

Preservation of Mulletts in CO₂ Enriched Gas-mixture at 6-7°C

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Small mullets were stored at 6-7°C in gas mixtures containing 60% carbon dioxide & 40% air and 80% carbon dioxide & 20% air. It was found that fish stored in gas mixture containing 60% carbon dioxide and 40% air was acceptable upto 9 days and that stored in 80% carbon dioxide and 20% air upto 10 days as compared to 7 days for control packed in normal atmosphere.

Fish is one of the most perishable food items. Extension of the shelf life of fresh fish will increase the marketing range of the fresh products and enable greater amounts of seasonal surplus to be marketed fresh. Coyne (1933) reported that carbon dioxide concentration upto 100% was beneficial for preserving fresh fish, 40-60% CO₂ giving the optimum result. Many scientists (Banks *et al.*, 1980; Parkin *et al.*, 1981; Brown *et al.*, 1980; Mitsuda *et al.*, 1980; Shewan, 1950; Tarr, 1954) used different percentage of CO₂ and found beneficial effect on the shelf life of different species. Use of CO₂ enriched atmosphere for storage of fish and other products was reviewed by Wolfe (1980). In this paper the results of the studies on the effect of CO₂ enriched gas mixtures at 6-7°C on shelf life of mullet are reported.

Materials and Methods

Fresh mullet, *Mugil keelarti*, (30-35 g) was obtained from the local landing centre. The fish was washed and cleaned with fresh-water. One portion of it was packed in 200 gauge high density polythene (HDPE) bags in normal atmosphere. The second portion was packed in 200 gauge HDPE bags in CO₂ air mixture (3:2). The third portion was packed with 4:1 CO₂ air mixture. The bags were sealed air tight and stored at 6-7°C.

The samples were analysed for total volatile basic nitrogen (TVBN) (Conway, 1947), total bacterial count and sensory characteristics. Raw and cooked fish were evaluated by five judges for appearance, texture, odour and flavour on 5 point scale. (Excellent 5, Good 4, Fair 3, Poor 2, soft and spoiled 1).

Results and Discussion

Table 1 shows the TVBN and total bacterial count of samples stored in gas mixtures containing 60% CO₂, 80% CO₂ and control. Bacterial count was less in samples stored in gas mixtures. TVBN values were also less in samples stored in gas mixtures showing the same trend as total bacterial count.

In the present study it is found that CO₂ enriched atmosphere has substantial retarding effect on bacterial count but the effect is not as high as that noticed by Brown *et al.* (1980). This may be due to initial bacterial flora of tropical fish which is known to predominate in gram positive bacteria in contrast to gram negative bacteria in fish from colder region (Shewan & Hobbs, 1967). CO₂ is found to inhibit gram negative rods but to stimulate gram positive Cocci (Banks *et al.*, 1980; Brown *et al.*, 1980). Some authors have advocated that TVBN is not a suitable spoilage indicator for modified atmosphere stored fish (Bank *et al.*, 1980). On contrary

Table 1. Storage characteristics of fish in gas mixture

No. of days	TVBN, mg%				Total bacterial count/g			
	CA	CB	A	B	CA	CB	A	B
0	8.00	8.56	8.00	8.56	1.2×10^4	1.2×10^4	1.2×10^4	1.2×10^4
2	13.12	14.38	11.30	10.12	5.4×10^4	3.5×10^4	3.2×10^4	1.4×10^4
4	18.25	19.12	16.89	14.60	2.2×10^5	1.8×10^5	8.8×10^4	4.2×10^4
6	24.89	25.72	20.92	18.85	9.8×10^5	9.2×10^5	3.0×10^5	1.0×10^5
7	29.12	29.58	23.56	20.94	3.0×10^6	1.2×10^6	5.3×10^5	2.5×10^5
8	34.98	35.21	26.62	23.61	9.2×10^6	8.1×10^6	8.8×10^5	4.7×10^5
9	39.21	39.15	29.12	26.12	2.8×10^7	1.1×10^7	1.3×10^6	8.1×10^5
10	47.52	48.32	35.68	29.92	7.2×10^7	3.9×10^7	5.2×10^6	1.5×10^6
11	—	55.27	—	34.21	—	9.8×10^7	—	5.0×10^6

