EFFECT OF ASCORBIC ACID ON KEEPING QUALITY OF FROZEN OYSTERS

By S. R. Pottinger*

ABSTRACT

SHUCKED OYSTERS WERE TREATED WITH ASCORBIC ACID IN AN ATTEMPT TO PREVENT OR RETARD DARKENING AND OTHER UNDESIRABLE CHANGES DURING FROZEN STORAGE. ON THE BASIS OF ORGANOLEPTIC TESTS, CHANGES IN THE FROZEN OYSTERS TREATED WITH ASCORBIC ACID WERE NOT APPRECIABLY RETARDED IN COMPARISON WITH UNTREATED FROZEN OYSTERS USED AS CONTROLS.

INTRODUCTION

Packers and distributors have from time to time encountered difficulties due to color changes in frozen oysters. These changes are variously described as "darkening," "discoloration," or "browning," and occur during frozen storage. This darkening was also noticed in past studies of frozen oysters by the U. S. Fish and Wildlife Service.

The cause of these changes in color in oysters is not definitely known. It is known, however, that enzymatic action will cause undesirable changes in the odor and flavor of frozen fish and under certain conditions, will also cause color changes on the surface of the fish. Possibly a similar reaction occurs in frozen oysters.

Earlier work (Bauernfeind, et al, 1948; Tarr, 1946 and 1948) indicated that ascorbic acid is a practical antioxidant in retarding discoloration and undesirable flavor changes during freezing and frozen storage of certain types of fish. In similar work with oysters, conflicting results have been reported as to whether ascorbic acid is effective in maintaining quality and retarding the darkening of oysters during frozen storage.

In order to investigate further the effectiveness of this antioxidant in this respect, a series of tests with frozen oysters were made at the Service's College Park, Maryland, laboratory. Prior to beginning the tests, discussions were held with representatives of manufacturers of ascorbic acid in order to benefit from their experience with previous work along these lines. The concentrations of ascorbic acid used in these tests and the method of incorporating it with the oysters are based on the information obtained through these discussions.

PREPARATION OF SAMPLES

Freshly prepared, commercially shucked oysters were obtained from an oyster-packing house in the Chesapeake Bay area and brought, well packed in crushed ice, to the College Park laboratory. They were divided into eight groups for preparation prior to final freezing and storage.

The samples were prepared as follows:

GROUP A: THE FRESH SHUCKED OYSTERS WERE DIPPED IN ONE-PERCENT ASCORBIC ACID SOLUTION (ONE POUND OF OYSTERS IN ONE QUART OF SOLUTION) FOR ONE MINUTE, AND THEN DRAINED FOR ONE MINUTE ON A LABORATORY-SIZE SKIMMING TABLE.

* TECHNOLOGIST, FISHERY TECHNOLOGICAL LABORATORY, BRANCH OF COMMERCIAL FISHERIES, U. S. FISH AND WILDLIFE SERVICE, COLLEGE PARK, MARYLAND.

GROUPS B-1, B-2, AND B-3: ASCORBIC ACID WAS ADDED DIRECTLY TO THE FRESH SHUCKED OYSTER MEATS. THE MATERIAL WAS FIRST DISSOLVED IN A SMALL QUANTITY OF WATER AND THEN THOROUGHLY MIXED WITH THE OYSTERS. THE OYSTERS IN GROUP B-1 CONTAINED 100 MILLIGRAMS OF ASCORBIC ACID PER POUND OF OYSTER MEATS; THOSE IN GROUP B-2 CONTAINED 200 MILLIGRAMS PER POUND; AND THOSE IN GROUP B-3 CONTAINED 300 MILLIGRAMS PER POUND.

GROUP B-4: CITRIC ACID WAS ADDED DIRECTLY TO THE OYSTERS IN THE SAME MANNER AS IN GROUPS B-1, B-2, AND B-3 IN A CONTENTRATION OF 300 MILLIGRAMS PER POUND OF OYSTER MEATS.

GROUPS C-1 AND C-2: THE OYSTERS WERE FIRST FROZEN IN ONE POUND BLOCKS IN A MOLD AND THEN GLAZED. THE BLOCKS OF OYSTERS IN GROUP C-1 WERE GLAZED IN PLAIN WATER; THOSE IN C-2 WERE GLAZED IN TWO-PERCENT ASCORBIC ACID SOLUTION.

