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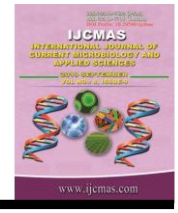

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Cryoprotective Effect of Maltodextrins on Frozen Storage of Bleached Horse Mackerel (*Megalapsis cordyla*) Minced Meat

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A B S T R A C T

Bleached horse mackerel Surimi were mixed with maltodextrins of 18, 20, 22, and 24, DE unit at 8% w/w surimi, along with polyphosphate, industrial mixture and control. All the lots were mixed with butyl hydroxyl anisol (BHA) at the rate of 0.02%. All the lots were packed, frozen and cold store at -18^{o}C±2^{o}C and subjected to biochemical tests. There was increase in values of peroxide value, expressible water loss %, Moisture and decrease in organoleptic scores, protein, salt soluble protein (SSN) and folding test grade. Among the treatments 24 DE and industrial mixture were found to be superior in retarding the undesirable changes as compared to other treatments and control.

Introduction

In fish surimi industry, for long term storage of surimi, cryoprotectants are used to prevent undesirable changes as a consequence of denaturation of fish protein, which occur during frozen storage. The denaturation is caused by the several factors such as effect of ice crystal and ion binding, fatty acids and lipids oxidation product to proteins, oxidation and interaction of thiol groups as well as the chemical reaction of amino acids residues in proteins with endogenous formaldehyde (FA) and other reactive components in the muscle (Love, 1996; Sikorski and Kolakowaska, 1990; Suzuki, 1981; Shenouda, 1980; Matsumoto, 1979; Haard, 1992).

At present sugar and polyphosphate (8% and 0.3%) are used as a cryoprotectant for the preparation of frozen surimi. However the excessive sweet taste imparted by the sugar is highly objected and many non sweeteners with low colorific value alternative compounds such as polydextrose, lactitol, palanitint and maltodextrin etc. has been tried (Sych *et al.,* 1990; Park *et al.,* 1988, MacDonald and Lanier, 1991). Meanwhile maltodextrin is easily digestible, available in dry powder and have low sweetness in taste. It is a non penetrating cryoprotectant and works on the principle of glass transition theory and water immobilization.

However, there is no work done so far on the effect of maltodextrins on the horse mackerel surimi. Hence, an attempt has been made in the present study to find out the effect of maltodextrins on frozen storage of bleached horse mackerel surimi.

Materials and Methods

Fresh horse mackerel (*Megalapsis cordyla*) procured from Mirkarwada landing centre, Ratnagiri under iced condition and transfer to processing laboratory of Department of Fish Processing Technology and Microbiology, College of Fisheries, Ratnagiri. Further, it was weighed, dressed (deheaded, eviscerating, gutted) washed, filleted, flesh separated manually chopped into meat particle size (4-5mm) approximately similar to obtained by meat separator.

Picked meat was subjected to alkaline washing (0.5% $NaHco_3$) for 90 minutes, followed by Plain water washing about 15 mins then again washed with plain water content 0.2% salt for 15 mins. Final washed meat was subjected to hydraulic press such that the final moisture content was 70%. This was subjected to mincing in fish meat minor with three plates having holes of 4 mm, 3 mm and 2 mm diameter.

The minced meat was mixed with maltodextrins of different dextrose units i.e. 18, 20, 22 and 24 DE. at 8% w/w surimi with 0.3 sodium tripolyphosphate, industrial mixture (sugar 8% and 0.3 % polyphosphate) and control sample without any cryoprotectants. All the samples were mixed with antioxidant BHA at 0.02%. The samples were packed in polythene bags placed in inner cartoons, frozen in plate freezer at – 40^{o}C; Packed in aluminum perforated container and stored at -18^{o}C ± 2^{o}C in cold storage. Samples were drawn at regular monthly intervals, thaw and utilized for biochemical, microbiological, organoleptic and physical analysis. Whereas the experimental data were subjected to appropriate statistical analysis (Snedecor and Cochran, 1967). The significant difference observed were referred as P<0.05.

Results and Discussion

TMA-N values of raw fish and surimi were found to be 0.60 mg% to 0.56mg% respectively and TVB-N values of were 6.8 mg% and 6.6mg% respectively.

Hotton *et al.,* (1990) indicate that the best quality mackerel surimi was prepared using a three cycle mince washing techniques. They also observed similar observation regarding biochemical analysis of mackerel surimi.

