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RESULTS OF SOME TESTS WITH FROZEN OYSTERS^{1/}

By S. R. Pottinger*

INTRODUCTION

Freezing of oysters should offer wide opportunities for expanding the market for these shellfish. Although oysters are highly perishable and are generally produced in quantity only during the colder months of the year, only a relatively small proportion of the total production is frozen. While marked improvements have been made in refrigerated transportation of foods, there are still definite limitations to the areas over which fresh or unfrozen oysters may be readily distributed. Retail outlets for frozen foods are being constantly expanded and there has been a tremendous increase in the use of home freezers and frozen food lockers. This expansion in storage facilities offers opportunities for frozen oysters to reach not only the more distant areas but to become part of the stock of frozen foods maintained in the home freezer and the locker plant.



A number of inquiries have been received by the U.S. Fish and Wildlife Service in regard to methods of preparing oysters for freezing, the proper packaging required for extended periods of frozen storage, and other factors having a bearing on the quality of the frozen product. To have this information available, a series of studies with packaged frozen fishery products, including oysters, was made at the Service's Technological Laboratory in College Park, Maryland. Although studies were not as extensive as desired, they have served to give some insight into the characteristics of packaging materials and techniques of freezing.

TEST PROCEDURES

Freshly-shucked Chesapeake Bay oysters, prepared in the usual commercial manner and obtained from a shucking house, were used in the tests. A sufficient number of test packages were prepared to permit periodic examinations of the oysters for quality and of the packages for indications of brittleness and other faults during a year's storage period. The packaged oysters were frozen at approximately -30° F. and held in storage at 0° F.

At monthly intervals, one of each type of package was removed from storage and the appearance of the frozen oysters was noted, particularly with reference to desiccation or "freezer-burn." After defrosting, the quantity and pH of the free liquor were determined. Organoleptic tests for appearance, flavor, and texture of the oysters were made by a panel of impartial judges. All of the packages were weighed once a month in order to determine any loss of moisture, since moisture retention in the product is of primary importance in maintaining the quality of any frozen food.

* FISHERY PRODUCTS TECHNOLOGIST, BRANCH OF COMMERCIAL FISHERIES, U.S. FISH AND WILDLIFE SERVICE, BOSTON, MASSACHUSETTS.

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WEIGHT LOSS

Frozen foods must be stored at a low temperature in order to maintain quality and keep undesirable changes at a minimum. A temperature of 0° F. or lower is recommended for extended periods of storage. Low temperatures such as these, however, cause rapid desiccation or drying out of foods which are exposed unprotected to the dry air of the cold storage room. In order to prevent this drying, much care should be given to the selection and application of a proper covering for the food. Such covering must not allow the moisture to escape from the covered product into the surrounding air—in other words, it must be moisture-vaporproof (a term which is used to designate the proper type of covering to be used in frozen-food packaging).

A wide variety of packages and packaging materials were tested, some of which were satisfactory, while others were not. The average loss in weight, or moisture, of the frozen product packed in the better types of packaging materials amounted to only a few tenths of one percent. This is considered a negligible loss and would not affect the appearance of the frozen product as far as desiccation is concerned.



With the bag-in-box type of container, comparable results for retention of moisture-vapor were obtained, whether the bags were made of cellophane, laminated cellophane and paper, specially coated paper, pliofilm, or polyethylene. The use of an overwrap on these packages made no appreciable difference in preventing weight loss. Some types of rectangular containers are often used without an inner bag. With this type of container, however, a good quality overwrap was found to be very necessary for retaining moisture within the package.

Only negligible differences in weight losses were found between cartons containing single cellophane bags and those with duplex or double bags. Cylindrical containers were generally unsatisfactory due to extreme desiccation on the top surface of the oysters in the head space within the container.

pH AND FRESHNESS

The change in pH of oyster liquor as freshness decreases has proven to be a useful index of the degree of freshness of fresh oysters. This measurement was made at monthly intervals on the liquor from the frozen oysters, after thawing. There was, in general, a decided drop in pH of the oysters after a short period of storage. The pH values then remained relatively constant at about 6.2 for the remainder of the storage period of one year. It is not clear from these tests whether pH measurements are of value in indicating the state of freshness of oysters that have been held in a frozen condition. It would appear, however, that the values do not change enough to be of much use as an index of freshness for frozen oysters.

