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COMPARATIVE ASSESSMENT OF QUALITY OF FARM AND MARKET PROCURED *CTENOPHARYNGODON IDELLA* AND ENHANCEMENT OF SHELF LIFE THROUGH PRESERVATION METHODS.

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ABSTRACT

The present course of investigation, an experiment was conducted to determine the shelf life (keeping quality) of *Ctenopharyngodon idella* procured from local Fish farm (F) and market (M), on the basis of biochemical and microbial analysis. Further, with an aim to extend the shelf life, the frozen samples-12^{O}C (both farmed and marketed) were subjected to different preservation and storage techniques i.e. brining (group .B_F and $B_{M)}$ and vacuum packaging(Gp.V_F and V_M) for a period of 3weeks. Proximate composition of muscles reveals a decreasing trend for protein and lipid parameters in all the samples with signifantly low ($P<0.5$) decrease in V_F and V_M samples followed by B_F and B_M and highest in unprocessed frozen control. Values for TBA were found to be within permissible limits i.e. 8 mg MA/ kg. After 21 days, it was 2.19 mg MA/kg in V_F and 2.96 mg MA/kg in V_M but in B_M samples, it crosses its limit on 18th day of storage i.e.8.12 MA/kg while in both untreated control samples, the TBA limit was maintained only upto 7 days. Similarly, the values for FFA after 21 days were 3.65% in V_F and 4.12% in V_M while it crossed the acceptable limits of 5% on 18th day in Gp. B and 9th day in untreated control. Based on the microbial load in terms of total plate count(TPC) in various samples the following trend appears after 21 days i.e control $_M$(9.18 logcfu/g)> Control $_F$(8.10 log cfu/g) > B_M(7.16 logcfu/g)> B_F(5.8 logcfu/g 0)>V_M (4.13 logcfu/g)>V_F(2.96 logcfu/g).

KEY WORDS: *Proximate composition, Thiobarbituric acid (TBA), Free fatty acid (FFA), Total plate count (TPC).*

INTRODUCTION

Fish meat is a wholesome food type because of including high–quality protein, essential vitamins and healthful polyunsaturated fatty acids.(Ackman, 1989). However, the high protein concentration can cause a risk in the decomposition.. As fish is highly perishable material, so whatever may be the amount of harvest, it has no value until it reaches the consumer as food. Fish preservation is a very important aspect of the fisheries. Normally the fish farms or other fish capturing sites are located far off from the market place and there is chance of fish decomposition and the uncertainties of their sale in market. When the fishes are caught in numbers, greater than the amount of consumption, their preservation becomes a necessity for their future use. Preservation and processing, therefore become a very important part of commercial fisheries. It is done in such a manner that the fishes remain fresh for a long time, with a minimum loss of flavour, taste, odour, nutritive value and the digestibility of their flesh. Proper pre-treatment or processing of premium quality fresh fish can minimize the post harvest loss and thus reduced the amount of fish spoilage. Shelf-life of highly perishable food products like fish is limited due to chemical effects of atmospheric oxygen and the aerobic microorganisms. (Mackie, 1993; Verma *et al*., 1995) **Shelf-life extension** can be achieved by various preservative methods such as low temperature storage, salting, brining (wet salting), icing, smoking, drying, frying, proper packaging and glazing with solution of protecting chemicals and antioxidants. (Richards et al., 1998; Lin and Lin, 2005; Yildiz et al., 2006).The freezing of fish is an effective way of long term preservation by lowering temperature. At low temperature, micro-organisms become inactive, enzymatic activity also slows down, thus biochemical activities decreases. Consequently, the fish remain free from spoilage for longer duration.

Keeping this in mind, the present work has been designed to generate information on the changes in biochemical and microbiological composition of muscle of Raw muscle of a edible carp *Ctenopharyngodon idella* in the domestic refrigerator during which it remains fit for human consumption. Further, various preservative methods (**brining**, &**Vacuum packing**) have been applied on fish muscle in order to enhance the keeping

quality and shelf life during frozen storage for prolonged human consumption purpose.

MATERIALS AND METHODS

Collection of fish samples

Fresh samples of *Ctenopharyngodon idella* were purchased from fish farm (F) and local market of Jammu city (M). They were immediately brought to the lab in polythene bags along with crushed ice. The viscera of fish were removed and the fish was washed with large amount of water. Analytical procedures for biochemical and microbiological changes were done on 0, 10th, 20th and 30th day of storage.