SSN value of for raw fish and minced meat were 82 % of TN_2 and 79 % of TN_2 . PH value for both i.e. raw fish and picked meat was 6.5.

Fresh fish (*Megalapsis cordyla*) flesh had a moisture content of 75 % and the crude protein, crude fat and ash content were found to be 19.68 %, 3.76 % and 1.56 % respectively.

Chakrabarti and Gupta (2000) reported proximate composition of horse mackerel (*Megalapsis cordyla*) was 75.1 % moisture content, 20.1 % protein content, 1.9 % fat content and 1.4 % ash content.

During present study, raw fish and surimi free from all pathogenic bacteria, while TPC of raw fish was 1.72x10^6 cfu/gm and surimi was 5.00 x10^5 cfu/gm. Kamat (1999) also reported similar observation in the mackerel mince meat used for preparation of fish ball and fish cutlet was free from all pathogenic organisms. There was gradual reduction in protein in all the samples i.e. treated and control samples.

The extent of decrease in protein contents was less in the samples 22 and 24 DE maltodextrins and industrial mixture samples unlike the other samples. It was show in Table 1 and Figure 1.

Similarly, Ravishankar (1990) reported that there was decrease in protein content in control and treated samples of oil sardine minced meat.

The Table No. 2 and Figure No. 2 show the reduction trend of SSN content in all treated and control sample during frozen storage. The extent of decreased was much less in the samples treated with 24 DE moltodexteins (77.07 to 57.82% of TN_2) and industrial mixture samples (77.07 to 58.90% of TN2) as compared to those treated with moltodextrin of different DE units i.e. 18, 20, and 22 DE. Control sample without maltodexton with antioxidant showed slight decreasing trend in SSN and it was lowest at the end of 4^{th} month.

During frozen storage there will be denaturation of protein particularly myosin due to which solubility of protein decreased

The denaturation is caused by several factors. Among the factors involved in freeze denaturation are the effect of ice crystals and ions binding of fatty acids and lipid oxidation products to proteins, oxidation and interactions of thiol groups as well as the chemical reactions of amino acids residues in proteins with endogenous formaldehyde (FA) and other reactive compounds components in the muscles (Love 1966, Suzuki 1981, Sikorski and Kolakowaska, 1990; Haard, 1992). However, cryoprotectants like sucrose, sorbitol mixture at the rate of 8% along with 0.3% polyphosphate were found to have best cryoprotective effect without significant changes in SSN in the treated surimi (Park *et al.*, 1988, Sych *et al.*, 1990 and Wang *et al.*, 1990).

Dondero *et al.*, (1996) found similar observation, that jack mackerel surimi treated with 25 DE and 36 DE and had higher amount of SSN content during storage as compared to those treated with lower DE units.

pH of horse mackerel minced meat of treated sample and control sample did not show much variation & remained near pH 6.5 throughout the storage.

Same finding was observed by Prabhu *et al.*, (1988), there was no change in pH during frozen storage of minced meat at lesser sardine (Table 3 & fig. 3).

In present study, moisture of frozen horse mackerel minced meat, treated samples and control samples did not show much variation and ranged between 78% to 80% throughout the storage and it was given in table 4 and fig 4.

Similarly Thorat, (2000) and Ravishankar (1990) also reported that treated pink perch and oil sardine minced meat respectively did not show much variation throughout the storage.

Peroxide Value increased in all samples and it was show highest at the end of 6^{th} month frozen storage.

Peroxide Values for treated samples i.e. between minimum and maximum ranged was 1.79 to 9.00 meq 02 / kg of fat (Table 5 & Fig. 5). Ravishankar (1990) find same trend, the treated samples of sardine minced meat had a shelf life of 5 months storage period with peroxide value as within limits (9.85 millimoles of O2 / kg of fat).

