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Research article

STUDIES ON THE EFFECT OF VACUUM PACKAGING ON SOME QUALITY CHANGES IN *LABEO ROHITA* DURING FROZEN STORAGE PERIOD

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ABSTRACT: This study was designed to investigate the influence of vacuum packaging on nutritional, chemical and microbial parameters of rohu fillets during frozen storage. Quality assessment of vacuum packaging rohu for up to 1 month at -12°C was done by the monitoring of nutritional quality, free fatty acids (FFA), thiobarbituric acid (TBA), pH and expressible moisture (EM). Results showed that free fatty acid, primary and secondary oxidation products, expressible moisture and pH value of vacuum packaging samples were significantly lower than those in control samples ($p<0.05$). Results indicated that vacuum packaging was effective in reduce lipid oxidation and increased shelf life of rohu frozen fillets. Similarly the microbial load of vacuum packaging samples was significantly lower as compared to control samples. Thus the employment of vacuum packaging alone or in combination with other protective strategies is recommended.

Key words: Rohu, Frozen storage, Lipid oxidation, vacuum packaging.

INTRODUCTION

L. rohita popularly known, as "Rohu" is one of the most widely consumed carp obtained from the Indian fresh water. Fish in general is considered important for the nutritional point of view (James, 1984, Kent, 1987, Sikorski et al, 1990). A good amount of fish qualitatively becomes in acceptable before reaching the consumer or to the processing factory. Postmortem fish undergoes four stages as rigor mortis, dissolution of rigor mortis, autolysis and bacterial spoilage. The oxidative rancidity of fish lipids is caused by the activity of tissue enzymes and the oxygen radical spices. For inhibition of the lipid oxidation in chilled fish it is necessary to limit or avoid the oxygen admission (Decker and Xu, 1998). Therefore, the present study aimed to improving the quality and extending shelf life of the frozen fish using vacuum packaging.

MATERIAL AND METHODS

Collection of fish samples

Fresh samples of *Labeo rohita* were purchased from local market of Jammu city. They were immediately brought to the lab in polythene bags along with crushed ice. The viscera of fish was removed and the fish was washed with large amount of water. The fish was cut into pieces and these pieces were immediately wrapped in aluminum foil, kept in air tight plastic bags and stored at -12±2°C (frozen storage). Analytical procedures for biochemical and microbiological changes were done on 0, 10th, 20th and 30th day of storage.

Analysis

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

Statistical Analysis: Mean 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. p values <0.05 were considered as significant and p values <0.001were considered as highly significant.

RESULTS AND DISCUSSION

Proximate Composition

Protein content: In present investigation a decreasing trend was observed in Total protein content of both control and vacuum packaging samples for a period of 30 days.

Table 1:-Changes in proximate and biochemical composition of frozen fish muscle

	0	10th	20th	30th
Protein (%)	15.01±0.06%.	14.00±0.02%	12.92±0.03%.	11.04±0.2% .
Lipid (%)	3.84±0.014%	3.03±0.025%	2.77±0.03%	2.00±0.03%
Moisture (%)	84.28±0.1%.	82.01±0.015%	79.56±0.043%	75.54±0.09%
Ash (%)	1.90±0.12%..	1.66±0.02%	1.13±0.001%..	0.99±0.04%.
TBAmgMA/kg	0	5.94±0.06mg	9.16±0.03	10.01±0.02
FFA (%)	0.45±0.024	4.14±0.06%	8.26±0.04%.	12.27±0.07%.
pH	6.32±0.2.	7.0±0.1	7.75±0.5	7.85±0.4

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Perusals of table 1 & 2 depicts that that minimum protein loss i.e.16.52% occurred in processed vacuum packaging muscle and raw unprocessed muscles shows maximum loss i.e. 26.44%. This low protein content in unprocessed raw samples was perhaps mainly due to the increased microbial growth and higher water activity. Manju (2005) while working on the effect of vacuum packaging on the shelf life of pearls pot and black pomfret *{parastromateus nigei}* during chill storage found that Vacuum packaging achieves its preservative effect by maintaining the product in an oxygen deficient environment

