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# APPLICATION OF STEAMING AND VACUUM TO SHUCKING AND CLEANING SCALLOPS

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SUMMARY

A new method has been devised for shucking scallops and removing the viscera from the muscle by application of heat and vacuum. Heating one shell of the scallop for approximately 20 seconds loosens that shell and releases the remaining portion of the scallop. The viscera are then removed by applying a vacuum, and the muscle is loosened from the remaining shell with a second application of heat and then is chilled in ice water, drained, packaged, and frozen. The viscera, drawn into a trap tank in the vacuum line, can be digested, concentrated, and marketed as solubles or meal supplements. The shells can be sold either whole or ground.

Commercial application of the processes involved is outlined and discussed.

## INTRODUCTION

In recent years, a number of large beds of calico scallops (Pecten gibbus) have been found along the southeastern and Gulf coasts of the United States. One of these beds, discovered by the U. S. Bureau of Commercial Fisheries exploratory trawler Silver Bay off Cape Canaveral, Fla., has aroused much commercial interest.

Fig. 1 - Shucking scallops from new Florida bed requires concentrated effort of crew of motor vessel Silver Bay, U. S. Bureau of Commercial Fisheries research trawler which made find. The shells are easy to open, but real know-how is needed to quickly separate viscera from meat by hand.

Among the difficulties in establishing a fishery for these scallops is the high cost of hand shucking and cleaning. Several methods for mechanical shucking therefore have been considered, and one method has been tested successfully in a pilot plant. The successful method utilizes two principles: heat and vacuum. Development of the method arose from the belief that (1) if one shell of the scallop were heated briefly, in near-boiling water, the edible muscle (also known as the meat or eye) might pull loose from that shell and (2) if a vacuum were applied to the viscera surrounding the muscle,

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the viscera might be removed, leaving the clean muscle attached to the remaining shell. The shell could then be separated by a second application of heat, freeing the edible product.

This paper presents the results of experiments designed to test these beliefs and discusses the results and their application to commercial practice. Also included is a discussion of the handling of the byproducts--viscera and shell.

## EXPERIMENTAL SHUCKING

PROCEDURE: The scallops were placed by hand in a flat, shallow pan, where they were held for 20 minutes in sufficient boiling water (approximately $\frac{3}{4}$ of an inch) to cover the lower shell. The heated shell was then removed, and the scallops were placed in front of an operator who vacuumed the viscera from the muscle with a 1-inch-diameter flexible hose attached to a 2-cylinder high-vacuum pump powered by a $7\frac{1}{2}$-horsepower electric motor. Approximately 22 inches of vacuum was used. The remaining shell, still containing the muscle, was next placed in boiling water for 15 to 20 seconds. The shell and muscle were then separated, the muscle being flipped into an ice-water bath. After a few minutes of chilling, the accumulated muscles were quickly drained, packaged, and frozen.

Fig. 2 - Removing the scallop viscera by vacuum. Operator is applying vacuum to the scallop half shell. The viscera will be sucked into the hose and pulled into the cylindrical viscera trap tank. The hose leading from the other side of the trap tank is connected to the vacuum line.

RESULTS: Heating the scallops for 20 seconds in $\frac{3}{4}$ of an inch of boiling or near-boiling water effectively loosened the shell exposed to the water so that it was easily removed from the muscle by hand. Covering both shells with hot water, or applying excessive amounts of heat, loosened both shells and made vacuum removal of the viscera impossible. Even moderate exposure to heat, beyond the 20-second interval, or in water of too great a depth, loosened the top shell-muscle connection so that the muscle pulled off with the viscera and was lost in the vacuum-line trap tank. Slight variations of steaming time therefore were necessary, owing to variations in the size of the scallops, the temperature of the shell, and the time that had elapsed since the scallops were caught.

## SIMULATED COMMERCIAL SHUCKING

PROCEDURE: After experimentation proved that the principles involved in the new method were correct, the next step was to determine the economic feasibility of the method. Accordingly, a series of tests was conducted to obtain figures for time consumed and yield obtained for both hand and vacuum operations so that these operations could be compared. Since facilities for rapidly heating large quantities of scallops were not available, that part of the process dependent on heat was handled manually by a shucker who removed one shell and passed the other shell with the adherent muscle and viscera to a vacuum-hose operator. A third man completed the shucking by cutting out the muscle after removal of the viscera. As a control, an expert hand shucker worked on 1-bushel samples.

