A Seafood Quality Program for the Mid-Atlantic Region Part IV

A Report

Mid-Atlantic Fisheries Development Foundation, Inc.

The Kroger Company

Sea Grant at Virginia Tech

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FINAL REPORT

on

A QUALITY SEAFOOD TESTING PROGRAM FOR THE MID-ATLANTIC REGION PART IV

by

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Executive Summary

Previous quality maintenance studies revealed several important needs that must be satisfied if quality fresh seafood is to be successfully marketed:

1) Processing plant quality control (assurance) personnel need training in proper plant sanitation practices and procedures.

2) Processing plant facilities must be improved so that fish can be produced with reduced surface microflora.

3) Alternative handling procedures and processing operations must be implemented which will maintain product quality from harvest through consumption.

4) Methodology of inspecting fish at dockside and after processing must be reliable and indicative of available shelf-life.

This present study was designed to investigate each of the above issues and make recommendations on how they can be successfully implemented in a comprehensive fresh fish processing operation.

Development and Implementation of an On-Site Hands-On Seafood Sanitation Program

This program was designed so that plant personnel can establish sanitation programs that will result in the continuous production of high quality fresh fish products. Course participants were required to: attend lectures on sanitation principles and procedures; participate in demonstration and laboratory sessions; clean a plant at the termination of processing operations; and evaluate the sanitary conditions of a host plant before and after cleaning operations. The participants were also trained on how to evaluate or score a plant according to guidelines established by the National Marine Fisheries Service.

Development, Evaluation, and Implementation of Alternative Processing Procedures to Achieve a Minumum 12-day Fresh Fish Shelf-life.

I) Dockside Grading

The objective of this study was to compare grading methods of Mid-Atlantic fish at dockside relative to the perceived quality and

shelf-life of the processed product. The specific dockside grading methods which were applied consisted of the following;

1. **U.S. Department of Commerce/National Marine Fisheries Service grading program.** Code of federal regulations title 50 subpart A - U.S. standards for grading of whole or dressed fish.

2. **Maine Department of Marine Resources Freshness Assurance Standards.** This method, which is a modification of the Torry Laboratory Grading Scale, monitors descriptive characteristics that are species specific and change over time.

3. **Canadian Grade Standard for Raw Atlantic Groundfish.** This method evaluates the fillet or flesh portion of the fish. Intrinsic characteristics of the whole fish (eyes, gills, etc.) are not examined.

4. **Bremner Method.** A demerit system which utilizes generalized quality scoring that is species-independent.

5. **Torrymeter Fish Freshness Meter.** Determines freshness by measuring dielectric properties of fish flesh.

From the microbiological and sensory analysis data it is apparent that Flounder lot # 2 was superior in quality to lot # 1 and that lot # 4 of Gray Sea Trout was superior in quality to lot # 3. The ability of the grading methods applied, to distinguish initial quality differences at dockside, varied with the species inspected.

The U.S. Department of Commerce/National Marine Fisheries Service standards were more selective in the grading of flounder than gray sea trout. While 100% of the sea trout in lots 3 and 4 were classified as grade A, 80% and 85% of the flounder in lots 1 and 2 made grade A classification. The remainder of the flounder were classified as grade B. The greater number of minor defects assigned to the flounder were mainly due to gill discoloration defects. 80% and 85% of the flounder in lots 1 and 2 had minor defects due to gill discoloration, compared to 10% and 22% (lots 3 and 4) of the sea trout. With this methodology however, differences in the overall grading of the lots, relative to quality and available shelf-life, were not discernable.

Inspection by the Maine Department of Marine Resources Freshness Assurance Standards provided numeric scores which were slightly greater for lot # 2 of flounder and lot # 4 of sea trout. However, only the difference between lots 1 and 2 of flounder was

statistically significant (ANOVA, Duncan's α = .05).

Application of the Canadian grade standards, for lot inspection, was the most critical method of assessing overall quality. Lot # 1 of flounder had 45% grade A, 50% grade B, and 5% grade C fish. In comparison lot # 2, which was determined to have a longer shelf-life, had 75% grade A and 25% grade B fish. In lot # 1, a significant number of B grades were assigned due to the presence of blood clots and bruising in the fillets. Since the other inspection methods graded whole fish and not fillets, these defects were not detected.

Inspection of gray sea trout, by the Canadian groundfish standards, also demonstrated significant differences in overall quality. Lot # 3 had 0% grade A, 40% grade B, and 60% grade C fish. Lot # 4, which had a longer shelf-life, consisted of 30% grade A fish, 10% grade B fish, and 60% grade C fish. It was apparent with this methodology, however, that the standard for assessing texture would have to be modified. All of the B and C grades were assigned because of the degree of gaping in the fillets. Gray sea trout is inherently a soft fleshed fish that is prone to gaping. The Canadian standards for texture specify that only up to 10% of the surface area can display gaping for grade A designation. Grade B fish are allowed 10% to 25% gaping and grade C fish are allowed 25% to 75%. If greater than 75% of the surface is gaping the fish is rejected. A modification of this scale, to allow a greater tolerance for gaping, would be necessary in this case.