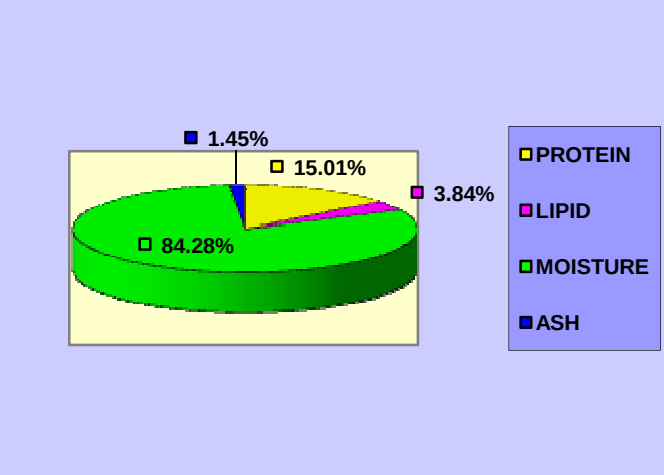

Fig-1: Proximate composition of unprocessed raw muscle during frozen storage at -12±10c ON DAY 0.

Lipid content: The results shown in table-1 & 2 show that the lipid content decreased significantly (p ≤0.05) from day 0 i.e. 3.84±0.014% to 2±0.03% in control and 3±0.03% in vacuum packaging on day 30th. Taheri *et al* (2012) reported in cobia fillets (*Rachycentron canadum*) treated by vacuum packaging lowest rate of peroxide formation (8.65) and highest (18.65) in control samples during frozen storage. It was concluded that vacuum packaging treatment has significant effect on delaying lipid oxidation.

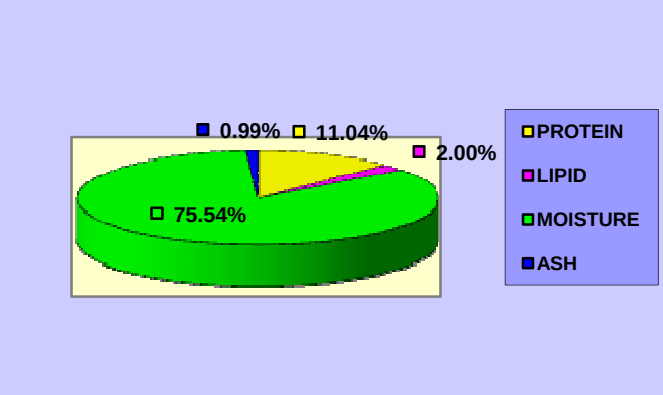

Fig-2: Proximate composition of unprocessed raw muscle during frozen storage at -12±10c ON DAY 30th

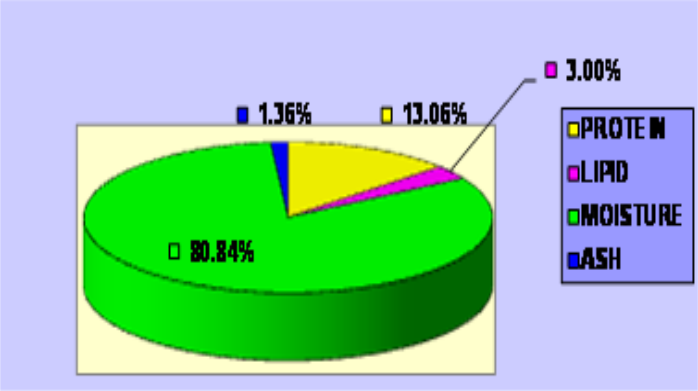

Fig-3: Proximate composition of vacuum packaging fish muscle during frozen storage at -12±10c ON DAY 30th

Moisture: The total moisture content of the fish sample decreased from 84.28±0.1%.on day 0 to 75.54±0.09% in control and 80.84±0.09% in vacuum packaging on day 30th. Total percent decrease was 5.34% and 11.63% in vacuum packaging and control samples respectively. These results are favoured by the findings of Rostamzad *et al*, 2011. Bhat *et al.*, 2010, Shakeela *et al* 2005, who proposed that Vacuum packaging fish prior to storage, is the commercial way of affording protection against dehydration and to some extent against the development of rancidity.