CA & CB - control; A - CO₂ : Air = 60 : 40; B - CO₂ : Air = 80 : 20

to above observation, it was found in this study that trend in TVBN value closely followed the bacterial growth pattern and provided an adequate quality index which was also backed by organoleptic analysis of the cooked and raw fish (Table 2). Taking

into consideration the data presented in Table 1 and 2, it can be concluded that fish stored in gas mixture containing 60% CO₂ and 40% air is acceptable upto 9 days and that stored in gas mixture containing 80% CO₂ and 20% air upto 10 days as compared

Table 2. Organoleptic characteristics of raw and cooked fish stored in gas mixture

No. of days in storage	Appearance		Raw Texture		Odour		Cooked Flavour		Texture	
	C	G.M.	C	G.M.	C	G.M.	C	G.M.	C	G.M.
0	A	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0
	B	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0	5.0±0
2	A	5.0±0	5.0±0	5.0±0	5.0±0.18	5.0±0	5.0±0.18	5.0±0	5.0±0.18	5.0±0
	B	5.0±0	5.0±0	5.0±0	5.0±0.25	5.0±0.18	5.0±0.25	5.0±0.18	5.0±0.18	5.0±0
4	A	4.0±0.18	4.5±0.18	4.0±0.18	4.5±0.18	4.0±0.15	4.5±0.18	4.0±0.25	4.5±0	4.5±0.50
	B	4.0±0.5	4.5±0.35	4.0±0.18	4.5±0.18	4.0±0.18	4.5±0	4.0±0	4.5±0.18	4.5±0.25
6	A	3.5±0.25	4.0±0.18	3.5±0.18	4.5±0.25	3.0±0.18	4.0±0	3.5±0.18	4.0±0.18	3.5±0.18
	B	3.5±0.15	4.5±0.25	3.5±0	4.5±0.18	3.0±0	3.5±0.50	3.5±0.25	4.5±0.35	3.5±0.35
7	A	3.0±0.35	4.0±0.25	3.0±0.25	4.0±0.18	3.0±0.25	4.0±0.18	3.0±0.25	4.0±0.25	3.0±0.25
	B	3.0±0.18	4.5±0.35	3.0±0.25	4.5±0.50	3.0±0.25	4.0±0.18	3.0±0.18	4.0±0.18	3.0±0.25
8	A	2.0±0.5	3.5±0.25	2.0±0.35	4.0±0.25	2.0±0.35	3.5±0.18	2.0±0.25	3.5±0.18	2.5±0.18
	B	2.0±0.35	4.0±0.18	2.0±0	4.0±0.18	2.0±0.18	4.0±0.35	2.0±0.0	4.0±0.25	2.5±0.18
9	A	1.5±0.5	3.0±0.25	1.5±0.35	3.0±0.25	1.5±0.35	3.0±0.25	1.5±0.25	3.0±0.25	2.0±0.18
	B	1.5±0.18	4.0±0.35	1.5±0.18	3.5±0.25	1.5±0.00	3.5±0.18	2.0±0.25	4.0±0.35	2.0±0.18
10	A	1.0±0.5	2.0±0.35	1.0±0.18	2.0±0.18	1.0±0.18	2.0±0.25	1.0±0.18	2.0±0.18	2.0±0.18
	B	1.0±0	3.0±0.18	1.0±0	3.0±0.18	1.0±0.18	3.0±0.18	1.0±0.18	3.5±0.18	1.0±0.5
11	A	-	-	-	-	-	-	-	-	-
	B	1.0±0	2.5±0.18	1.0±0.18	2.5±0	1.0±0	2.0±0	1.0±0	3.0±0	1.0±0.18

Average value of five observations along with standard deviations are presented

C - control; G.M. - gas mixture; A = CO₂ : Air - 60:40; B - CO₂ : Air - 80:20

to 7 days for control packed in normal atmosphere. A shelf life of 14 days was observed by Brown *et al.* (1980) in rock fish fillets stored in 40% CO₂ at refrigerated temperature compared to 7 days for the fillets in normal atmosphere. The difference in microflora in the two regions may account for this difference.

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