Fish Treatment-BRINING AND VACUUM PACKAGING

Analyses

The proximate composition (ash and moisture) of the fish samples were evaluated using the standard AOAC procedure (AOAC, 1995). The protein content was determined using the Lowry et al. (1951). Fat content was determined using Folch et al (1957). Thiobarbituric acid value of fish muscle during storage was determined using the method of Witte et al (1970). Free Fatty Acid (FFA) was determined by method of US Army laboratories (Natick) described by Koniecko (1979). Extract Release Volume (ERV) was determined as per the method of Strange et al. (1977). The pH of fish muscles was determined by the method of Keller et al. (1974) the microbiological profile was determined according to APHA method (1984). Data were expressed as mean ± SD and were analyzed by one- way ANOVA test using SPSS statistical programme.

Statistical Analysis

Means and standard errors were calculated for different parameters. The data analyses were performed using SPSS software (12.0 for Windows). Differences between treatments were analyzed using independent-measures one-way ANOVA. Post-hoc comparisons were conducted using Duncan's test. The values were expressed as mean ± SE. values <0.05 were considered as significant and p values <0.001were considered as highly significant p.

RESULTS AND DISCUSSIONS

Triplicate flesh samples of farmed and marketed frozen *Ctenopharyngodon idella* with different preservation methods were analyzed for determining its proximate composition viz. protein, lipid, moisture and ash content during 30 days of frozen storage period.

Table 1: Comparative change in biochemical composition in raw muscle of farmed and marketed *Ctenopharyngodon idella* stored under frozen condition at -12±2ºC for 3 weeks. (Control, untreated)

Days	0 day		7th day		14th day		21st day	
	Farmed	Market	Farmed	Market	Farmed	Market	Farmed	Market
Protein(%)	17.72^{a}±0.05	16.90^{a}±0.03	16.00^{b}±0.06	14.98^{b}±0.2	14.93^{c}±0.2	13.79^{c}±0.06	13.32^{d}±0.03	12.15^{d}±0.05
Lipid(%)	2.18^{a}±0.04	2.13^{a} ±0.05	2.00^{b}±0.06	1.8^{b} ±0.02	1.74^{c}±0.02	1.32^{c} ±0.06	1.28^{d}±0.05	0.96^{d} ±0.04
TBA*(mgMA/kg)	0.73^{a}±0.02	0.90^{a} ±0.01	8.17^{b}±0.03	8.86^{b}±0.08	10.72^{c}±0.08	11.13^{c}±0.03	12.65^{d}±0.01	13.12^{d}±0.02
FFA**(%)	0.95^{a}±0.02	1.12^{a} ±0.07	4.34^{b}±0.03	4.58^{b}±0.05	5.98^{c}±0.05	6.73^{c} ±0.03	8.83^{d}±0.07	9.23^{d}±0.12

-Mean±SD with different superscript in a row differs significantly
*** Thiobarbituric Acid, ** Free Fatty Acid.**

Table 2: Comparative change in biochemical composition in processed (20% brined) muscle of farmed and marketed *Ctenopharyngodon idella* stored under frozen condition at -12±2ºC for 3 weeks. (Gp.B)

Days	0 day		7th day		14th day		21st day	
	Farmed (B_F)	Market (B_M)	Farmed (B_F)	Market (B_M)	Farmed (B_F)	Market (B_M)	Farmed (B_F)	Market (B_M)
Protein(%)	16.39^{a}±0.03	15.72^{a} ±0.1	15.52^{b}±0.01	14.78^{b}±0.08	14.82^{c}±0.08	13.63^{c}±0.01	13.29^{d}±0.1	12.4^{d} ±0.03
Lipid(%)	2.05^{a}±0.09	1.89^{a} ±0.01	1.96^{b}±0.06	1.70^{b}±0.04	1.58^{c}±0.04	1.31^{c} ±0.06	1.16^{d}±0.01	0.97^{d} ±0.09
TBA*(mgMA/kg)	0.35^{a}±0.02	0.60^{a} ±0.15	4.86^{b}±0.04	5.46^{b} ±0.2	6.62^{c}±0.08	6.98^{c} ±0.08	8.08^{d}±0.2	9.15^{d} ±0.04
FFA**(%)	0.45^{a}±0.01	0.65^{a} ±0.07	1.96^{b}±0.03	2.18^{b}±0.05	4.5^{c}±0.05	4.81^{c} ±0.03	6.4^{d}±0.07	6.89^{d} ±0.01