Inspection by the Bremner demerit scoring system assigned slightly better quality scores to flounder lot # 2 and sea trout lot # 4 (these lots displayed a longer shelf-life). The differences were statistically significant (ANOVA, Duncan's α = .05). It may be possible, however, to reduce the variability by modifying the scoring system to be more specific for mid-Atlantic fish.

Analysis with the torrymeter was also variable. While the average scores were higher for lots 2 and 4, the difference was statistically significant only between lots 1 and 2 of flounder (ANOVA, Duncan's α = .05). There may not have been enough difference in the age of the fish for the torrymeter to further distinguish between the overall quality of the lots.

II) Extending the Shelf-life of Fresh Fish

Previous studies, conducted during parts I and II of the Quality Maintenance Program, have indicated that the fresh shelf-life of processed finfish can be effectively extended by reducing surface microflora. In this study, part IV, experiments continued with the following treatments.

1) High pressure wash.

2) High pressure washing with surfactants.
3) Bionox application.
4) Various combinations of high pressure washing with surfactants and Bionox application.

The data indicated that quality can be better maintained by high pressure washing whole fish, prior to filleting, rather than high pressure washing the fillets themselves. The physical appearance of the fillets, especially those from soft fleshed fish, is easily abused by high pressure spray.

A number of alternative treatments have been revealed. High pressure washing whole fish with 0.1% CPC and Bionox application were very successful in reducing the surface microflora. Dipping in CPC prior to high pressure washing with tap water was also effective. From this study the following treatment, for providing high quality fillets with low microbial counts, could be recommended.

1) Scale fish and rinse with tap water (especially important with large scaled fish).

2) High pressure wash with a 0.1% solution of CPC. As an option the fish could be dipped in CPC and then be high pressure washed with tap water.

3) Spray fish with Bionox (optional).

4) Fillet fish under sanitary conditions.

5) Spray the fillets with Bionox (optional).

III) Use of Sodium Bicarbonate in Absorbent Pads for Controlling Odors of Tray-packed seafood.

Research has continued on the effectiveness of sodium bicarbonate in controlling fish odors in tray-packed products. In previous studies (Quality Maintenance Program Part II) the processed fish were stored in jars and the headspace gas was evaluated for odor intensity. These studies indicated that the addition of sodium bicarbonate, to the absorbent pads, may be beneficial in reducing the intensity of odor. The addition of 5 grams of bicarbonate was slightly more effective than pads containing just 2 grams, while 1 gram had no noticeable effect. Since these results were not conclusive, the following study was performed, in which the fish were overwrapped as they would be for self-service retail sale. Three variables were evaluated; (1) control with a normal absorbent pad; (2) an absorbent pad containing 5 grams of bicarbonate; (3) a normal absorbent pad plus a tissue packet containing 5 grams of bicarbonate placed next to the fish. The bicarbonate was added externally in the third variable to determine if the practice of adding the bicarbonate

inside the absorbent pad (where it becomes wet and matted down under the weight of the fish) restricts odor absorption.

In two trials with tray-packed dressed croaker, one trial with dressed seatrout, and one trial with Spanish mackerel fillets, there were no consistent differences in the odor intensities of the three variables. From these experiments, it can be concluded, that if sodium bicarbonate does help reduce odors in tray-packed seafood, the reduction is not readily noticeable or statistically significant (ANOVA $\alpha = .05$) by subjective sensory analysis.

IV) USDC/NMFS Grade A Inspection

During part III of the Seafood Quality Program, considerable effort was applied to process mid-Atlantic fish capable of receiving grade A designation. A major obstacle, to fulfilling this goal, was the lack of specifications for many of the mid-Atlantic fish species. The standards that were applied are generic standards for grading whole or dressed fish (Appendix I) and fish fillets (Appendix VI).

All dressed fish (mackerel, whiting, porgy, sea bass, and croaker) failed to pass for grade A because of the gut cavity. It was required for grade A that all traces of the kidney be removed. Although this can be accomplished by slicing the membrane, brushing and washing, the task is too tedious and cost prohibitive on a production level. Larger fish could more easily be handled. Additional minor defects had been assigned for scales, cutting defects, and discolored belly flaps.

Fillets of mackerel, bluefish, and seatrout also failed grade A approval. These species could not pass the stringent specifications for generic white boneless fish fillets. Mackerel fillets failed because of the floating pin bones which run down the center. Our best chance of acquiring grade A was with the bluefish and seatrout fillets. Our efforts also failed here, however due to pin bones, or the quality of the cut. Seatrout fillets were particularly troublesome due to the soft nature of their flesh.

The purpose of this current study, was to reevaluate the inspection of processed mid-Atlantic fish by generic standards, which appear to be designed for north Atlantic fish species.