Effect of maltodextrin on frozen storage of horse mackerel minced meat

Fresh Fish: Horse Mackerel

↓

Washing

↓

Dressing
(Descaling, Deheading, Eviscerating)

↓

Thoroughly Washing

↓

Meat Separately Manually

↓

Chopping using knife approximately 4-5 mm diameter

↓

Cold water washing
(15 mins, 30 mins, 60 mins & 90 mins with two plain water wash)

↓

After each duration wash
Samples are drawn & subjected to PH, colour Improvement

Alkaline solution washing
(0.5% NaHCO3, 15 mins, 30 mins, 60 mins & 90 mins with two plain water wash)

↓

After each duration wash
Samples are drawn & subjected to PH colour both analysis

↓

After final wash removed excess water by using Hydraulic press

↓

Mincing followed by bleached minced meat divided into 6 lots

↓

Mixed with different maltodextrin units viz. 18,20,22,24 D. E. units Industrial mixture and control without any additives

↓

Packed and freeze at -40^{o}c

↓

Stored in cold storage at -18 ^{o}c

Table.1 Changes in protein (%) during frozen storage of treated and control samples of water bleached horse mackerel minced meat

Samples / Storage in months	Control A water bleaching without maltodextrin	Industrial mixture of sugar + poly 8% + 3 %	Maltodextrins of different D. E. units @ 8 % and 0.3 % polyphosphate			
			18 D. E.	20 D. E.	22 D. E.	24 D. E.
0	16.01	16.01	16.00	16.00	16.02	16.01
1	15.82	15.95	15.78	15.82	16.00	15.94
2	15.42	15.48	15.10	15.25	15.42	15.46
3	15.00	15.19	14.92	15.04	15.00	15.26
4	14.50	15.00	14.57	14.85	14.92	15.04
5	14.44	14.80	14.00	14.68	14.70	14.78
6	14.00	14.44	13.80	14.35	14.56	14.70

Table.2 Changes in SSN (% TN) during frozen storage of treated and control samples of water bleached horse mackerel minced meat

Samples / Storage in months	Control A water bleaching without maltodextrin	Industrial mixture of sugar + poly 8% + 3 %	Maltodextrins of different D. E. units @ 8 % and 0.3 % polyphosphate			
			18 D. E.	20 D. E.	22 D. E.	24 D. E.
0	77.07	77.07	77.02	77.07	77.07	77.07
1	73.95	74.56	70.02	70.00	71.86	72.91
2	60.12	69.92	63.10	64.92	67.04	68.54
3	50.00	71.00	65.00	61.58	69.80	65.40
4	42.00	71.92	58.68	59.82	60.25	60.00
5	40.12	63.86	50.19	54.58	60.00	59.50
6	39.00	58.90	46.92	49.00	54.00	57.82

Table.3 Changes in pH during frozen storage of treated and control samples of water bleached horse mackerel minced meat

Samples / Storage in months	Control A water bleaching without maltodextrin	Industrial mixture of sugar + poly 8% + 3 %	Maltodextrins of different D. E. units @ 8 % and 0.3 % polyphosphate			
			18 D. E.	20 D. E.	22 D. E.	24 D. E.
0	6.50	6.50	6.50	6.50	6.50	6.50
1	6.50	6.50	6.51	6.53	6.52	6.50
2	6.52	6.53	6.51	6.55	6.51	6.58
3	6.51	6.54	6.53	6.52	6.52	6.53
4	6.53	6.52	6.54	6.50	6.54	6.52
5	6.51	6.55	6.53	6.53	6.54	6.50
6	6.50	6.54	6.55	6.54	6.57	6.53

Table.4 Changes in moisture during frozen storage of treated and control samples of water bleached horse mackerel minced meat

Samples / Storage in months	Control A water bleaching without maltodextrin	Industrial mixture of sugar + poly 8% + 3 %	Maltodextrins of different D. E. units @ 8 % and 0.3 % polyphosphate			
			18 D. E.	20 D. E.	22 D. E.	24 D. E.
0	80.00	81.00	80.00	80.08	86.00	80.80
1	80.50	80.04	79.00	78.90	80.00	80.00
2	79.00	79.00	79.12	78.52	79.50	78.90
3	78.50	78.50	80.00	77.90	79.00	78.46
4	78.00	78.40	79.00	77.58	78.06	78.20
5	77.96	78.00	78.00	77.50	77.64	78.00
6	77.80	77.90	77.82	77.48	77.60	77.80

Table.5 Changes in peroxide value (P. V.) meq of 02/kg of fat of treated and control samples of water bleached horse mackerel minced meat

Samples / Storage in months	Industrial mixture of sugar + poly 8% + 3 %	Control A water bleaching without maltodextrin	Maltodextrins of different D. E. units @ 8 % and 0.3 % polyphosphate			
			18 D. E.	20 D. E.	22 D. E.	24 D. E.
0	1.80	1.84	1.82	1.79	1.90	1.80
1	4.00	3.67	4.46	4.90	3.58	3.82
2	5.62	4.50	5.42	5.72	3.92	4.24
3	6.80	5.32	7.20	8.22	6.50	5.57
4	8.12	6.70	8.20	8.90	7.40	6.90
5	9.94	7.38	8.38	9.32	8.90	7.89
6	11.02	8.95	10.02	11.80	9.92	9.00