GROUP D: THIS GROUP CONSISTED OF COMMERCIALLY SHUCKED FRESH OYSTERS WITH NO FURTHER TREATMENT.

The oysters in Groups A, B, and D were packaged in moisture-vaporproof cellophane bags, heat sealed, and then placed in waxed cartons. Those in Group C, after freezing in blocks, were glazed, wrapped in sheets of moisture-vaporproof cellophane, and packaged in waxed cartons.

All samples were frozen at a temperature of approximately -20° F. and were stored at 0° F. A sufficient number of samples were prepared to permit examinations at monthly intervals for a period of one year.

Sample B-4 was included for comparative purposes. Samples C-1 and D were used at the controls.

EXAMINATION OF SAMPLES

At intervals, the samples were removed from storage and were allowed to thaw at room temperature. The general appearance of the oysters was noted and palatability tests with the raw oysters were made by a panel of 3 or 4 members of the laboratory staff. Scores were based on appearance, flavor, and texture of the product. A sample receiving a weighted score below 85 was considered unacceptable. It was not possible to have the same taste panel after the sixth month's test. To what extent this affected the scores after this time is, of course, not known.

Determinations of pH of the oyster liquor were made initially, and at intervals of several months during frozen storage. A Beckman pH meter, Laboratory Model G, was used for making these determinations.

RESULTS

The average palatability scores for the oysters are given in table 1. Although considerable variation in scores occurred from month to month, due possibly to differences in individual oysters within the pack and to the change in the taste panel, no one group receiving a particular treatment has consistently stood out as being superior or inferior. The final scores, after the oysters had been held in storage for nearly a year, were with one exception (B-4) indicative of an acceptable product. However, this one exception was very close to attaining an acceptable score. No off-flavors due to addition of ascorbic or citric acids were reported by the judges.

The average scores for appearance of the oysters are given in table 2. Practically no differences in the appearance of the oysters were noticeable through the sixth month of storage. After that time, slight changes in appearance occurred but there was no definite indication that the ascorbic acid had an appreciable effect in preventing discoloration of the oysters. Some darkening occurred in all groups.

Table 1 - Palatability Scores for Oysters Stored at 0° F.

Samples Of Oysters			Average Palatability Score[1]								
			Storage Period in Months								
Group Number	Treatment	Packaging	1½	2½	3½	4½	6	8	9	10	11½
A	Dipped in 1 percent ascorbic acid solution for 1 minute	MVP[2]-cellophane bag, heat-sealed, in waxed carton	91	87	94	90	90	88	86	84	88
B-1	100 mg. ascorbic acid per pound	MVP[2]- cellophane bag, heat-sealed, in waxed carton	93	92	93	90	85	85	92	84	89
B-2	200 mg. ascorbic acid per pound	do	-	-	92	92	-	-	-	85	87
B-3	300 mg. ascorbic acid per pound	do	90	88	91	90	90	-	-	86	88
B-4	300 mg. citric acid per pound	do	92	-	93	95	93	-	82	83	84
C-1	Frozen in 1-lb. blocks, glazed with water	Frozen blocks wrapped in MVP[2]-cellophane sheets, in waxed carton	89	92	91	92	88	83	80	73	86
C-2	Frozen in 1-lb. blocks, glazed in 2 percent ascorbic acid solution	do	93	-	86	95	93	-	-	81	86
D	None	MVP[2]-cellophane bag, heat-sealed, in waxed carton	89	90	92	90	85	84	83	90	85

1/THE PALATABILITY SCORE WAS CALCULATED AS FOLLOWS: THE SAMPLE WAS SCORED ON THE BASIS OF 1 TO 10 POINTS EACH FOR APPEARANCE, FLAVOR, AND TEXTURE. THE FLAVOR SCORE WAS DOUBLED IN ORDER TO GIVE ADDITIONAL WEIGHT TO THIS FACTOR. THE MEAN AS A PERCENT OF THESE SCORES RESULTED IN THE PALATABILITY SCORE. A SAMPLE WITH A SCORE BELOW 85 WAS CONSIDERED UNACCEPTABLE.
2/MVP--MOISTURE-VAPORPROOF.

