PRESERVATION OF PRAWNS WITH CHEMICALS

FATIMA SHAIKHMAHAMUD & N. G. MAGAR
Department of Biochemistry, Institute of Science, Bombay-1

[The preservation of prawns with boric acid, dipotassium hydrogen phosphate, sodium bisulphite, ascorbic acid, citric ascorbic acid mixture, acronise pd, feromycin and penicillin have been investigated. Acronise pd, foromycin and citric ascorbic acid mixture in the order named proved the most effective inhibitors of growth of the natural mixture flora at temperatures between-18°C and 28°C; while foromycin inhibited yeast growth and sodium bisulphite and boric acid retarded melanosis. Acronise pd caused marked inhibition of bacterial growth in 5 to 50 per ml. concentration, when used as an immersion medium for 10 to 15 minutes. The other chemicals used exerted a less intense action or were without any effect.]

Introduction

The preservation of prawns in ice has been a common practice for many years, but there has been a continuous research for improved methods of preservation (Campbell et. al., 1952 Fieger et. al., 1954; Green, 1949). Ice by itself does not prolong the 'shelf-life' but chemical and antibiotic ices appear to appreciably extend the storage life of prawns (Tarr et. al., 1950; Fieger et. al., 1956).

Various chemicals like boric acid, salicylic acid, benzoic acid, citric acid, ascorbic acid, parahydroxybutyl benzoate sodium nitrite and hexamine have been used by several workers (Tetsumoto et. al., 1955; Venkataraman et. al., 1955) for the preservation of prawns and other sea products. But before these chemicals could be added to food intended for human consumption, it was essential to ascertain whether they were harmless, tasteless and odourless as well as whether their use was permitted by the drug control act.

From this point of view, antibiotics are better for the preservation of prawns. Since they are destroyed by heat and also disappear gradually during storage, they have no direct value as permanent preservatives of prawns. However, in case of unavoidable delay between the catch and landings and preservation by canning or freezing, the use of such antibiotics might prevent undesirable changes in the food for a reasonable period.

Experimental Procedure

Fresh prawns were purchased at Sassoon Docks and after washing thoroughly, the heads were removed as quickly as possible and the beheaded prawns were washed once again. Batches of approximately 4 lbs. were introduced into 2 litres of the preservative solution and stirred with porcelain table spoons for 10 to 15 minutes. The excess liquid was then drained off, the prawns were divided into different groups, wrapped in moisture proof celophane bags and stored at 28-30°C, 5°C and —1°C. Organoleptic test such as colour, flavour and condition of the muscle as well as quantitative analysis of bacteria were carried out at intervals of either a few hours or days (as necessary) to determine the effectiveness of the various chemicals in comparison to the controls.

Results and Discussion

As shown in Table I, the quality of the treated prawns was somewhat superior to that of the control. The treated prawns had a better and a more attractive look, were firmer and maintained their natural flavour slightly longer than the control.

The boric acid, sodium bisulfite and to a lesser degree the ascorbic-citric acids

mixture decreased the formation of black spots during the first 32 hours of storage at room temperature but not later on. Acronise penicillin and dipotassium hydrogen phosphate had no effect on black spot formation. Acronise pd. and foromycin dips reduced bacterial growth while penicillin was without any effect in this respect. Judged by visual observations, foromycin was more effective than acronise pd., which in turn was more effective than sodium bisulfite.

Both foromycin and acronise pd. retarded bacterial growth, and the former decreased melanosis too, but its side effects indicated spoilage. A well marked bleaching effect, formaldehyde smell and unusual hardening of the material were evident.

After storage for 32 hours at room temperature, the prawns treated with acronise pd. definitely showed less off-odour, better general appearance and low baterial count than those treated with other chemicals. Acronise pd., foromycin, penicillin and the citric-ascorbic acids mixtures had only very feeble bacteriostatic action. After 1 day the bacterial count decreased and all samples were putrified by $2\frac{1}{2}$ days.

Immersion of beheaded prawns in acronise pd. solution for 10 minutes proved more effective for storage at both 5°C and —1°C than foromycin and caused a marked retardation of bacterial spoilage (Tables II and III).

Boric acid, ascorbic acid, the ascorbic citric acids mixture, foromycin and sodium bisulfite retarded melanosis for 3, 4, 5, 10 and 12 days respectively while acronise pd. and penicillin did not prevent the formation of black spots. However, penicillin was found to be of little value in the preservation of prawns as reported in the literature, sodium bisulfite was superior in retarding melanosis, while acronise was found to be the best in controlling the bacterial growth and thus the spoilage of prawns.

In another set of experiments, whole washed prawns were treated with the 2 antibiotics, viz, acronise pd. and foromycin which showed the best results in the previous experiments, and stored at —18°C. The results (Table IV) indicated that acronise pd. was a more effective preservative for prawns than foromycin, but the differences were not as marked as those at the 3 higher temperatures. The beneficial effects of antibiotics were more evident after 5 months storage and these samples were in a marketable condition even after 12 months except that dehydration and decolouration were more pronounced in the case of acronise pd. and foromycin respectively.