The following species and market forms of mid-Atlantic fish were sent to the USDC/NMFS Northeast Lot Inspection Office in Gloucester, MA.; dressed Atlantic croaker, dressed spot, skin-on Spanish mackerel fillets, skin-on flounder fillets, and skinless gray seatrout fillets. All fish were of excellent quality at the time of processing.

The dressed Atlantic croaker met grade A standards with zero defects, while dressed spot met grade A standards with a minor

defect assigned for discoloration of belly flaps.

From three lots of skin-on Spanish mackerel fillets, the first lot failed to meet grade A standards due to the presence of bones. An excessive defect was assigned because over four instances of bones were found in one sample unit. When the majority of the pin bones were removed, by making a deep "V" cut, a second lot of mackerel fillets did meet grade A standards for fish fillets. Minors were assigned for bones, but no major defects were found. A third lot of mackerel fillets, which were also processed using a deep "V" cut, met grade A standards with minor defects assigned for slightly soft texture and skin defects. Single lots of skin-on flounder fillets and gray seatrout fillets met grade A standards with zero defects. A second lot of gray sea trout also met grade A standards, however, minor defects were assigned for bones. While the lots of dressed fish inspected in this study did meet grade A standards for whole or dressed fish, the labor involved to adequately clean the belly cavity (slicing the membrane, brushing, and washing) of these small fish is too tedious and cost prohibitive to be done on a production level. Larger fish, which also have a higher market value, would be a better choice for inspection as grade A dressed fish.

Mid-Atlantic fish species, which can be processed into fillets, are the most likely candidates for grade A inspection. Spanish mackerel fillets were able to meet grade A standards after the majority of the pin bones were removed with a "V" cut. Seatrout and flounder fillets passed grade A standards with minors assigned for bones. In previous inspection trials, during the marketing phase of this program, seatrout and bluefish fillets could not pass grade A standards due to soft texture and gaping. This is especially prevalent in larger fish. For inspection of these species, on a full time basis, allowances may be required for some degree of gaping. Cutting and trimming defects, which were also encountered during the marketing phase, can be eliminated through careful handling in the cutting room. If the market will support the higher prices required for processing grade A fish, and if consistent standards are set for the inspection of mid-Atlantic fish, the availability of grade A fish can become a reality in the mid-Atlantic region.

V) Storage of Menhaden and Squid in Refrigerated Water Containing Dissolved Carbon Dioxide.

While the dissolved CO_2 was effective in reducing microbial growth, the raw sensory attributes of the menhaden declined rapidly in both systems. Appearance, odor, and texture sensory scores were all below borderline in quality (score of 5) in less than 4 days regardless of which storage system was used. Differences in sensory scores of the 2 systems were not statistically significant (ANOVA $\alpha = .05$). On day 3 of storage it was noted in both systems

that the menhaden flesh was soft, scales were loose, and the gills had a slimy white appearance. Apparently menhaden does not hold up very well after a few days of storage in refrigerated water, regardless of whether CO_2 is added. It should be noted however, that the menhaden had numerous parasites burrowed into their flesh which may have accelerated spoilage. While the menhaden were freshly caught pound net fish (caught morning of study and iced), greater differences in quality may have been noticed if the fish were stored in a MRW system as soon as they were harvested.

The addition of carbon dioxide to the refrigerated seawater containing squid did inhibit microbial growth, but not to the degree observed in the previous system with menhaden. As with the menhaden however, differences in the sensory quality of the squid in the two storage systems were not readily apparent. Appearance, odor, and texture) were all below borderline in quality (sensory score less than 5) between 5 and 6 days of storage. The greatest differences were seen in texture during the first 5 days of storage. The RSW squid had a more gelatinous, watery texture than the MRSW stored squid. It was noted on day 7 of storage that even though the squid in both systems were obviously spoiled, there was a more pronounced pink discoloration of the skin on the squid stored in RSW.

This study indicated that the addition of carbon dioxide to RSW storage systems for holding squid will help to restrict microbial growth. Slight benefits in overall quality can also be expected. Ideally for maximum benefit to quality, the squid should be placed into a MRSW system at the time of harvesting. These studies were done with squid which had been stored on ice. The captain of a squid trawler in the mid-Atlantic region has demonstrated that he can land superior quality squid by storing them in RSW rather than storing them in bulk on ice. The addition of carbon dioxide to this system should further enhance the maintenance of quality.

Application of Modern Food Engineering Practices for Improving Quality and Extending Shelf-life of Fresh Fish

The objective of this study was to apply modern food engineering practices to improve quality and extend the shelf-life of seafood products. J. Peter Clark, president of Epstein Process Engineering, made several visits to virginia seafood processors (2 finfish plants, 2 crab plants, and 2 clam plants). Dr. Clark observed the processing operations at these plants and has made recommendations which address some of the problems which the Virginia seafood industry must resolve.

