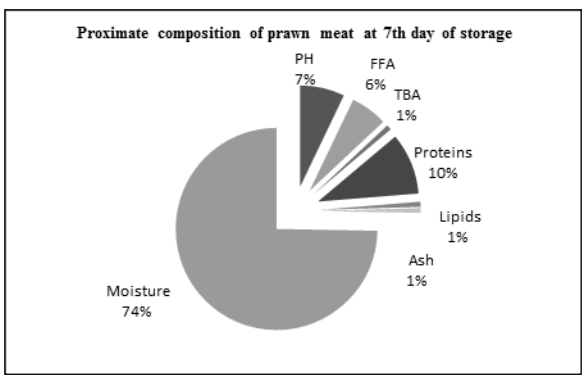

Figure 2

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