Table.6 Changes in expressible water percentage during frozen storage of treated and control samples of water bleached horse mackerel minced meat

Samples / Storage in months	Control A water bleaching without maltodextrin	Instrial mixture of sugar + poly 8% + 3 %	Maltodextrins of different D. E. units @ 8 % and 0.3 % polyphosphate			
			18 D. E.	20 D. E.	22 D. E.	24 D. E.
0	7.30	7.12	7.38	7.28	7.20	7.00
1	7.46	7.00	7.32	7.20	7.04	6.90
2	7.52	7.20	7.40	6.92	7.16	7.14
3	7.70	7.25	7.42	7.00	6.98	7.22
4	8.45	7.29	7.55	7.58	7.35	7.00
5	9.48	7.32	7.80	7.62	7.59	7.24
6	-	7.36	8.62	7.60	7.72	7.29

Fig. 1 Changes in protein (%) during frozen storage of treated and control samples of water bleached horse mackerel minced meat

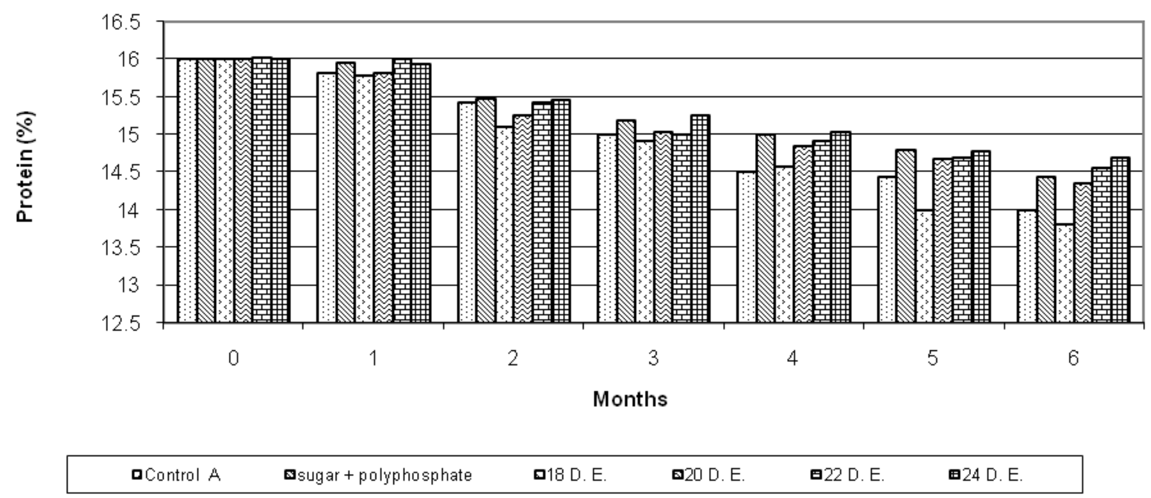


Fig. 2 Changes in SSN (% TN) during frozen storage of treated and control samples of water bleached horse mackerel minced meat

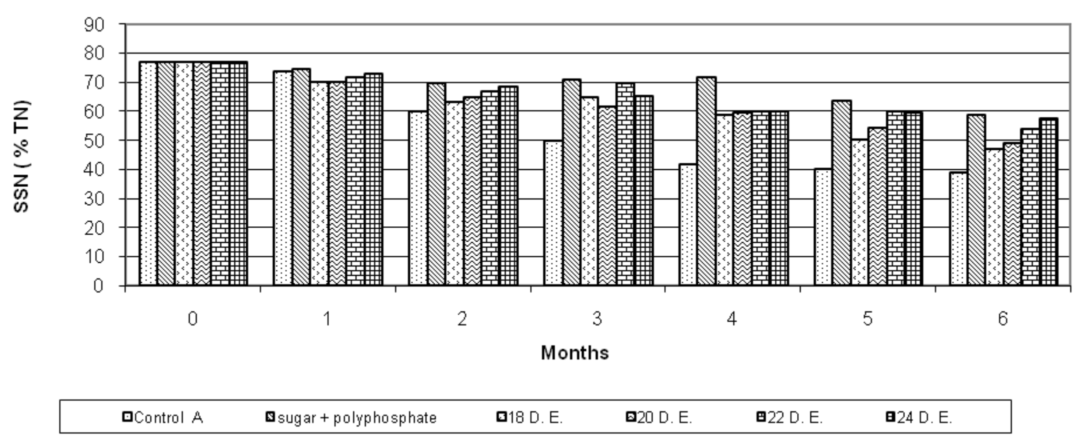


Fig. 3 Changes in pH during frozen storage of treated and control samples of water bleached horse mackerel minced meat