A major concern of the clam processing industry is the large volume of water used during processing and the large amount of waste water, which is high in BOD and suspended solids, that is generated. Dr. Clark recommended that a series of filtrations

could remove a large portion of the dissolved and suspended solids. This in turn could make the water suitable for reuse in certain parts of the plant. Dr. Clark stated that great opportunities exist for water conservation through recycling and better process control.

In the crab processing plants, Dr. Clark also observed that there was opportunity for water conservation and waste water control. In the hand picking of crab meat, where workers are paid by the pound, Dr. Clark recommended setting up an incentive program to motivate the workers to optimize yield and quality.

In the finfish processing plants, Dr. Clark observed that there was opportunity for improved plant design and layout, as well as sanitation.

According to Dr. Clark, the seafood industry is an important, but somewhat neglected element of the food processing industry. He stated that there is an opportunity for engineering firms to make a positive contribution to the industry and to become, in turn a significant factor in the design and construction of seafood processing plants.

Introduction

The distribution of fresh fish caught in Atlantic waters has principally occurred along the coast with limited movement of product to inland markets. From a traditional perspective, this marketing system was effective since it: included the major eastern population centers; offered readily identifiable products to consumers; and minimized product loss through restricted transportation requirements. As the country became a more mobile society and as the advantages of fish as dietary alternatives became more accepted by consumers, new markets for fresh fish and seafood were established. Consequently, seafood has been an exciting menu item for both home and food service use. These changes in demography and consumer attitudes reflected new marketing opportunities for the retail food industry which they did not ignore. Within the past nine years, seafood departments or shops began to be included as a profit center both in national and independent retail food chains. There was also an increase in the number of restaurants featuring seafood dishes and the use of further processed seafoods in fast food establishments and school lunch rooms rapidly expanded.

One of the recent significant changes was the commitment of the Kroger Company in establishing seafood as a major food commodity within the meat department. The firm created and maintained over 300 service seafood counters in their 1200 store chain and almost every store maintains a self-service section. Studies conducted by Kroger and the Mid-Atlantic Fisheries Development Foundation, Inc. have shown that the mid-West contains one of the largest unsatisfied markets for fresh seafood in the country and that consumers are willing to pay for a quality product. The future for fresh seafood retail sales was so encouraging that Kroger made a significant commitment to seafood merchandising by: purchasing a trout firm; increasing the number of retail seafood specialty shops; and employing on-site quality control inspectors. Unfortunately Kroger's and other retailer's enthusiasm for increased fresh seafood sales could not be sustained for long. The market definitely existed but present product quality could not provide the necessary shelf-life to successfully match the demand. Attempts to identify suppliers capable of consistently providing high-quality products have been most disappointing. In order to define the problems a Consortium of seafood processors, suppliers of services and equipment, academic (Virginia Tech), and a retail food chain (Kroger) was formed in 1980. Funding to the group was provided by the Mid-Atlantic Fisheries Development Foundation, Inc., to:

1) Conduct an audit of seafood quality from harvest through consumption.

2) Compare unit operations in two firms and develop utilization systems capable of producing a 12-day shelf-

life. One of the participating firms was recognized as a consistent producer of high quality seafood with a minimum 10-day shelf-life. The second was a more typical seafood firm producing a product of variable quality but interested in increasing sales through expanded product distribution and improved quality.

3) Conduct a quality harvesting study including; a one and two step evisceration; stowage by boxing and short-shelving compared to bulking; and improved handling and sanitation practices.

4) Identify problems of in-plant handling, sanitation, processing, packing, storage, and distribution and their effect on product quality.

5) Conduct an integrated quality fresh fish marketing study in mid-West cities for selected non-traditional mid-Atlantic fish species.

Project results to date have identified several serious problems and opportunities within the fresh seafood industry. Audits of fishing vessels, processing plants, transportation systems, and distribution centers have indicated the prevalence of marginal, if not unacceptable, product quality and handling practices.

Typically, traditionally handled processed fresh fish cannot be expected to have a shelf-life greater than 4 to 6 days. This limited shelf-life seriously affects marketability from a fundamental perspective. Unless the problem is adequately solved, fishery development plans from any agency or group becomes somewhat meaningless. It is difficult to believe that plans to develop new markets, promote underutilized or non-traditional species, and introduce new products will be even marginally effective. A recent experience as reported by a major retail food chain has further supported this conclusion. A large test market on Atlantic mackerel acceptability conducted in the mid-West by a Gulf Coast organization was quickly removed from retail stores after numerous consumer complaints concerning unsatisfactory quality were received. The chain has now stated their reluctance to participate in future marketing programs involving fresh seafood.

At a planning meeting between Consortium members and the Mid-Atlantic Fisheries Development Foundation, Inc. in 1983, the following fresh fish quality maintenance and marketing development plan was developed:

Parts 1 & 2.

Development of a program to produce fresh fish with a 12-day minimum shelf-life and initiation of a study comparing

seafood handling practices in plants with acceptable and unacceptable quality images. 1984-1986[1,2]

Part 3.