On the basis of organoleptic scores, the quality of the frozen oysters was about the same in the various types of packages which provided good moisture-vapor retention. Slight darkening of the oysters occurred during storage, regardless of the type of container used. The oyster meats became somewhat flabby as the storage period increased and some change in flavor was also noticeable.

FREE LIQUOR

The average quantity of free liquor which formed upon thawing the oysters was quite variable during the entire storage period and showed no particular relationship to the time the oysters were held in storage. The values often exceeded 20 percent. However, and 10 to 15 percent of free liquor was quite common. The oysters were, of course, very "watery" under these conditions.

Further tests were made in an attempt to find what might influence the amount of free liquor which forms when frozen oysters are thawed. It was believed that the methods used in preparing the shucked oysters before freezing might be a factor. Tests were made on this basis.

Samples of oysters, all from the same plant and same lot of shell stock, were prepared under the following conditions: blown in fresh water for 3, 15, and 30 minutes; blown in 0.75 percent salt water for 3, 15, and 30 minutes; not blown but sprayed with fresh water; and those prepared commercially at a shucking house. All lots were packaged, frozen at about -30° F., and stored at 0° F. under identical conditions. Examinations were made at monthly intervals, and included palatability tests, quantity of free liquor upon thawing, and pH value of the liquor.

Upon thawing the oysters, considerably more liquor was obtained from those blown in fresh water for 15 and 30 minutes than for those blown only 3 minutes. Those blown in the weak salt solution, whether for 3, 15, or 30 minutes, released about equal quantities of free liquor upon thawing, which in each instance was considerably less than that obtained from the oysters that were blown in fresh water for only 3 minutes. The quantity of liquor from the oysters that were not blown at all was about the same as that obtained from the three lots blown in the salt water. In contrast, the oysters prepared commercially released much more free liquor than did any of the other lots.

On the basis of palatability scores and pH values, all lots were of about equal quality at the end of one year of storage.

FRESHNESS IMPORTANT

It is very important that foods be strictly fresh at the time of freezing. The quality of foods is not improved by freezing and storage, but on the contrary, some undesirable changes will occur. If the quality is poor at the time of freezing, it will be poorer after the product is thawed out.

It was shown during the course of these tests that oysters, just as any other foods, must be strictly fresh at the time of freezing if a reasonable storage life is to be expected. Fresh oysters from the lot used in some of the other tests were held in friction-top oyster cans packed in crushed ice. When the quality of the oysters were considered to be nearing the lower limit of freshness, though still edible and salable, they were packaged, frozen, and stored at 0° F. with the other samples of oysters.

After only one month of storage this lot of oysters had a very stale odor when thawed and was considered by the taste panel to be inedible. The oysters that were strictly fresh when frozen were still quite satisfactory and remained so for a number of months. This test indicates the necessity of using only very fresh oysters for freezing.

ASCORBIC ACID TESTS

As mentioned before, frozen oysters darkened somewhat as the storage period progressed. Just why this occurred is not known, but going on the assumption that the darkening might be due to oxidation and that ascorbic acid might retard an oxidative change in oysters as it does in certain other frozen foods, a series of samples were prepared in which ascorbic acid was incorporated in varying concentrations up to 300 mg. per pound of oysters. Moisture-vaporproof packaging was used and the samples were stored at the temperature used in the other tests, namely 0° F.

No appreciable differences in quality of the treated oysters as compared to those containing no ascorbic acid were noticeable during a storage period of approximately one year. The degree of darkening in both lots was substantially the same, indicating that no protective action in this respect was provided by the ascorbic acid under the conditions of these tests.

PINK YEAST

In some of the freezing tests with oysters, several of the lots stored at 0° F. for only one month showed, while being thawed, a localized pink to red discoloration of the oyster liquor. Thorough mixing of the oysters and liquor imparted a pink color to the liquor similar to that produced by "pink yeast" in unfrozen oysters. There were no signs of this discoloration at the time the oysters were packaged and placed in the freezer. Though the "pink yeast" organism was suspected of causing the discoloration, studies made with it in the past have indicated that its activity is inhibited at about the temperature of melting ice or 32° F. Further bacteriological examinations confirmed, however, that "pink yeast" organisms were present in the discolored liquor from the frozen oysters and also, that "pink yeast" is capable of growing at a temperature of 0° F. and lower. From these findings, the need for maintaining strict cleanliness in the production of shucked oysters, whether fresh or frozen, is more obvious than ever.

