Studies on the use of Alginates in Frozen Fishery Products

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[Results of preliminary studies on the use of sodium alginate as a protective coating for fishery products showed that several varieties of fishes and shell fish had better keeping qualities when coated with sodium alginate.]

Introduction

Frozen seafoods undergo several changes during storage. Chief among these are flavour changes, oxidation of fat, tendency to toughen and drying out of the products due to loss of moisture. The most widely practised method to overcome or retard these changes has been to give the product an ice glaze by dipping the frozen fish in cold water. Because of its inexpensive nature and adaptability to the production line ice glaze still remains to be the only procedure of commercial importance, in spite of its susceptibility to cracking, its brittleness and high vapour pressure.

Studies, however, have been in progress to find out a more complete and effective glazing material for frozen fishery products. In the course of these attempts pectinates (MaClay & Owens, 1948), gelatin-coatings (Hall & Griffiths, 1933), vegetable gel formed from Irish Moss mixed with sorbitol and water (Anon, 1952), thermoplastic waxes (Anon, 1947) etc. were tried with certain measure of success. But none appeared to have been successful for application in commercial Plants.

More recently (Anon, 1955 ; Oleson, 1957) a method developed in Norway — the Protan Method — has shown much promise. The method used a gel formed from sodium alginate to cover the frozen block. This was claimed to be very effective in preventing dehydration or desiccation, denaturation of proteins, and in reducing the ' thaw drip ' thus preventing loss of flavour. Anon (1957) reported that retail and institutional packages of mackerel fillets frozen in Protan Jelly were being marketed in the United States of America.

Because of the promise given out by this method experimental work was initiated in India as early as 1957. Some of the results obtained from these studies are reported here. The alginate used in these studies were very kindly supplied by the British Alginate Industries through their Indian counterparts Messrs. Gillanders Arbuthnot & Co., Calcutta.

Experimental Procedure

Three different varieties of fish and two species of prawn were used in these experiments. The gel for coating was prepared from a 2.5% solution of alginate by mixing it with calculated quantities of phosphate salts of sodium and calcium followed by addition of citric acid so that the mixture sets into a strong gel within seven minutes. The fish samples, after cleaning, were either given a dip in the freshly prepared gel and immediately frozen at —14°F or dipped after freezing and stored at —10°F. The prawns were peeled and deveined and then subjected to the above treatment, except that in this case quick freezing was done at —40°F. The samples thus stored were analysed at periodic intervals for their chemical and bacteriological characteristics. In each series the control samples were given a water glaze as practised by the trade.

Results and Discussion

The results of analysis of the fish samples *Sardinella gibbosa, Elopes sp.* and *Sillago sp.* during storage for six months are given in Table I. The changes in the bacterial counts observed in the case of the prawn samples for a period of ten months are shown in Table II.

The data indicate that the jelly coated samples of fish retained their moisture content better than the control samples. In the case of the three fishes the drop in the moisture content during six months was only of the order of 3.4%, 4.8% and 2.1% respectively in the jelly-coated samples as against 10.4%, 11.2% and 6.1% respectively in the control samples. Denaturation of protein as measured by 5% salt soluble nitrogen and fat oxidation as measured by peroxide value (PV) are considerably reduced in all the three varieties of fish used in these experiments. The relative difference in the spoilage of the treated and un-treated samples of the fish are further indicated in the total volatile nitrogen (TVN) values.

TABLE I. — Results of analysis of jelly coated frozen fish samples during storage

Period in months	Treatment	Moisture %	T. V. N. mgN%	PV ml. N/500 $Na_2S_2O_3$	5% salt soluble N % of total N
		Sardinella gibbosa			
Initial		80.4	12.8	7.2	47.0
1	Control	77.2	46.2	26.6	35.0
	Jelly coated	79.4	25.8	19.0	45.5
2	Control	75.8	56.0	43.0	30.0
	Jelly coated	78.9	31.0	27.0	43.0
3	Control	73.0	117.6	74.4	28.0
	Jelly coated	77.3	50.0	36.4	42.8
4	Control	72.3	127.6	89.0	28.0
	Jelly coated	77.3	49.8	41.2	41.0
6	Control	70.0	151.5	102.7	—
	Jelly coated	77.0	72.3	50.0	—

		Sillago sp.			
Initial		82.0	7.2	Nil	52.0
1	Control	78.2	22.1	12.1	37.0
	Jelly coated	80.2	9.3	Nil	49.2
2	Control	76.0	32.0	23.0	33.0
	Jelly coated	80.0	14.5	3.0	45.5
5	Control	70.8	56.0	47.6	28.0
	Jelly coated	77.4	22.0	28.0	43.0
		Elopes sp.			
Initial		78.1	16.4	31.6	52.0
1	Control	76.3	27.3	72.0	49.0
	Jelly coated	77.6	20.2	41.0	50.0
2	Control	73.2	42.3	135.0	41.0
	Jelly coated	76.4	28.0	75.0	48.0
4	Control	72.0	56.0	197.0	36.0
	Jelly coated	76.0	39.2	178.5	38.0

The values for jelly coated samples are, in most cases, less than 50% of those given by the control samples.

It is surprising to note that in the trials with prawns (Table II) the total bacterial plate counts in the jelly coated samples are considerably less than those in the control samples throughout the entire period of storage. This lowering may be due to the effect of the small quantities of citric acid present in the jelly.

TABLE II. — Changes in the total bacterial plate counts of jelly coated frozen prawn during storage.

(Counts expressed as number of colonies per gram muscle)

Period in months	Sample I		Sample II	
	Control	Jelly coated	Control	Jelly coated
Initial		3.2×10^5		5.1×10^5
Immediately after freezing		2.3×10^4		6.9×10^4
1	3.8×10^4	2.5×10^4	6.7×10^5	4.0×10^4
2	7.0×10^4	3.0×10^4	8.5×10^5	4.8×10^4
4	1.0×10^5	3.0×10^4	1.0×10^6	7.0×10^4
6	2.5×10^5	3.3×10^4	1.0×10^6	6.6×10^4
8	7.5×10^5	6.0×10^4	1.2×10^6	6.2×10^4
10	7.0×10^5	8.6×10^4	9.3×10^5	7.2×10^4

Summary

The preliminary studies showed that alginate jelly is a very effective coating material for frozen fish and shell fish products. Its commercial application, however, depends on the cheapness of the treatment and the adaptability of the method to factory procedures.

References :—

MaClay, W. D. & Owens, H. S.,	*Modern Packaging, 22* (1), 157,(1948)
Hall, L. A. & Griffith, E. L.,	U. S. Patent No. *1*, 914, 351
Anon.,	*National Provisioner, 127*(11), 23,(1952)
Anon.,	*Food Industries, 19*(4), 22,(1947)
Anon.,	*Canadian Fisherman, 42,* 14,(1955)
Oleson, A.,	*Quick Frozen Foods, 20,* (2), 238,(1957)
Anon.,	*Ibid. 20,* (12), 128,(1957)