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THE INFLUENCE OF POST-BLANCH TREATMENTS ON THE STORAGE LIFE OF SUN-DRIED SHRIMP

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Seven dip solutions were screened for their ability to extend the shelf life of sun-dried shrimp during storage at room temperature. Treatments with ascorbic acid and potassium sorbate, ascorbic acid and sodium benzoate and potassium metabisulphite and citric acid proved to be equally effective in extending shelf life.

A comparative study of the sensory, biochemical and microbiological changes in laboratory processed and commercially processed shrimp during storage at room temperature was also conducted. Laboratory processed shrimp were found to be acceptable upto 7 months whereas commercially processed shrimp spoiled in 3 months.

Key words: Storage, sun dried, shrimp.

INTRODUCTION

The Karachi Makran coast is a rich source of high quality shrimp. In the year 1984, 26 697 metric tons of shrimp were landed at the Karachi Fish Harbour. Best quality, large sized shrimp are frozen and exported and fetched Rs. 912 million in foreign exchange in 1984 [1]. Small sized shrimp, locally known as "kiddi" are canned by the local industry for export purposes. A considerable amount of the these shrimp, particularly during the glut season (October to December) are mostly "beach dried" employing primitive crude methods. The shrimp are boiled in sea water for about 5 min. drained and are allowed to dry in sun at the sea shore.

The locally dried product is unattractive with foul smell and has a short shelf life. The product is sold in the open market and exported to Sri Lanka and other countries. Due to the inferior quality of the product the return is poor. Distributors have recently been interested in applying new processing methods as a means of maintaining the quality of the product from both a sensory and chemical standpoint. The glut season of "kiddi" shrimp is very short and the need for proper processing and preservation of the catch is greatly felt.

The objectives of this work were (i) to determine the effect of a number of post-blanch additives on the preservation of dehydrated shrimp under conditions that might be used commercially and (ii) to compare the quality of laboratory and commercially processed samples.

MATERIALS AND METHODS

Sample. Small shrimp, locally known as "kiddi", (average size 3"), predominantly *Parapenaeopsis stylifera* were obtained from the Karachi Fish Harbour. They were stored in a deep freezer (-29°) overnight till the commencement of the experiment (next morning). For comparative studies, locally sun dried samples were obtained from the local markets at Karachi. All market samples were processed one to two days prior to purchase.

Processing

Experiment 1. Before processing, the shrimp were thawed, tap washed, drained and blanched in boiling 6 % (W/V) brine for 2-3 min. After cooling, the shrimp were treated by immersing for 15 min. in a "dip" solution comprising various additives (singly or in combination) as specified in Table 1. After draining the excess dip solution, the treated shrimp were dried in the sun. Drying was accomplished by spreading the samples on perforated trays in almost single layer and keeping in the sun for about 18-20 hr. Drying was considered adequate when the shrimp became pink in colour with a moisture content of less than 15 %. After drying, the samples were lightly thrashed to remove exoskeleton, packed in polythene bags, sealed, stored at room temperature in the laboratory. To assess the merits of various treatments, samples were examined for sensory qualities (odour, colour and appearance), rehydration ratio and total bacterial count after two months storage at room temperature.

Experiment 2. The following combinations were tried: (a) ascorbic acid 0.2 % + patassium sorbate 0.3 %; (b) ascorbic acid 0.2 % + sodium benzoate 0.2 %; and (c) potassium metabisulphite 0.5 % + citric acid 0.5 % samples after processing were stored at room temperature in sealed polythene bags for 0,1,2, 3, 5, and 7 months. For comparison, dried market products purchased locally, were also examined. At the end of each storage period the samples were examined for the following parameters: (1) sensory evaluation; (2) total plate count; (3) total volatile bases (TVB); (4) trimethylamine nitrogen (TMA-N); (5) ammonia; (6) rehydration percentage and (7) moisture.

Analytical methods

Sensory evaluation. Samples were served after boiling for 5 min. to each of the eight members of the panel, all members of the staff of Marine Food Division who were familiar with the product and knew what constituted good quality product. Panelists evaluated each sample for colour, odour and aceptability (olfactory evaluation) in the case of market samples and for odour, flavour, colour and acceptability (gastatory and olfactory evaluation) in the case of laboratory processed samples using a 9 point scale with 9 representing "excellent" and 1 "very poor" for each colour, odour, flavour and overall acceptability. The score of each parameter was calculated in terms of average score awarded by the panel to each sample. The results represent an average of three determinations at each evaluation day. All data was analysed by the analysis of variance and Duncans Multiple Range Test procedures.