Training of seafood department managers in a mid-West retail food store and development of appropriate informational materials for store managers and consumers.

Shipment of fresh seafood (non-traditional species only) to target mid-West retail food firms. This task included developing appropriate advertising and publicity programs and conducting marketing studies before and after test shipments to determine profitability. Included in this study was the effectiveness of in-store demonstrations, materials for food editor use in newspapers, and in-store promotional materials. 1987[3]

Part 4.

Development and presentation of a fresh fish plant sanitation program, implementation of alternative unit operations to improve quality and extend shelf-life, and evaluation of fresh fish quality at dockside and after processing by established methodology. 1988, Present report.

During 1983-85, the Consortium was involved with Part 1 of the above protocol. The goal of obtaining a 12-day fresh fish shelf-life has already been achieved. As information on the project was released, requests for assistance and further information were received. Since 1985, visits were made to six processing plants from Virginia to Massachusetts on requests to specifically assist in the improvement of product quality. These requests were made with the anticipation that increased sales to retail food stores would eventually be realized. It is interesting to note that more interest and pledges of industry cooperation have been received by this project than any previous investigation. Clearly, the need for high quality seafood has been demonstrated

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1. Demonstration of a Quality Maintenance Program for Fresh Fish Products. 1984. Mid-Atlantic Fisheries Development Foundation, Inc. Virginia Tech, Blacksburg Va. 252 pp.

2. A Seafood Quality Program for the Mid-Atlantic Region - Part II. 1986. Mid-Atlantic Fisheries Development Foundation, Inc. Virginia Tech, Blacksburg Va. 97 pp.

3. A Seafood Quality Testing Program for the Mid-Atlantic Region - Part III. 1987. Mid-Atlantic Fisheries Development Foundation, Inc. Virginia Tech, Blacksburg Va. 58 pp.

as well as the willingness of industry to provide that product. The results of studies, conducted during parts 2 and 3 of the project, indicated that mid-Atlantic seafood was harvested with high microbial populations (10^5-10^7 cfu/cm^2). This microflora quickly contaminates equipment (such as sorting tables, scales, skinners, cutting and packing tables) and utensils (such as knives and scalers) so that within 15 minutes after processing operations begin, the microbial populations within the plant environment and product itself approached a steady state ranging from 10^5-10^8 cfu/cm^2.

A study was designed to reduce the microbial population through improved processing and handling operations as well as the application of a high pressure wash. The shelf-life was extended from the customary 5-7 days to 12 days. Only two fish species, bluefish and Atlantic mackerel were unable to maintain quality past a 9-11 day period. The mid-West quality marketing project with the Kroger Company indicated the mid-Atlantic fish could be sold at premium prices to recover the extra cost associated with the product.

The four quality studies revealed several important needs that must be satisfied if quality fresh seafood is to be successfully marketed:

1) Processing plant quality control (assurance) personnel need training in proper plant sanitation practices and procedures.

2) Processing plant facilities must be improved so that fish can be produced with reduced surface microflora.

3) Alternative handling procedures and processing operations must be implemented which will maintain product quality from harvest through consumption.

4) Methodology of inspecting fish at dockside and after processing must be reliable and indicative of available shelf-life.

This present study was designed to investigate each of the above issues and make recommendations on how they can be successfully implemented in a comprehensive fresh fish processing operation.

Development and Implementation of an On-Site Hands-On Seafood Sanitation Program

Objective

This program was designed so that plant personnel can establish sanitation programs that will result in the continuous production of high quality fresh fish products. Course participants were required to: attend lectures on sanitation principles and procedures; participate in demonstration and laboratory sessions; clean a plant at the termination of processing operations; and evaluate the sanitary conditions of a host plant before and after cleaning operations. The participants will also be trained on how to evaluate or score a plant according to guidelines established by the National Marine Fisheries Service.

Program Content

Day 1

6pm Hospitality social.

Day 2

8am - 12pm How to design a cleaning program.

- Sanitary evaluation of equipment and surfaces prior to processing and at various times during the day at a local seafood firm. (use Petri film, Rodac plate, and swab).
- Explain basic chemistry of soils; types and effective removal of.
- Explain basics of microbial growth, attachment and effective use of sanitizers.

12pm - 1pm Lunch

1pm - 5pm Demonstration (in the processing lab) of cleaning methodology and microbiological testing.

- Proper use of cleaning agents, tools, machines, and sanitizers.
- Proper use of objective sanitation evaluation test materials (Petri film, Rodac plates, and surface swabs).

5pm - 6pm Dinner

6pm - 8pm Hands-on workshop at a local seafood plant.

- Cleaning and sanitizing equipment and surfaces.
- Sanitary evaluation of cleaned surfaces.

Day 3

8am - 12pm Pest control in seafood processing.

- View and discuss video.
- Basics of pest control.
- Demonstrate (in lab and at plants) proper use of pest control chemicals and equipment.
- Set bait stations and traps at plants.