Table 3: Comparative change in biochemical composition in vacuum packaged muscles of farmed and market *Ctenopharyngodon idella* stored under frozen condition at -12±2ºC for 3 weeks. (Gp. V)

Days	0 day		7th day		14th day		21st day	
	Farmed (V_F)	Market (V_M)	Farmed (V_F)	Market (V_M)	Farmed (V_F)	Market (V_M)	Farmed (V_F)	Market (V_M)
Protein(%)	19.77^{a}±0.05	18.44^{a}±0.03	18.98^{b}±0.08	17.82^{b}±0.2	18.16^{c}±0.2	17.32^{c}±0.08	17.55^{d}±0.03	16.10^{d}±0.05
Lipid(%)	3.18^{a}±0.01	3.03^{a} ±0.15	3.11^{b}±0.04	2.92^{b}±0.07	2.96^{c}±0.07	2.44^{c} ±0.04	1.98^{d}±0.15	1.82^{d} ±0.01
TBA*(mgMA/kg)	0.13^{a}±0.15	0.21^{a} ±0.07	1.02^{b}±0.2	1.10^{b} ±0.03	1.97^{c}±0.03	2.18^{c} ±0.2	2.19^{d}±0.07	2.96^{d} ±0.15
FFA**(%)	0.30^{a}±0.01	0.41^{a} ±0.13	1.17^{b}±0.05	1.58^{b} ±0.02	2.63^{c}±0.02	2.89^{c} ±0.05	3.65^{d}±0.13	4.12^{d} ±0.01

Protein content: In case of farmed *Ctenopharyngodon idella*, the protein content on day 0 was 17.72% in untreated control, 16.39% in 20% brined (Gp. B_F) and 19.77% in vacuum packaged (Gp. V_F) muscles. This content further decreased to 13.32% in untreated control, 13.29% in 20% brined (Gp. B_F), and 17.55% in vacuum packaged (Gp. V_F) muscles. A significant ($P \leq 0.05$) percental decrease was found in total protein content i.e 24.83% in untreated control, 18.91% in 20% brined (Gp. B_F), and 11.22% in vacuum packaged muscles (Gp. V_F) after 21 days of storage period. The marketed fish muscles of *Ctenopharyngodon idella* also revealed the decreasing trend for protein i.e. from 16.90% to 12.15% in untreated control, 15.72% to 12.40% in 20% brined (Gp. B_M) and from18.44% to 16.10% in vacuum packaged muscles (Gp. V_M). These findings are supported by the studies of Bekelvik *et al.* (2005) in sea bass (*Dicentrarchus tabreri*), Siddique *et al*. (2011) in Puntius, who suggested that loss of protein might be due to leaching effect of amino acids with melting ice. Sameul *et al.* (2010) and Holma *et al.* (2013) stated that the increased NaCl slowed down autolysis in the fish muscle of *Clarius gariepinus* which consequently slowed down the protein breakdown. Further, the lowest percental decrease as observed in vacuum packaged muscles may be attributed to the preservative effect of Vacuum packaging by maintaining the product in an oxygen deficient environment. (Manju, 2005 and Gandotra *et al*. 2015).

Table: Comparative percental decrease in proximate composition of muscles of farmed and marketed *Ctenopharyngodon idella* during different processing conditions after 21 days of storage period.

Storage conditions	Protein		Lipid	
	Farmed	Marketed	Farmed	Marketed
Raw (Control, untreated)	24.83	28.10	41.28	54.92
Brined (Gp. B)	18.91	20.73	43.41	48.67
Vacuum packaged (Gp. V)	11.22	12.52	37.73	39.93