As shown in Table V, 10μg/ml. of acronise pd. was more beneficial than a concentration of 5 μg/ml for inhibiting the growth of bacteria. In the initial stages, concentrations of 20 and 50μg/ml. reduced the bacterial count considerably, but due to enzymatic and other spoilage, these prawns were classed as of poor quality.

Similarly though higher concentrations of foromycin reduced bacterial growth, the side effects were unpleasant and it was considered advisable to use only a 0.2% concentration. Penicillin was found to be ineffective, and sodium bisulfite was not as effective as acronise pd. and foromycin in arresting bacterial growth. Melanosis was retarded considerably with a 0.1% concentration while a 0.5% solution was found to be ineffective. A 1% concentration of ascorbic acid promoted the growth of yeast while 5% did not.

From the above experiments it was evident that acronise pd. at a concentration of 10μg/ml. was superior to any other antibiotic or chemical. Foromycin was effective at a 0.2% concentration, while penicillin and ascorbic acid were useless from the preservation point of view. Sodium bisulfite was superior to boric acid and citric acid in retarding melanosis.

References

1. Campbell, L. L. Jr. & Williams, O.B., *Food Tech., 6,* 125, (1952).
2. Fieger, E. A. & Friloux, J. J., *Food Tech., 8,* 35, (1954).
3. Green, M., *Food Res., 14,* 372, (1949).
4. Tarr, H. L. A., Southcott, B. A. & Bissett, H. M., *Fish. Res. Bd. Can. Prog. Repts. Pacific. Coast. Stas.* No. 83, 35, (1950).
5. Fieger, E. A., Bailey, M. E. & Novak, A.F., *Food Tech., 10,* 518, (1956).
6. Tetsumoto, S., Ohitsu, T. & Fukuta, M., *Proc. I. P. F. C., 6th Session, Sec.* 2, 288, (1955).
7. Venkataraman, R., Chari, S. T., & Sreenivasan, A., *Proc. I. P. F. C., 6th Session, Sec.* 2, 434, (1955).

Discussion

Shri Mitra asked whether the authors recommended any particular chemical for preservation. The general opinion was that although each type of compound dealt with by all research workers is effective against a single type of organism or reaction, there has not so far been any chemical that could be said to be a 'cure all' for all spoilage changes in fish or prawn. Closely allied to this is the question whether chemicals are necessary at all and whether mere process control would not be effective in producing a quality product.

Ascorbic acid-citric acid mixture does not present the danger of residue in the treated product as in the case of a sulfite-treated product.

Dr. M. V. Rajgopal pointed out that a mixture of 90% citric acid and 10% ascorbic acid used along with iced material has helped in preventing melanosis in prawns for three days. The important question however was the high concentration of chemicals.

The use of acidic compounds is not generally viewed with favour, as this would bring in changes in the chemical structure of the material.

TABLE — I

EFFECT OF PRESERVATIVES ON PRAWNS STORED AT 28—30°C (ROOM TEMPERATURE)

Time (hour)	1		8		24		32		48		56	
Preservative	* Org. observation	B.C.**	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.
Control	+	2.1×10^3	$\pm\!\!=$	4.8×1^5	++	5.8×10^{10}	++++	Very heavy growth	++++	Very heavy growth	++++	Very heavy growth
Boric acid 2%	+	1.8×10^3	±	1.8×10^3	$\pm\!\!=$	2.5×10^6	+++	3.9×10^6	++++	4.8×10^7	++++	Very heavy growth %
Dipotassium hydrogen phosphate 1%	+	2.1×10^3	$\pm\!\!=$	2.8×10^4	$\pm\!\!=$	4.4×10^4	++	4.9×10^6	++++	6.9×10^7	++++	Very heavy growth
Sodium bisulphite 1%	+	2.1×10^3	±	$1\ 8 \times 10^3$	±	9.8×10^4	+ ++	$6\ 5 \times 10^6$	++++	6.6×10^7	++++	Very heavy growth %
Ascorbic acid 1%	+	1.6×10^3	+	2.3×10^3	±	3.9×10^5	+++	4.7×10^6	++++	$5\ 5 \times 10^7$	++++	Very heavy growth %
Citric acid + Ascrobic acid 1% 50,50	+	1.7×10^3	+	1.9×10^3	±	3.6×10^4	+++	5.2×10^6	++++	8.3×10^7	++++	Very heavy growth %
Acronise pd. 10γ/c.c.	+	1.6×10^3	+	$\angle 0.02 \times 10^4$	+	0.3×10^3	±	8.7×10^4	±	63×10^5	++	485×10^6 %
Foromycin 20γ/c. c.	+	1.5×10^3	+	$\angle 0.03 \times 10^3$	+	0.15×10^3	+	83×10^4	++	78×10^4	++	945×10^6
Penicillin 10γ/c. c.	+	1.9×10^3	±	0.15×10^4	$\pm\!\!=$	3.6×10^6	++	78×10^6	+++	92×10^8	++++	360×10^8 %

* Org. observation = Organoleptic observation.