12pm - 1pm Lunch

1pm - 3pm Basic concepts of Food microbiology.

3pm - 5pm Basic concepts of sanitation, and plant hygiene.

Day 4

8am - 8:30pm Review results of surface sanitary evaluation sampling from monday.

8:30am - 10am Hands-on lab session on basic microbiological techniques.

10am - 12pm Evaluate seafood plants (Amory and/or Graham & Rollins) for sanitation and pest control.

- Walk through evaluation.
- Check bait stations and traps for pest management.
- Evaluate and design sanitation program for plants.

12pm - 1pm Lunch

1pm - 3pm	Design sanitation and pest control program for your own plant.

An optional pre and post plant evaluation, by members of the instructional staff, will be offered to each participating firm.

Results

The conference was proposed, but industry representatives requested that the program be presented on a regional basis since most firms had several individuals who should attend. As a consequence, the program will be implemented during the summer and fall of 1989. Specific Programs will be presented to crab, clam, oyster, and fish dealers.

By July 15, 1989, five seafood firms have actively participated in the program. One of the firms is a mechanized clam processor, another a shrimp processor, and three produce crab meat. All five firms have received their initial visit and three have been the recipient of a comprehensive microbiological audit to evaluate the effect of unit processing operations on product quality and safety. The participating firms have employed either a microbiologist or food technologist having a baccalaureate or Master of Science degree. Accomplishments of the program has enabled each firm to identify problem areas, evaluate their product and premises for the presence of Listeria monocytogenes, and develop comprehensive quality assurance programs.

A computer program has been developed for the mechanized clam plant so that results of the quality assurance program can be rapidly accessed. The PC based program uses a data base manager that enables the information to be recalled by date, specific unit operation process, and specific microorganism. To enhance the utility of the program, specific criteria were included for both solid and liquid wastes. The program was designed to be user friendly so that prior experience with computers is not necessary. A copy of the program screens is contained in Appendix 7.

One employee training program has been presented to workers in a crab plant and another program will be presented to supervisors in the mechanized clam plant during September. The program for supervisors will basically follow the previously described syllabus. An evaluation of the effectiveness of the crab plant program has indicated that the employees appreciated the training and have attempted to modify some of their work habits. The firm management plans to introduce an incentive program that will provide monetary awards and prizes for those employees demonstrating exceptional cooperation.

Development, Evaluation, and Implementation of Alternative Processing Procedures to Achieve a Minumum 12-day Fresh Fish Shelf-life.

I) Dockside Grading

Objective.

The objective of this study was to compare grading methods of Mid-Atlantic fish at dockside relative to the perceived quality and shelf-life of the processed product. The specific dockside grading methods which were applied consisted of the following;

1. **U.S. Department of Commerce/National Marine Fisheries Service grading program.** Code of federal regulations title 50 subpart A - U.S. standards for grading of whole or dressed fish.

2. **Maine Department of Marine Resources Freshness Assurance Standards.** This method, which is a modification of the Torry Laboratory Grading Scale, monitors descriptive characteristics that are species specific and change over time.

3. **Canadian Grade Standard for Raw Atlantic Groundfish.** This method evaluates the fillet or flesh portion of the fish. Intrinsic characteristics of the whole fish (eyes, gills, etc.) are not examined.

4. **Bremner Method.** A demerit system which utilizes generalized quality scoring that is species-independent.

5. **Torrymeter Fish Freshness Meter.** Determines freshness by measuring dielectric properties of fish flesh.

Description of methodology.

1. **U.S. Department of Commerce/National Marine Fisheries Service grading program.** U.S. standards for grades of whole or dressed fish have been published in the Code of Federal Regulations Title 50, Subchapter G, Part 261, Subpart A. This section has been reproduced and included as appendix I. Whole fish are classified as grade A, B, or substandard based on evaluation of flavor, odor and the presence of physical defects. If the evaluation of raw odor indicates the existence of any off-odors, the sample is then cooked and evaluated for both flavor and odor. Grade A fish must possess good flavor and odor, while grade B fish must possess reasonably good flavor and odor. Each of the fish in the sample

is examined for physical defects using the list of defect definitions, and the defects noted and categorized as minor, major, and serious in accordance with Table 1 (see Appendix 1). A score sheet used for the inspection of whole and dressed fish is also found in Appendix I.

2. **Maine Department of Marine Resources Freshness Assurance Standards.** Freshness assurance standards were developed as part of the Maine Fresh Groundfish Quality Control Program (reproduced in Appendix II). The program is designed to provide inspection services to Maine processors in order to improve the marketing of fish products. Maine processors who voluntarily comply with these quality control procedures receive certification of program compliance from the Department of Marine Resources. The quality control program includes standards for the physical plant and equipment, sanitation, product handling, and freshness assurance. The freshness of whole fish to be processed under this program are evaluated by the in-house inspector prior to cutting by the freshness assurance standards. These standards are specific for different species of fish and point values are assigned according to intrinsic characteristics of the whole fish. In this system higher scores are indicative of good quality. For raw flat fish general appearance is scored from 1 to 5 points, flesh (including the body cavity) is scored from 0 to 5 points, odor is scored from 0 to 10 points, and texture is scored from 1 to 5 points. The maximum score is therefore 25 points. Full compliance requires a minimum numeric score of 17, or 68% of 25 total scoreable points. If all of the standards of this quality control program are met, the processor can have the lot of fish certified for a six or nine day expiration date.