Biochemical Composition

Thiobarbituric acid (TBA): 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. MDA is formed through hydroperoxides, which are the initial reaction products of polyunsaturated fatty acids with oxygen. The present study showed a progressive increase in TBA value (secondary oxidation product) with increase in storage period under frozen conditions. The values rose from 0.16±0.2 on day 0 to 10.01±0.05 in control and 5.99 mg MA/kg in vacuum packaging on 30th day of frozen storage period. Varga *et al.* (1980) showed the lower values of TBA in herring fillets stored under vacuum compared to fillets stored in ice. Rate of spoilage in herring fillets in low-pressure storage was lower and the storage life was 9% higher than for fillets stored in ice. Vacuum packaging has been found to substantially reduce oxidative deterioration in frozen fish and fishery products (Taheri *et al*,2012).

Table 2:-Changes in proximate and biochemical composition of vacuum packaging fish muscle.

	0	7	14	21
Protein	15.93±0.04%	15.01±0.02%	14.14±0.03%.	13.06±0.04%.
Lipid	3.86±0.04%	3.65±0.02%	3.25±0.04%	3.00±0.03%
Moisture	84.74±0.1%.	83.82±0.015%.	82.45±0.02%.	80.84±0.09%
Ash	1.79±0.01%	1.69±0.012%	1.57±0.02%	1.36±0.03%
TBA	0.16±0.04	2.01±0.04	3.67±0.13	5.99 ±0.01
FFA	0.45±0.04%	1.12±0.02%	2.32±0.03%.	3.76±0.04%.
pH	6.2±0.2	7.0±0.02	7.1±0.15	7.2±0.4.

Free fatty acids (FFA) : The values for Free Fatty Acids (FFA) were 0.45±0.02 on day 0 and it rose to 12.27 in control and 3.76 in vacuum packaging samples on 30 th day of frozen storage respectively. The results thus clearly depicts, that there was a gradual increase in the FFA content with increasing storage time. The levels had also direct correlation with pH (Table) showing that it could act as a good indicator for the assessment of the freshness of all the three forms of stored fish muscles. Balev et al. (2011) reported that at the end of storage the total FFA concentration of air packaged and vacuum packaged samples increased of 1.17 and 0.85g/kg fresh fish weight respectively in Russian Sturgeon during frozen storage. Their results showed that vacuum packaging significantly (P<0.05) delayed lipolysis of lipids.