Microbiological evaluation. Aerobic plate counts were determined by the spread plate technique on nutrient agar (Merck with an additional 1 % NaCl W/V) by placing 0.1 ml of appropriate dilution in peptone water (1 % w/v). The plates were incubated at 35° for 48 hr.

Chemical evaluation. All analyses were performed on 7.5 % trichloro acetic acid extract of the samples. Total volatile bases (TVB) were estimated by microdiffusion method as described by Cobb *et al.* [2]. Trimethylamine nitrogen (TMA-N) was determined by Dyer's picric acid procedure [3] as modified by Hoogland [4] and ammonia was estimated by the method of Burnett [5]. Moisture and salt content were determined according to AOAC [6] and the reconstitution was determined by using water rehydration method of Connell [7]. The weighed and dried sample was fully immersed in excess water at room temperature, removed at intervals, lightly blotted with filter paper and rewighed.

RESULTS AND DISCUSSION

Comparison of the effect of various treatments.

Experiment 1. This preliminary experiment was designed to assess the merit of various treatments on the quality of dehydrated shrimp. The results are presented in Table I. After 2 months' storage at room temperature (23-30°) samples treated with ascorbic acid (0.2 %), potassium ascorbate (0.3 %), sodium benzoate (0.2 %) and potassium metabisulphite (0.5 %), and citric acid (0.5 %) were found to be superior than other treated samples as evidenced by higher sensory scores and rehydration percentage. None of the treatments was found to be effective in controlling the bacterial count which was remarkably equal on all the samples. The data was analysed statistically. Treatments 5,

Table 1. Effect of various treatments on sensory quality, bacterial growth and rehydration of dehydrated shrimp.

S. No.	Treatment	Sensory score			Rehydration (%)	APC/g
		Odour	Texture	Colour		
1.	Potassium metabisulphite (0.5 %)	8	7	8	82.4	$6.3x10^4$
2.	Potassium metabisulphite (0.5 %) + Potassium sorbate (0.3 %)	7	8	8	88.6	$7.2x10^4$
3.	Potassium metabisulphine (0.5%) + Sodium benzoate (0.2%)	7	7	8	82.6	$7.6x10^4$
4.	Potassium metabisulphite (0.5 %) + Potassium sorbate (0.3 %) + Sodium benzoate (0.2 %)	7	8	8	89.4	$7.2x10^4$
5.	Ascorbic acid (0.2 %) + Potassium sorbate (0.3 %)	9	8	9	96.9	$7.0x10^4$
6.	Ascorbic acid (0.2 %) + Sodium benzoate (0.2 %)	8	8	9	95.5	$6.6x10^4$
7.	Potassium metabisulphite (0.5) + Citric acid (0.5 %)	9	8	9	94.2	$5.2x10^4$
8.	Blanched sample (no treatment)	7	8	7	88.2	$7.2x10^4$

6, and 7 (Table 1) found to be superior and resulted in significantly better products than those obtained by other treatments (Table 2). Therefore, these treatments were selected for a more detailed experiment.

Experiment 2. Table 3 shows the various changes that take place during the storage of laboratory processed samples stored in polythene bags at ambient temperatures for seven months. It will be seen that all samples were acceptable even after 7 months storage. All treated samples were found to be superior than blanched sample. The difference was more pronounced with the time of storage. A slow and consistant decrease was noted in moisture, rehydration % and sensory score with a corresponding increase in TVB, TMA-N, ammonia and total plate count. Very slight fading in colour and slight fishy smell developed after 7 months' storage. Blanched sample showed significant difference ($P < 0.01$) if compared with treated samples in rehydration %, TVB, TMA-N after seven months' storage. Difference was also noted among the three treated samples but was not statistically significant.

The influence of various preservatives on the storage of dried shrimp has been studied by various workers. Venkataraman, *et al* [8] reported that semi-dried prawns treated with 0.07 % ascorbic acid (on weight of brine) brings down the bacterial count by 99.93 % by the end of 8 weeks in spite of heavy bacterial load. A combination of citric and ascorbic acids has also been reported as an effective growth inhibitor of natural flora of prawns. Ascorbic acid in this study proved to be a good preservative for the retention of quality during storage but had no significant effect on bacterial counts if compared with other treatments. Shrivestava and Anandavally [9] studied the storage life of dried prawns at room temperature. Without the application of any preservative, these workers reported 2 months' storage life of prawns at room temperature. Our results showed that after proper treatment with

Table 2. Sensory evaluation of different treated samples after 2 months. (odour, colour, and acceptance)