** Bacterial count (total) per gm. of material (prawn)

\+ Fresh

± Very slight odour

$\pm\!\!=$ Slightly putrified odour

$\pm\!\!=$ Moderately putrified with black spots

++ Strong foul odour etc.

+++ Strong foul odour, mucle soft

++++ Spoiled or in unmarketable condition

% Presence of yeast cells

TABLE — II

EFFECT OF PRESERVATIVES ON PRAWNS STORED AT 5°C (REFRIGERATOR)

Time days	1		3		6		8		10		12	
Preservatives	Org. observation	B. C.	Org. observation	B. C.	Org. observation	B. C.	Org. observation	B. C.	Org. observation	B. C	Org. observation	B. C.
Control	+	0.98×10^{8}	±	67×10^{4}	≡	$\cdot87\times10^{10}$	++++	Crowded	++++	Very heavy growth	++++	Very heavy growth
Boric acid 2%	+	1.1×10^{8}	±	4.9×10^{8}	++++	41×10^{4}	++++	78×10^{5}	++++	730×10^{6}	++++	Crowded
Dipotassium hydrogen phosphate 1%	+	1.5×10^{8}	±	3.9×10^{4}	++++	35×10^{4}	++++	52×10^{6}	++++	920×10^{6}	++++	Crowded
Sodium bisulphite 1%	+	1.2×10^{8}	+	$\cdot17\times10^{4}$	±	3.9×10^{4}	±	25×10^{6}	+ ≡	340×10^{6}	++	Crowded
Ascorbic acid 1%	+	1.6×10^{8}	+	2.6×10^{4}	+++	15×10^{5}	+++	45×10^{7}	++++	670×10^{6}	++++	78×10^{10}
Citric acid ascorbic acid 1% 50/50	+	1.4×10^{8}	+	3.5×10^{4}	++	17×10^{5}	++	68×10^{6}	+++	120×10^{7}	++++	360×10^{8}
Acronise pd. 10r/c.c	+	0.87×10^{8}	+	0.1×10^{8}	+	$\cdot18\times10^{4}$	+	6.5×10^{5}	+	36×10^{4}	±	460×10^{6}
Foromycin 30r/3.c.	+	0.67×10^{8}	+	0.98×10^{8}	±	$\cdot65\times10^{4}$	±	7.8×10^{5}	±@@	52×10^{4}	±@	680×10^{6}
Penicillin 10r/c. c.	+	0.92×10^{8}	+	1.8×10^{4}	+ ≡	19×10^{6}	++	118×10^{7}	+++	530×10^{6}	++++	Crowded

@ Discolouration

@@ Discolouration more pronounced

TABLE – III

EFFECT OF PRESERVATIVES ON PRAWNS STORED AT—1°C (GOVERNMENT COLD STORAGE PLANT, BOMBAY)

Time (days)	2		4		5		7		9		11		13	
Preservatives	Org. observatfon	B.C.	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.	Org. observation	B.C.
Control	±	39×10^4	++	55×10^4	+++	40×10^4	++++	9.7×10^9	++++	Crowded	++++	Very heavy growth	++++	Very heavy growth
Boric acid 2%	+	5.8×10^4	±	78×10^4	+++	66×10^5	++++	86×10^5	++++	48×10^6	++++	490×10^6	++++	Crowded
Dipotassium hydrogen phosphate 1%	+	4.7×10^4	±	45×10^4	+++	79×10^4	++++	63×10^6	++++	68×10^6	++++	386×10^6	++++	Crowded
Sodium bisulphite 1%	+	0.91×10^4	+	0.51×10^4	±	4.3×10^4	+ ≡	53×10^5	+++	36×10^6	+++	412×10^6	++++	Crowded
Ascorbic acid 1%	+	3.1×10^4	±	6.6×10^4	++	19×10^5	+++	33×10^6	++++	78×10^7	++++	350×10^6	++++	Crowded
Citric acid + ascorbic acid 1% 50/50	+	3.3×10^4	±	8.7×10^4	++	9.1×10^5	++	46×10^6	+++	159×10^5	++++	635×10^6	++++	Crowded
Acronise pd, 10r/c.c.	+	0.01×10^4	+	0.09×10^4	+	0.11×10^4	+	0.87×10^4	+	$.91\times10^5$	+	42×10^4	±	56×10
Foromycin 20r/c.c.	+	0.07×10^4	÷	0.1×10^4	+	0.43×10^4	+	0.92×10^4	+	$.65\times10^5$	± @	28×10^4	± @@	65×10
Penicillin 10r/c.c.	+	2.5×10^4	±	5.8×10^5	++	38×10^5	+++	112×10^6	++++	310×10^5	++++	975×10^6	++++	Crowded