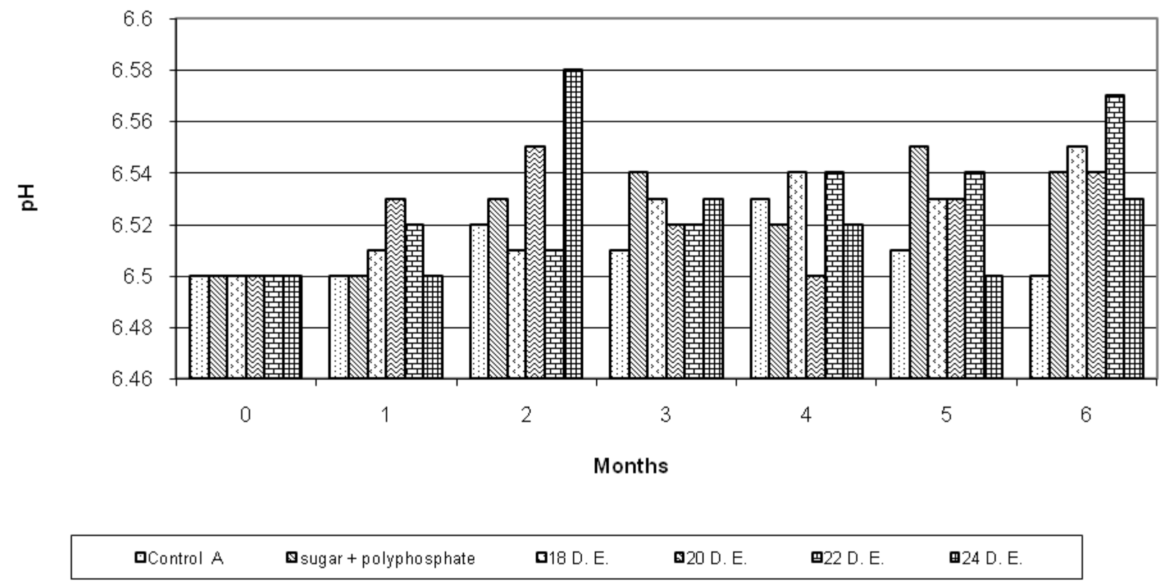
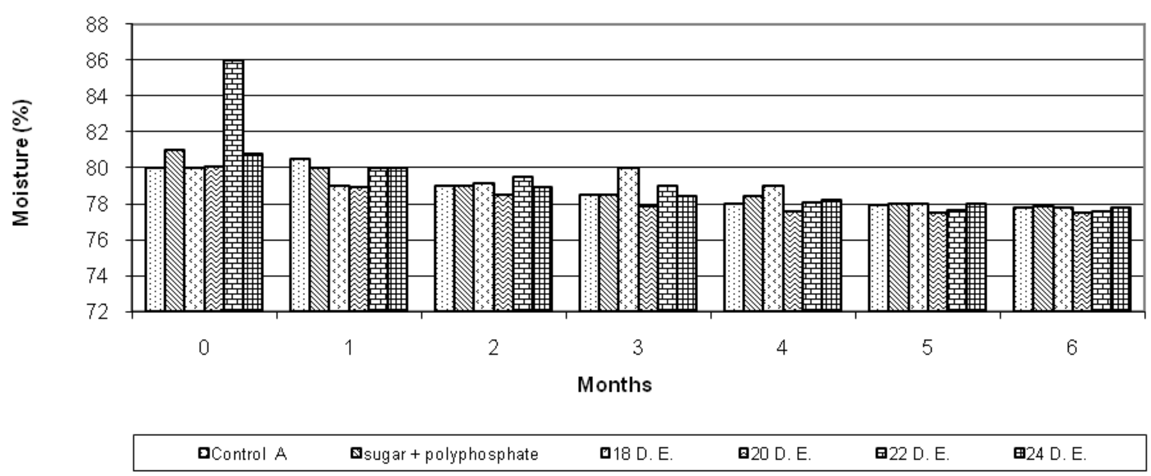