	Treatment									
Panelists	1	2	3	4	5	6	7	8	Total	Mean
P_1	7.66	7.66	7.33	7.66	8.66	8.33	8.66	7.3	53.29	7.91
P_2	7.33	7.33	7.66	7.66	8.33	8.66	8.66	7.66	63.29	7.91
P_3	7.00	7.33	7.33	7.00	8.66	8.33	8.66	7.33	61.64	7.705
P_4	7.66	7.00	7.00	7.33	8.33	8.33	8.66	7.00	61.64	7.705
P_5	7.66	7.33	7.33	7.33	8.66	8.66	8.33	7.66	62.96	7.87
P_6	7.33	7.66	7.33	7.66	8.00	8.33	8.66	7.33	62.30	7.78
P_7	7.66	7.33	7.33	7.00	8.66	8.33	8.66	7.35	62.30	7.78
P_8	8.00	7.66	7.66	7.66	8.66	8.00	8.66	7.66	63.96	7.99
Total	60.30	59.3	58.97	59.3	67.96	67.30	68.5	59.30		
Mean	7.54	7.41	7.37	7.41	8.5	8.41	8.62	7.41		

P = Panelists

Analysis of variance

Source of variance	DF	SS	M	F
Sample	7	17.78	2.54	50.8*
Panelists	7	0.61	o.087	1.74 * *
Error	49	2.49	0.05	
Total	63	20.88		

Se = 0.079

*Significant at 1 % level

* * Not significant either at 5 or 1 % level

Duncan's multiple range test revealed that samples 5.6 and 7 are better and significantly different from samples 1.2.3.4, and 8. No significant difference was found among samples 5,6 and 7. Similarly no significant difference was found among samples 1.2,3,4, and 8.

Table 3. Effect of storage on the keeping quality of laboratory processed shrimp (treated products).

Storage time (months)	Sample number	Moisture (g/100 g)	Rehydration (%)	Total volatile bases (TVB) (mg/100/g)	Trimethy-lanime nitrogen (TMA-N mg/ 100 g)	Ammonia	Total Plate count (per g)	Remarks
0	1 T_1	13.0	98.0	45.0	8.4	9.72	$4.1x10^4$	Pink and glossy attractive
	2 T_2	11.8	88.3	42.5	8.6	6.38	$5.2x10^4$	colour; almost odour less;
	3 T_3	12.5	97.2	47.0	8.4	11.72	$4.8x10_4$	Excellent texture.
	4 B	13.0	89.0	42.5	9.2	3.86	$6.3x10^4$	
1	1 T_1	12.7	98.0	45.0	8.9	7.62	$1.2x10^5$	No apparent changes
	2 T_2	11.1	90.0	46.5	9.2	9.62	$1.8x10^5$	after 1-month storage.
	3 T_3	12.5	92.0	47.5	8.6	18.4	$2.6x10^5$	
	4 B	12.9	83.0	44.5	9.6	18.56	$5x10^5$	
2	1 T_1	12.5	88.5	50.4	10.5	6.3	$5.2x10^5$	Pink in colour; very
	2 T_2	11.5	83.3	48.8	11.5	0.5	$5.6x10^5$	attractive; no objection
	3 T_3	12.4	86.0	49.4	10.3	6.14	$6.2x10^5$	able odour; excellent
	4 B	12.5	79.0	50.58	10.2	7.74	$1.2x10^6$	texture.
3	1 T_1	11.8	81.4	50.8	11.5	2.5	$4.8x10^5$	No apparent difference
	2 T_2	11.2	87.1	47.7	12.5	0.5	$4.9x10^5$	between 2 and 3 months
	3 T_3	12.0	82.6	59.5	9.5	19.6	$6.3x10^5$	storage.
	4 B	11.4	69.9	54.6	14.5	6.30	$6.8x10^6$	
5	1 T_1	11.5	81.0	55.8	12.5	3.3	$5.6x10^5$	Very slight fading of
	2 T_2	10.5	80.5	49.5	11.9	0.48	$5.6x10^5$	colour; very slight
	3 T_3	11.3	78.3	61.3	9.3	24.1	$7.1x10^5$	fishy smell; texture good.
	4 B	10.0	62.5	65.8	14.3	5.8	$6.2x10^6$	
7	1 T_1	11.0	82.0	65.2	18.8	13.76	$1.2x10^6$	Slight fading of colour;
	2 T_2	9.9	80.0	63.8	12.9	9.62	$5.4x10^5$	slight fishy smell; texture
	3 T_3	10.0	77.1	62.5	10.5	18.4	$5.7x10^5$	good; still acceptable.
	4 B	10.5	67.1	75.5	22.4	18.56	$7.1x10^6$	

T_1 = Ascorbic acid (0.2 %) + potassium sorbate (0.3 %) T_2 = Ascorbic acid (0.2 %) + sodium benzoate (0.2 %)
T_3 = Potassium metabisulphite (0.5 %) + citric acid (0.5 %). %) B = Control blanched.