SELECTION OF PACKAGE

When planning to go into the commercial production of frozen oysters, careful consideration should be given to the selection of the package. The package plays a very important role in protecting and merchandising the product. Only too often it is found that a poorly-designed or makeshift container is expected to do a job which it is entirely incapable of performing.

The proper package for frozen foods must perform a number of functions. It must, of course, possess enough rigidity to provide support for the contents during filling and handling before freezing. It should be watertight in order to prevent leakage of the contents and unsightly discoloration of the package. It must be of a type to permit easy filling and handling, yet possess the necessary toughness to prevent physical damage to the contents and to withstand the rough treatment to which it might be subjected during distribution to market. It must provide protection against moisture-vapor loss and desiccation of the contents over long periods of holding in the dry atmosphere of a frozen-storage room. In addition to its functional properties, it should be attractively printed, have a clean appearance, and have merchandising appeal, all of which are important to consumer acceptance. The details in the designing of such a package can be adequately taken care of by reputable package manufacturers.

It might be well, however, to offer a few suggestions to the prospective purchaser of packages for frozen oysters. The requirements of the individual producer together with the degree of handling by hand prior to freezing, particularly in the

smaller plants, determine to a large extent the type of package that will be selected. It must be remembered that shucked oysters are a comparatively "wet" product, that is, they contain a certain amount of liquid, which must be considered in the selection of a package. If the packaging is done largely by hand, a completely water-tight container, such as a sealed moisture-vaporproof bag within a waxed carton, is desirable. A package of this type may be turned at any angle before freezing without having the contents spill. The carton may be overwrapped, if desired.

Cartons of the type which do not contain bags but rely on a moisture-vaporproof liner or coating to retain the moisture should be overwrapped. When used for a product, such as oysters, automatic machine wrapping is to be preferred, as difficulty due to spilling of the contents would undoubtedly be encountered in applying an overwrap by hand. Cartons of this type are used more generally in the more specialized types of freezing equipment.

An overwrap for most types of cartons provides added protection against leakage and against normal wear and tear which is to be expected during distribution. It also serves as an excellent medium for attractive labelling and eye-catching color combinations being used so extensively on frozen food packages today.

SUMMARY

The following suggestions are offered in the freezing of oysters:

1. FREEZE ONLY STRICTLY FRESH, HIGH-QUALITY OYSTERS. OYSTERS OF POOR QUALITY DETERIORATE VERY RAPIDLY IN FROZEN STORAGE.
2. SUBJECT OYSTERS TO A MINIMUM OF WASHING AND BLOWING IN FRESH WATER (0.75 PERCENT SALT WATER IS BETTER) DURING THE CLEANING PROCESS. THIS REDUCES THE QUANTITY OF FREE LIQUOR WHICH FORMS WHEN THE OYSTERS ARE THAWED. DRAIN OYSTERS THOROUGHLY PRIOR TO PACKAGING.
3. USE A WATERTIGHT, MOISTURE-VAPORPROOF, ATTRACTIVELY DESIGNED PACKAGE, PREFERABLY OF THE RECTANGULAR TYPE.
4. WHEN FILLING AND CLOSING THE PACKAGE, LEAVE ONLY ENOUGH HEAD SPACE TO ALLOW FOR EXPANSION OF THE OYSTERS DURING FREEZING. EXCESSIVE AIR SPACE IN THE PACKAGE WILL LEAD TO LOCALIZED "FREEZER-BURN" AND DISCOLORATION OF THE OYSTERS. SEAL TIGHTLY TO PREVENT LEAKAGE OF CONTENTS AND LOSS OF MOISTURE-VAPOR.
5. FREEZE IMMEDIATELY AT A LOW TEMPERATURE, ABOUT -20° F. OR LOWER.
6. STORE AT 0° F. OR LOWER IN ORDER TO OBTAIN A REASONABLE STORAGE LIFE.
7. THOROUGH CLEANLINESS AND STRICT SANITARY MEASURES MUST BE ADOPTED IN ALL PHASES OF THE PLANT OPERATION FOR THE PRODUCTION OF A QUALITY PRODUCT.