RESULTS: The following results were obtained:

1. The hand shucker averaged about 0.8 of a bushel per hour.

2. The yield from hand shucking averaged 4.25 pints of muscles per bushel.

3. Viscera could be removed with a suction hose at rates varying from 4 to 5.3 bushels per hour.

4. Yield with the vacuum method was poor until the hose man gained experience. The first 8 bushels yielded an average of only 3.25 pints of muscles per bushel, and it was noted that a large number of muscles were being pulled into the tank trap. The subsequent 9 bushels yielded an average of 4.75 pints per bushel with loss of muscles down to less than 5 percent.

By use of the same method of hand shucking and vacuum cleaning, with teams of 4 and 7 men working on a mechanical line, the average shucking rate in both cases was 1 bushel per man per hour compared with 0.8 of a bushel per man per hour by hand--an increase of 20 percent. The men composing the teams were relatively inexperienced. Each team included one hose man. Yields should be somewhat higher when facilities for heating the scallops become available. In hand shucking, the muscle is cut loose, with a consequent loss of the muscle still attached to the shell, which loss ranges from 5 to 20 percent by weight. When heat is used, however, the muscle is completely detached.

## BYPRODUCT TREATMENT

Viscera from the trap tank underwent enzymatic digestion when held 3 to 4 hours at 130° to 140° F. The resulting soupy liquid could be evaporated to 50-percent solids or evaporated to dryness and mixed with cereals for animal feeds. Composition of the scallop muscles and viscera was determined by proximate analysis (table 1). Additional byproducts can be obtained from the shells, which may be ground for use in poultry feed or may be used whole as a filler in concrete products. Whole shells are currently selling (1960) at approximately 3 dollars per cubic yard on the Gulf Coast.

Table 1 - Proximate Composition of Scallop Viscera and Meats (Muscles)

| Sample | Protein | Oil | Ash | Moisture |
|---|---|---|---|---|
| | (Percent) | | | |
| Viscera | 9.7 | 2.5 | 83.1 | 4.7 |
| Viscera | 9.5 | 2.6 | 82.7 | 5.2 |
| Viscera | 9.5 | 2.7 | 82.6 | 5.2 |
| Edible Meats (Avg. of 2 samples) | 16.2 | 0.8 | 81.4 | 1.6 |

## OUTLINE OF A SUGGESTED COMMERCIAL-SCALE HEAT-VACUUM SHUCKING OPERATION

The new heat-vacuum method of shucking and cleaning scallops lends itself well to mechanization and commercial application. A suggested mechanized set up, designed around two link-chain belts, is visualized as follows:

1. The whole scallops are received on the first link chain belt, which has been provided with a raking bar or fingers so that the shells will lie flat and be spread in a single layer.

2. The shells are moved on the belt into a shallow tray of boiling (or near-boiling) water, where only the bottom valve is covered.

3. After the shells have been passed through the hot water for a sufficient interval (approximately 20 seconds), the belt runs to a rotary tumbler, where it dumps the shells.

4. The rotary tumbler should effectively separate the heated, empty shells from the shells containing the scallop meats.

5. A chain belt, leading from the tumbler, conveys the opened shells to a group of men handling vacuum viscera extractors.

6. After the viscera have been removed, the shells are placed on a second link chain belt and passed into a second hot water bath, where the second valve or shell is removed.

7. Meats (muscles) are then hand-packed or suctioned off the line to a wash bath prior to sorting, packing, and freezing.

8. The viscera, suctioned off earlier, fall into a trap tank attached to the vacuum line, where they are digested and concentrated to the desired percentage of moisture.

In view of the success of removal of viscera by vacuum, using a hand-held hose, it seems possible that further research will yield completely automatic removal of viscera, and the necessity of handling will be eliminated.

Collecting the viscera in a trap tank off the vacuum line facilitates utilization of the viscera in animal feeds. A trap tank of a size suitable for commercial operation could be used also as a container for digestion of viscera by merely adding a steam pipe to the bottom of the tank. The digested product could then be piped into dehydrators or blenders for further preparation.

PRODUCTS DERIVED FROM SCALLOPS