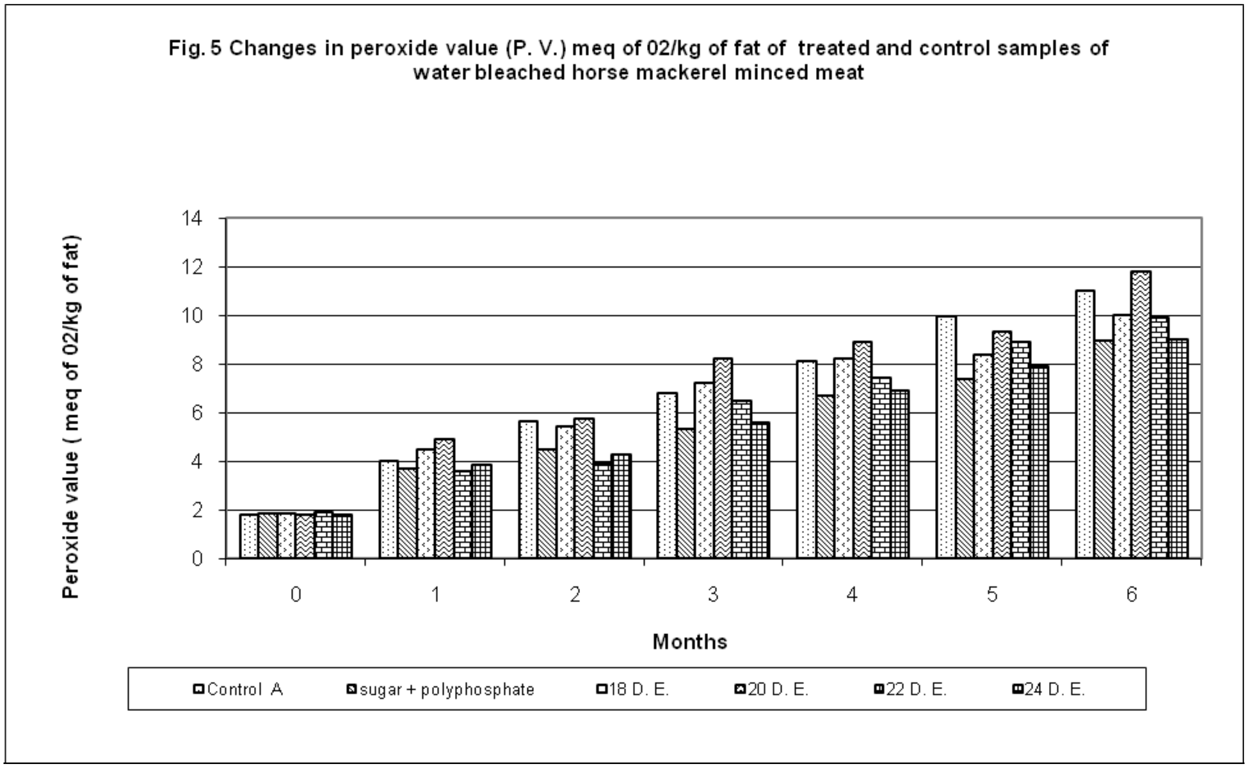
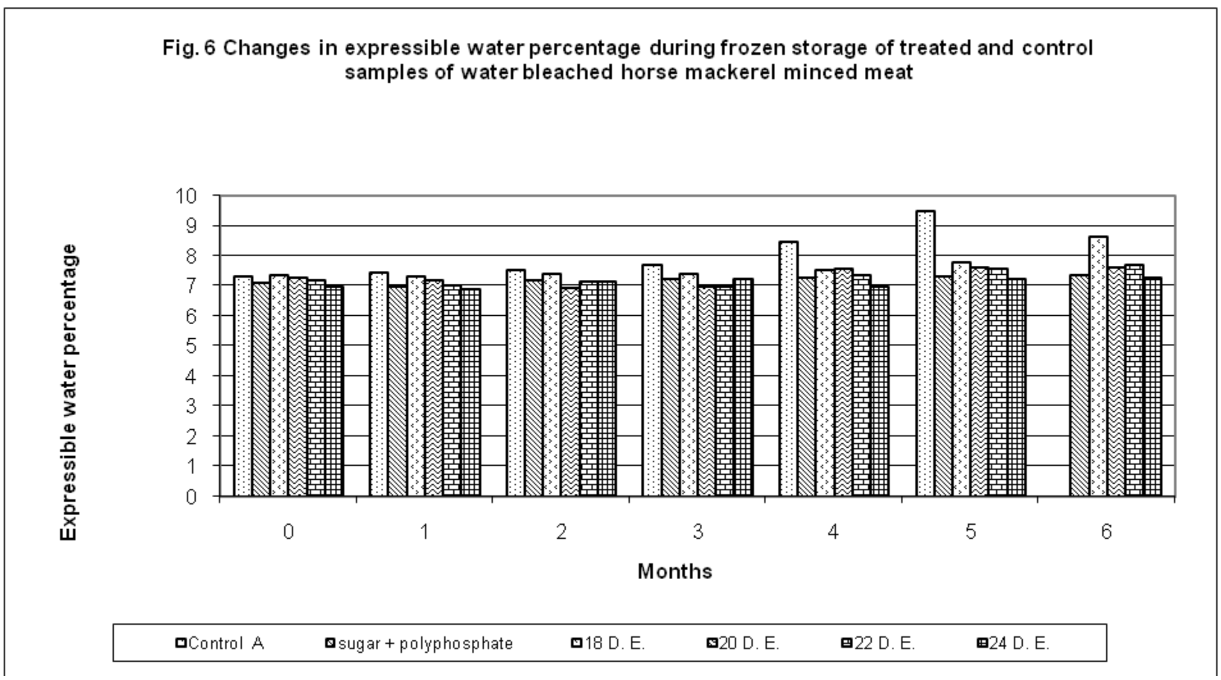