The low scores shown for group C-1 for the ninth month and tenth month of storage were due in part to desiccation of some of the oysters in these samples.

The pH values of the liquor from the various groups are given in table 3. The addition of ascorbic acid or citric acid to the oysters caused a drop in initial pH value, with the exception of group C-2. Groups A and B-4 showed further slight drops in pH upon subsequent storage at 0° F. Changes in pH during storage in the other six groups were considered insignificant

Table 2 - Appearance Scores for Oysters Stored at 0° F.

Sample Group Number	Average Appearance Score[1] Storage Period in Months								
	1½	2½	3½	4½	6	8	9	10	11½
A	9	9	9	9	9	9	8	8	9
B-1	9	9	9	9	9	9	9	9	8
B-2	-	-	9	9	-	-	-	9	8
B-3	9	9	9	9	9	-	-	8	8
B-4	10	-	9	9	9	-	8	8	8
C-1	9	9	9	9	9	8	7	7	8
C-2	9	-	9	9	9	-	-	8	8
D	9	9	9	9	9	9	9	8	8

1/THE HIGHEST POSSIBLE SCORE IS 10.

Table 3 - pH of the Liquor of Oysters Stored at 0° F.

Sample Group Number	pH of Oyster Liquor		
	Initial[1]	After 3½ months' storage of oysters	After 11½ months' storage of oysters
A	6.10	6.08	5.99
B-1	6.44	6.45	6.44
B-2	6.38	6.36	6.32
B-3	6.30	6.30	6.23
B-4	6.12	6.08	5.90
C-1	6.50[2]	6.50	6.47
C-2	6.50[2]	6.48	6.50
D	6.50	6.50	6.50

1/PRIOR TO FREEZING.
2/AFTER FREEZING, BUT PRIOR TO GLAZING.

CONCLUSION

Under the conditions of these tests, the addition of ascorbic acid to shucked oysters did not prevent or appreciably retard darkening or other quality changes in the oysters during frozen storage at 0° F.

LITERATURE CITED

BAUERNFEIND, J. C.; SMITH, E. G.; BATCHER, OLIVE; AND SIEMERS, G. F.
1948. RETARDATION OF RANCIDITY IN FROZEN FISH BY ASCORBIC ACID. QUICK FROZEN FOODS, VOL. 10, NO. 8, PP. 139-142; VOL. 10, NO. 9, PP. 68-70, 72.

TARR, H. L. A.
1946. CONTROL OF RANCIDITY IN STORED FISH III. PROG. REPT. PAC. COAST STA. FISH RES. BD. CAN., NO. 68, PP. 52-54.

1948. CONTROL OF RANCIDITY IN FISH FLESH II. PHYSICAL AND CHEMICAL METHODS. J. FISH. RES. BD. CAN., VOL. 7, PP. 237-247.

TECHNOLOGICAL SECTION

Branch of Commercial Fisheries, U. S. Fish and Wildlife Service
Department of the Interior

Washington, D. C.

Name	Title	Room Number	Telephone
Harold E. Crowther	Chief, Technological Section	3350	Republic 1820
Frank T. Piskur	Asst. Chief, " "	3352	Ext. 4745

Field Activities

Fishery Refrigeration

Name	Title	Address	Telephone
James M. Lemon	Technologist	Fishery Technological Laboratory P. O. Box 128 College Park, Md.	Warfield 5800

Laboratories

Location	Address	In Charge	Telephone
East Boston 28, Mass.	Fishery Technological Laboratory 61 Sumner Street	Joseph F. Puncochar, Chief, North Atlantic Technological Research	East Boston 7-4307
College Park, Md.	Fishery Technological Laboratory P. O. Box 128	H. W. Nilson, Pharmacologist, In Charge	Warfield 5800
Ketchikan, Alaska	Fishery Products Laboratory Box 647	John A. Dassow, Chief	540
Seattle 2, Wash.	Fishery Technological Laboratory 2725 Montlake Boulevard	Maurice E. Stansby, Chief, Pacific Coast & Alaska Technological Research	East 0586