In this study the freshness assurance standards were applied without the flesh and body cavity evaluation. This section was omitted because the fish were not gutted or dressed prior to inspection. The maximum scoreable points was therefore reduced to 20 points and 68% of this value is 13.6 points.

3. **Canadian Grade Standard for Raw Atlantic Groundfish.** This standard was designed to provide the Atlantic groundfish industry with a common means of measuring and identifying raw material quality. Fish are classified as grade A, B, C, or reject based solely on the evaluation of the cut surface of the fish or fillet. Grading criteria include color, odor, texture, blood clots, bruising and discoloration, and jelly or chalky condition. A grade is assigned for each factor, the final grade being the lowest grade assigned. The lot grade is determined by the percentage of each grade assigned to the sample units and these percentages are applied against the purchase weight to determine payment to the fisherman. A document which describes the Canadian groundfish grading standard and a sample inspection form are included in Appendix III.

4. **Bremner Method.** Bremner (1985) outlined a sensory method of inspecting whole fish at dockside which was designed to be species-independent. This demerit system can be used by persons with negligible training and with no particular knowledge of the species. The score sheet, which lists quality attributes that change over time as fish deteriorate, is included in Appendix IV. Quality attributes which are assessed include appearance, skin, scales, slime, stiffness, eyes, gills, belly, vent, and belly cavity. These characteristics are assessed and the appropriate demerit point score is recorded. The scores for the separate characteristics are then added to give an overall sensory score. Since this is a demerit scoring system, very fresh fish will have scores near zero, while fish further along the deteriorative process will have higher totals. The score should approach its maximum value near the limits for acceptability of the fish. In this study all of the attributes listed in appendix IV were evaluated with the exception of the belly cavity. This portion was omitted because the fish were not gutted prior to inspection. Further information on this system of fish inspection can be found in the following references.

H.A. Bremner. A convenient easy-to-use system for estimating the quality of chilled seafoods. DSIR Fish Processing Bulletin No. 7, Fish Processing Conference '85, Nelson, N.Z., 1985. Department of Scientific and Industrial Research, Wellington, N.Z. pp. 59-70.

H.A. Bremner, J. Olley, and A.M.A. Vail. Estimating Time-Temperature Effects By a Rapid Systematic Sensory Method, in: D.E. Kramer and J. Liston (Eds.), Seafood Quality Determination, Proceedings of an International Symposium Coordinated by the University of Alaska Sea Grant College Program, Anchorage, Alaska, November 1986. Elsevier Science Publishers B.V., Amsterdam. pp. 425-431.

A.C. Branch, and A.M.A. Vail. Bringing Fish Inspection Into The Computer Age. Food Technology In Australia, Vol. 37 No. 8, August 1985. pp. 352-355.

4. **Torrymeter Fish Freshness Meter.** The original research, which led to the development of the fish freshness meter, was performed at the Torry Research Station in Aberdeen, Scotland (Jason and Lees, 1971). The following description has been quoted from the Principle of Operation section of the gr Torrymeter Fish Freshness Meter Operators Handbook (GR International Electronics Limited, Perth, Scotland).

> It was found that certain dielectric properties of skin and muscle alter in a systematic way during storage as tissue components degrade. These alterations, occurring at the microscopic level, are strongly associated with the gross changes in appearance, odour, texture and flavour which take place during spoilage and

which are normally used to judge freshness. Hence determination of the appropriate dielectric properties gives a measure of the freshness of the fish.

The base of the instrument which is applied to the fish has two pairs of concentrically arranged electrodes. An alternating current is passed through the fish between the outer pairs of electrodes and the resulting voltage sensed by the inner pair. The phase angle between the current and voltage is measured and converted electronically for digital display on a convenient scale in the range of 0 to 16. The phase angle and hence the meter reading decrease on spoilage.

The readings acquired with the Torrymeter can be used to approximate the storage time of fish on ice and the approximate acceptable shelf-life that remains. This can only be accomplished however, by standardizing Torrymeter readings with different stages of quality, as determined by sensory analysis. These Torrymeter readings or freshness scores are dependent upon the species being evaluated as well as seasonal variations such as fat content. Handling conditions will also effect meter readings.

Jason, A.C. and A. Lees., 1971. Estimation of fish freshness by dielectric measurement. Department of Trade and Industry Report No. 71/7. Torry Research Station, Aberdeen.