Fig. 4 Changes in moisture during frozen storage of treated and control samples of water bleached horse mackerel minced meat







The organoleptic scores for taste and odor co-related with peroxide value, at the end of 6th month frozen storage all the treated samples developed rancid smell.

Water bleaching reduced the fat content from 3.76 % to 2.00 % and addition of antioxidant controls the oxidative rancidity of residual fat in the minced meat.

During frozen storage, increasing trend was show in the expressible water percentage in all samples. The treated horse mackerel minced meat with 24DE maltodextrin & industrial mixture samples showed lower expressible water percentage than the other treated samples of different DE units i.e. 18, 20 & 22 DE. Also the control sample showed gradual increase in expressible water percentage was higher at the end of 04^{th} month. It was show in Table 6 and Figure 6.

Ravishankar (1990) reported that the expressible water % increased from 7.12 to 7.25 in treated samples of oil sardine minced meat storage for 5 months.

There was gradual reduction in the folding test grade of fish ball prepared form horse mackerel minced meat stored at – 20˚ C. The extent of decrease in the grades was lover in the samples treated with 24DE maltodextrin and industrial mixture sample as compared to those treated with lower dextrose unit at maltodextrin at the end of 6^{th} month.

Dondero (1996) reported that the jack mackerel surumi treated with 24 DE maltodextrin found to have high jelly strength similar to that of industries mixture during frozen storage unlike those treated with lower DE maltodextrins units.

The extent of decrease in the TPC was lower in the samples treated with 24 DE maltodextrin and industrial mixture at the end of 6^{th} month as compared to those treated with lower DE maltodextrin units. Pathogens i.e. *E. coli*, *salmonella staphylococcus*, *Vibrio* and *streptococcus* were absent throughout the storage in all treated and control samples. Similar trend have been noticed by Reddy *et al.,* (1990) and Bhatkar (1998) during the cold storage of frozen minced meat.

There was decrease in scores of all the organoleptic characteristics in the fish ball from treated & control samples of horse mackerel minced meat. However, the decrease was more pronounced in the taste, texture, odor and overall acceptability unlike that at color & appearance.

The different treatment were found to be significantly different at p (ANOVA, two factor and single factor) and fish ball with 24 DE was found to be superior to there of others except industrial mixture. (LSD test) at p<005.

Similar closing finding carried out by Dondero et al., (1996) that jack mackerel surimi samples treated with 20, 25 maltodextrins DE unit had higher texture scores at the end of 27 weeks of storage at the – 18°C as compared to those with lower maltodextrins units.

Based on the biochemical, microbiological, organoleptic and physical tests, it can be concluded that frozen bleached maltodextrin 24 DE and the BHA treated horse mackerel minced meat can be stored for 6 months.

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