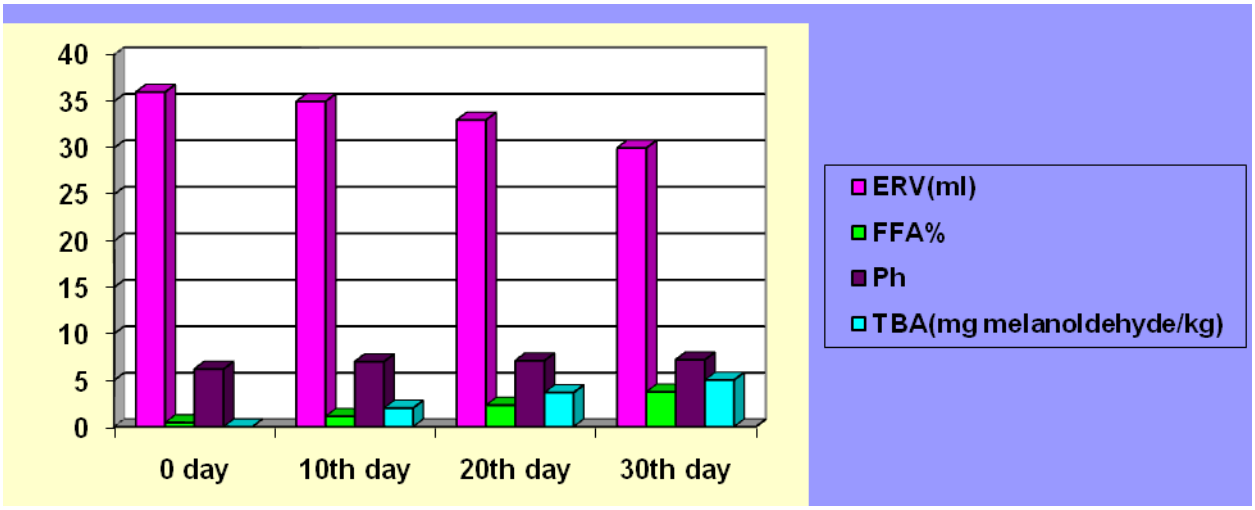

Figure-4: Changes in biochemical composition of vacuum packaged muscle of *Labeo rohita*

pH: The pH values also showed an increasing trend with increase in frozen period. The pH values ranged from 6.32±0.2. On day 0 to 7.85±0.4 in control and 7.2±0.4. In vacuum packaging on 30th day. Decrease or constant levels of pH might be attributed to increasing solubility of CO_2 at storage time, effecting on 2 growth of aerobic microflora (Mahmoudzadeh et al., 2010), Taheri *et al* (2012).

Microbial quality+: The quality of fish meat is largely dependent on its microbial

Table-3: Bacteriological Changes in raw muscle of *Labeo rohita* stored under frozen conditions at -12±2^{0}C.

Days	0	10	20	30
TPC*	2.44±0.2 ^{a}	7.34±0.11^b	8.30±0.07^c	9.10±0.02^d
CC**	1.30±0.15^a	2.08±0.1^b	2.25 ±0.07^c	3.16±0.2^d
PC***	2.00±0.2^a	3.30±0.04^b	5.11±0.1^c	6.60±005^d

Contamination. Inquistive study of table shows an increasing trend for TPC, CC and PC during

Table-4: Bacteriological Changes in Vacuum Packaged muscle of *Labeo rohita* stored under frozen conditions at -12±2^{0}C.

Days	0	10	20	30
TPC*	2.04±0.2^a	4.01±0.11^b	4.30±0.07^c	5.10±0.02^d
CC**	1.30±0.15^a	2.68±0.1^b	3.25 ±0.07^c	3.76±0.2^d
PC***	2.30±0.15^a	3.68±0.1^b	5.25 ±0.07^c	6.76±0.2^d

*Total Plate Count (log10cfu/g) **Coliform Count (log10cfu/g) ***Psychrophillic Count(log10cfu/g)
--Mean±SD with different superscripts in a row differs significantly (P<0.05)

The frozen storage period. Initially the values for TPC were 2.44±0.2 log cfu/g and increased to 9.10±0.02 log cfu/g in control and 5.10±0.02 log cfu/g in vacuum packaging samples at the end of storage, thus crossing the permissible limits of 6 lof cfu/g on 10th day of storage in control samples. Similarly, CC and PC also showed an increasing trend in both control and vacuum packaged samples on last day of storage. Table-4. The complete removal of oxygen from a pack of fresh meat ensures longer preservation against microbial deterioration than packaging in oxygen. Likewise, Arannilewa *et al* found an increase in Coliform count with the increasing storage period in frozen Tilapia. Ozogul *et al* also reported a significant statistical increase in total viable counts of whole gutted common sole (*Solea solea*) over the storage period of 24 days. Simiilarly, Ola and Oladipo and Liu found an increasing trend for psychrotrophs during storage period. This increase in microbial count is attributed to growth promoting effect of moisture during frozen storage.

CONCLUSION

The main objective of this study was to observe nutritional, biochemical and microbial changes in *Labeo rohita* during frozen conditions. The freezing of fish at low temperature makes it less prone to spoilage by decreasing the bacterial activity. However, it was observed that there was a decrease in the nutritional parameters while an increase was observed in biochemical composition and microbial count during frozen storage. Therefore, it could be concluded that we should try to consume fish while it is fresh only. Since, all fishes are not available throughout the year; hence, freezing with vacuum packaging is best preferred when preservation of such fish species is of priority.

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