LIPID CONTENT

The lipid content also revealed a decreasing trend both in farmed and marketed fish muscles of *Ctenopharyngodon idella* during the 21 days of storage period. In case of farmed fish, the total percental decrease was 41.28%, 43.41%, and 37.73% in untreated control, 20% brined (Gp. B_F) and vacuum packaged (Gp. V_F) muscles respectively during frozen storage. Similarly, in case of marketed fish muscles the percental decrease so observed was 54.92% in untreated control, 48.67% in 20% brined (Gp. B_M) and 39.93% in vacuum packaged (Gp. V_M) muscles, thus representing the higher decrease in marketed samples than farmed ones. Similar observations were made earlier by Zoldos *et al.* (2010) in Allaska Pollack, Siddique *et al*. (2011) in *Puntius sps.* and Gandotra *et al.* (2012) in *Labeo rohita.* They attributed this loss in lipid to the oxidation of lipids. Also, Unlusayin *et al*. (2010) proposed that a part of fat in fish muscle was oozed out as extract release volume during salt treatment.

Free fatty acids (FFA): Free fatty acids are known to form off-flavour and undesirable taste producing low molecular weight compounds after oxidation. In the present study, FFA was determined to investigate deterioration of fats due to their hydrolysis. Perusals of Table- 1, 2 and 3 reveal the highest percentage of free fatty acids in untreated control samples of both farmed (8.83 %) and marketed (9.23%) samples after 21 days of storage as compared to in 6.4 % and 6.89% in B_F and B_M and 3.65% and 4.12%V_F and V_M respectively. Also, the acceptable limit of 5% was crossed on 9th day in both farmed and marketed untreated control samples while Gp. B and Gp. V samples were found to be within the acceptable limits till the end of storage.

Thiobarbituric acid (TBA): The TBA value is an index of lipid oxidation measuring malondialdehyde (MDA) content and widely used for assessment of degree of lipid oxidation. MDA is formed through hydroperoxides, which are the initial reaction product of polyunsaturated fatty acids with oxygen(Sallam,2007). Persuals of table-1, 2 and 3 show an increase in TBA (mg malonaldehyde/ kg) values in all the groups with increase in storage period. However, the highest increase was in the untreated control samples i.e. 12.15 mgMA/kg in farmed and 13.12 mgMA/kg in marketed samples and the lowest was in Gp. V i.e. 2.19 mgMA/kg V_F and 2.96mgMA/kg in V_M . the untreated control samples crossed the acceptable limits of 8 mgMA/kg on 5th day of storage while both Gp. B and Gp. V samples were within the acceptable limits till the end of 21st day.

MICROBIAL CHANGES

I. Total Plate Count (TPC)

The Total Plate Count (**TPC)** is used as an indicator of bacterial populations in a sample. It is also called **Aerobic Colony Count (ACC), Standard Plate Count (SPC), Mesophilic Count (MC) or Aerobic Plate Count (APC)**.

As recommended by **International Commission on Microbiological Specification for Food**, **ICMSF, (**1986), an increase of aerobic plate count (APC) up to levels exceeding the value of **6 log CFU/g** is regarded as microbial spoiled fish muscle not fit for human consumption.

The TPC increases with the increase in storage temperature. Persuals of table ….show an increase in TPC (mg malonaldehyde/ kg) values in all the groups with increase in storage period. However, the highest

increase was in the untreated control samples i.e. 1.38logcfu/g in farmed and 9.18logcfu/g in marketed samples and the lowest was in Gp. V i.e. 2.96 logcfu/g V_F and 4.13 logcfu/g in V_M . the untreated control samples crossed the acceptable limits of 8 mgMA/kg on 5th day of storage while both Gp. B and Gp. V samples were within the acceptable limits till the end of 21st day. Similarly Sachindra *et al.* (2005) reported that for sausage samples TPC value initially was 4.09 and this value exceeded the eatable limit on 16 th day for under air condition packed sausages and on 32 nd day for vacuum packed samples. 10 6 numbers / g was reported the acceptable limit of TPC bacteria for sausage.

Table: Comparative change in microbial load in raw, processed (20% brined) vacuum packaged muscle of farmed and market *Ctenopharyngodon idella* stored under frozen condition at -12±2ºC on 21st day of storage.

SAMPLES	RAW FROZEN		BRINED FROZEN		VACUUM PACKAGED FROZEN	
	Farmed	Market	Farmed	Market	Farmed	Market
Total Plate Count Count(PC) log cfu/g.	8.10^{d}±0.02	9.18±0.01	5.80^{d}±0.05	7.16^{d}±0.01	2.96^{d}±0.06	4.13^{d}±0.01

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