Table 4. Effect of storage on the keeping quality of commercially processed shrimp (market products).

Storage time (months)	Sample number	Moisture (g/100 g)	Rehydration (%)	Total volatile bases (TVB) (mg/100/g)	Trimethylanime nitrogen (TMA-N mg/ 100 g)	Ammonia	Total plate count (per g)	Remarks
0	1	27.07	178.0	168.0	3.8	15.28	$8.6x10^6$	Dark in colour; ammoni-
	2	30.0	68.0	170.0	4.8	14.92	$7.2x10^6$	cal odour; elastic and

(Continued. . . . .)

(Table 4, continued)

	3	17.5	83.3	282.0	6.0	25.68	$8.2x10^6$	rubbery; acceptable.
	4	11.3	83.0	141.0	4.5	12.72	$9.1x10^7$	
	5	9.3	87.0	112.0	3.6	19.28	$7.6x10^5$	
1.	1	24.5	76.5	215.0	4.3	19.66	$1.8x10^8$	Darker ammonical and
	2	27.9	69.0	210.0	5.9	18.52	$1.2x10^8$	fishy odour tough and
	3	17.1	79.0	214.0	6.6	18.98	$9.2x10^8$	papery when rehydrated.
	4.	10.7	82.0	222.3	5.3	20.21	$9.1x10^8$	acceptable.
	5	9.2	87.0	130.0	4.6	18.78	$2.8x10^7$	
2	1	24.5	67.0	270.0	4.3	18.26	$3.4x10^9$	Very unattractive colour,
	2	26.7	69.0	243.5	5.1	19.42	$4.2x10^9$	strong ammonical and
	3	16.3	71.0	263.0	6.9	25.86	$8.2x10^6$	fishy odour; dry woody
	4	10.3	81.05	264.0	6.5	22.38	$1.0x10^8$	when rehydrated;
	5	8.8	86.0	140.0	5.1	19.56	$7.8x10^8$	borderline.
3.	1	24.5	65.5	428.5	5.4	26.58	–	Further darkening in
	2	26.6	66.0	414.0	5.6	29.32	–	colour; very strong
	3	16.3	71.5	411.0	6.9	28.58	–	ammoniacal and fishy
	4	10.3	78.0	334.0	6.7	26.32	–	odour; slimy to touch;
	5	8.8	79.3	178.1	5.8	22.46	–	Spoiled; unacceptable.

preservatives, dried shrimps may be stored upto 7 months retaining acceptable quality and upto 3 months without any change in prime quality.

Biede *et al* [10] stored sun-dried shrimp from Taiwan and Louisiana at 22^{O} for 8 months in the modified atmosphere of air or vacuum. Similar to the findings of this study, total volatile nitrogen and ammonia increased during the storage period, with samples stored in air showing the greatest increase.

Table 4 shows comparative changes in commercially processed samples. Commercially processed samples were considered unacceptable after 3 months' storage and the experiment was discontinued. All the samples become unattractive, dark in colour having strong ammoniacal smell and were slimy to touch. When purchased, these products though acceptable were dark in colour with strong odours. Moisture in the products varied between 9.34 and 30.0 %. Similar to the laboratory processed samples, moisture level decreased continuoualy during storage and found to vary between 8.8 % and 26.6 % at the end of three months. This product had a relatively less rehydration capacity as compared with the laboratory processed samples. The rehydration capacity varied between 88. 3 and 89 % in laboratory processed samples which decreased to 67 and 82 % at the end of 7 months' storage. The corresponding values for commercially processed product varied between 68 to 87 % at the start of the storage and decreased to 65.5 and 79.3 % at end of 3 months' storage. Total volatile bases (TVB) level was significantly higher in commercially processed samples ($P < 0.01$) throughout the the storage period. Similar to TVB, levels of TMA-N, NH_3 and APC were significantly higher in the commercially processed samples if compared laboratory processed samples at the same storage period.

The results of this study have shown that the laboratory processing of shrimp can have a significant influence upon the composition of sun-dried shrimp. The results have demonstrated an improvement in the quality of treated sun-dried shrimps as compared to untreated commercially processed samples. Treatment with the combinations: (a) ascorbic acid + potassium sorbate, (b) ascorbic acid + sodium benzoate and (c) potassium metabisulphite + citric acid is equally effective in the extension of the storage life of dried shrimp at room temperature.

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