Control of Mould Growth and Reddening in Salted and Dried Mackerel

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Propionic acid at a concentration level of 4 per cent has been suggested as an effective chemical preservative for salted and dried mackerel. Mould growth and reddening can be brought under control even up to 62 weeks in the treated samples as against a normal shelf life of 15-20 weeks in the untreated controls. Results obtained from a detailed study of the propionic acid treatment have been discussed in the light of storage problems under tropical conditions.

REDDENING caused by halophilic bacteria and growth of moulds, popularly known as 'dun', constitute the main types of spoilage in fish, particularly under tropical conditions. Reddish discolouration has been noticed in 2-3 months in Indian commercial fish samples[1]. Although several preservative chemicals like sodium acid phosphate, sodium benzoate, boric acid, etc. have been recommended, none of them are found to be really satisfactory and even sorbic acid considered by Canadian workers[2] as the most effective fungistat for cured fish was found to be inactive[3,4] under Indian conditions. On the other hand, promising results have been obtained by using propionic acid as chemical preservative especially in the case of wet salted and pickled fish[5]. Further investigations on the use of propionic acid in the dry salting of mackerel are reported here which yield equally encouraging results with a modified procedure. Results of these studies reveal that salted and dried mackerel could be preserved for over one year without any microbial attack.

Process

Three hundred mackerel of size 21-22 cm. were gutted immediately after landing, gills and viscera removed and split dorsoventrally followed by thorough washing. Dressed fish were then divided into 13 groups and given a dip for 10 min. in propionic acid baths of 1, 2 and 4 per cent concentration. After removing the first lot three other groups were dipped in the same baths. The baths were thus employed four times in succession which reduces the cost of chemical treatment. The change in the preservative strength of the baths was found to be 10 per cent by titration. One group of fish was chosen to serve as the control. After removing from the preservative baths, the fish were salted in 1 : 4 ratio without further washing and left in salt for 48 hr. They were then rinsed in brine to remove excess salt and sun-dried for two days. After the initial analysis they were stored in glass bottles for studying their shelf life. Observations on mould growth, reddening due to halophiles and the organoleptic condition of the samples were recorded at definite intervals while chemical analysis was also undertaken when noticeable spoilage occurred in the different groups.

Results

Results of the periodical assessment of the products during storage have been recorded in Table 1 while the chemical data are given in Table 2. The earliest symptom of microbial spoilage is mould growth followed by reddening in about a month. Putrefaction sets in along with red halophile attack. Rancidity is also observed even earlier than microbial growth. Chemical examination confirms the visual findings, spoiled products showing total volatile nitrogen values above 100 mg. while the well preserved samples

treated with 4 per cent propionic acid showed a total volatile nitrogen level never above 50 mg. even after 62 weeks. Taste panel studies did not show any off flavours due to the chemical treatment. Some bitterness was, however, noticed when the rancid samples treated with 4 per cent propionic acid were examined after a prolonged storage for 62 weeks.

Table 1 — Effect of propionic acid treatment on the shelf life of dry-salted mackerel

Sample	Dip. No.	Period in weeks for onset of spoilage symptoms			
		Fungal growth	Reddening	Rancid odour	Putrid odour
Control	—	15	18	19	19
1 per cent propionic acid treated	1	19	23	*	23
	2	19	23	*	23
	3	18	23	*	23
	4	18	23	19	23
2 per cent propionic acid treated	1	40	49	23	45
	2	40	49	23	45
	3	40	49	23	45
	4	23	23	23	34
4 per cent propionic acid treated	1	*	*	48	*
	2	*	*	44	*
	3	*	*	44	*
	4	*	*	44	*

*The corresponding symptom is absent in these cases.

Table 2 — Chemical changes during storage of dry-salted mackerel* pretreated with propionic acid

Sample	Dip. No.	Period of storage in weeks					
		29 weeks		44 weeks		62 weeks	
		Moisture %	Total volatile nitrogen mg. %	Moisture %	Total volatile nitrogen mg. %	Moisture %	Total volatile nitrogen mg. %
Control	—	55·32	357·10	Sample discarded after 29 weeks			
1 per cent propionic acid treated	1	53·11	166·30	do			
	2	56·28	164·50				
	3	53·73	182·00				
	4	55·76	220·50				
2 per cent propionic acid treated	1	53·95	16·80	46·67	116·80	50·13	246·20
	2	53·98	20·30	46·34	111·20	—	—
	3	52·82	18·20	46·77	83·24	—	—
	4	51·99	45·85	Sample discarded after 40 weeks			
4 per cent propionic acid treated	1	52·73	19·95	42·81	25·02	37·71	39·04
	2	54·33	16·80	42·18	30·75	40·14	49·39
	3	50·94	21·00	43·53	29·05	39·24	40·32
	4	52·29	21·00	47·98	24·34	41·49	37·71

*Initial analysis of products: moisture 41·12; salt 16·13 per cent.

The results of the present study indicate that a dip in 4 per cent propionic acid preserves salted and dried mackerel against mould attack, reddening and development of putrid odours for more than a year while control samples deteriorate rapidly within 15-20 weeks and become unfit for human consumption. These encouraging results have been obtained by the use of a higher salt ratio and a longer salting period apart from increasing the duration of dip to 10 min. as compared with earlier experiments[5]. Recent work from another laboratory has also indicated the usefulness of sodium propionate as a fungistat for dry salted mackerel[3] although the storage studies reported were of a much shorter duration. There is a significant improvement even when the concentration of the chemical is reduced to 2 per cent while dips in 1 per cent bath is almost ineffective. No significant difference could be observed between the groups dipped in baths in succession except in the case of 2 per cent series wherein the last bath shows a wide divergence.

In the samples treated with 4 per cent propionic acid rancidity sets in only after 44 weeks and microbial spoilage is suppressed completely even up to 62 weeks as against a maximum storage life of 19 weeks in controls.

These results are significant when the moisture level of the products is considered. Reddening was not observed by Sen and coworkers[3,4] and Shewan[6] also reports its absence below a moisture level of 34·8 per cent. It would, however, be difficult in commerce to keep the moisture content below 40 per cent since even hard-dried fish pick up sufficient moisture to attain equilibrium levels of 45 per cent within 2 months (unpublished data) as observed in the present study at relative humidity levels of 75 per cent and above, prevailing in India. Results of the above investigation show that high moisture levels *per se* need not reduce shelf life if propionic acid can control mould growth and reddening under tropical conditions. Preservative treatment indicated in the present investigations may also offer a solution to packaging difficulties mentioned by Sen *et al.*[4] in the case of cured fish products with a moisture content above 35 per cent.

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