5. **Microbiological and Sensory Analysis.** This methodology has been described in Appendix V. The shelf-life evaluation of flounder, however, was limited to the dark-skinned side of the fish.

Cooperating personnel.

The service of the following inspectors were secured for this project; Phillip McKay a retired National Marine Fisheries Inspector who is still active in consulting, Jeff Armstrong a groundfish inspector from the Maine Department of Marine Resources, and Cliff Outhouse a retired Canadian groundfish inspector. Thomas Rippen, a seafood extension specialist of Virginia Tech, applied the Bremner demerit scoring system. Torreymeter readings were taken by Brian Mayer, a Research Associate with Virginia Tech Department of Food Science.

Species inspected.

Two lots of Flounder (Paralichthys dentatus) and two lots of Gray Sea Trout Cynoscion regalis), at various stages of quality, were tagged with a code number and randomly presented to the inspectors for grading by the methods listed above. While grading, the code numbers were recorded with the individual grade of each sample. This approach enabled a direct comparison of the inspection methods on both an individual sample basis as well as

a lot basis. Samples from each lot were also taken for shelf-life and microbiological analysis.

Inspection results of flounder.

Two lots of flounder (20 fish per lot) were inspected on 12/6/88. Table 1 lists the inspection results of lot # 1, which was offloaded on 12/2/88. Table 2 lists the inspection results of lot # 2, which was offloaded on 12/5/88. There were approximately 3 days difference in the actual harvest dates of these fish.

Inspection by the **National Marine Fisheries Service grading program (NMFS)** indicated that lot # 1 consisted of 16 (80%) grade A fish and 4 (20%) grade B fish. Grade A fish are allowed a maximum of 3 minor defects and grade B fish are allowed a maximum of 5 minor and 1 major defect (grade assignment is explained in Appendix I). In this case all of the grade B fish had 4 minor defects, while the grade A fish had 0 to 3 minor defects. In total, lot # 1 had 48 minor defects. 55% (11) of the samples had defects due to texture, 70% (14) had appearance defects, 80% (16) had gill discoloration defects, and 35% (7) had surface defects. In comparison, lot # 2 had 17 (85%) grade A fish and 3 (15%) grade B fish. As in lot # 1 all of the grade B fish had 4 minor defects and the grade A fish had a range of 0 to 3 minor defects. The total number of minor defects for lot # 2 was 47. 50% (10) of the samples had defects due to texture, 75% (15) had appearance defects, 85% (17) had gill discoloration defects, and 25% (5) had surface defects. With this methodology, little difference could be discerned between the quality of the flounder in each of these lots.

Inspection by the **Maine Department of Marine Resources Freshness Assurance Standards** provided numeric scores which ranged from 14.0 to 17.3 for lot # 1 (table 1). The average score and standard deviation was 15.6 ± 0.9. Lot # 2 (table 2) had an average score of 16.7 ± 1.0 and a range of 14.3 to 19.0.
The average score of the fish in lot # 2 was higher and the difference was statistically significant (ANOVA, Duncan's $\alpha = .05$). Since the freshness assurance standards require a score of 13.6 or greater (68% of total scoreable points, based on 20 points) all of the fish in both lots would, however, be in compliance.

Inspection by the **Canadian grade standards**, which evaluate fillets not whole fish, revealed the greatest difference in perceived quality. Lot # 1 had 9 (45%) grade A fish, 10 (50%) grade B fish, and 1 (5%) grade C fish. Grade B was assigned 6 times for blood clots, 3 times for bruising and discoloration, and 4 times for texture. Grade C was assigned 1 time for bruising and discoloration. In comparison, lot # 2 had 15 (75%) grade A fish and 5 (25%) grade B fish. Grade B was assigned 1 time for blood clots, 1 time for bruising and discoloration, 2 times for texture, and 1 time for odor. The deterioration in the quality of the fish in lot # 1 may have been aided by abusive handling. 6 (30%) of the

fish were downgraded to grade B because of blood clots, which were caused by handling the fish with picks.

Inspection by the **Bremner demerit scoring system** provided numeric scores which ranged from 9 to 20 for lot # 1 (table 1). The average score and standard deviation was 13.7 ± 3.0. Lot # 2 (table 2) had an average score of 11.6 ± 3.3 and a range of 7 to 18. With this scoring system, lower scores are indicative of better quality. The average score of the fish in lot # 2 was lower (better quality) and the difference was statistically significant (ANOVA, Duncan's $\alpha = .05$).

Analysis of the fish with the **torrymeter** provided freshness scores which ranged from 6.5 to 14.5 for lot # 1. The average score and standard deviation was 11.8 ± 1.9. Lot # 2 had an average score of 13.2 ± 1.6 and a range of 10.0 to 16.0. As previously noted with many of the other inspection methods, lot # 2 had better quality scores, the difference of which, was statistically significant (ANOVA, Duncan's $\alpha = .05$).

Table 1. Dockside grading data for flounder lot # 1.

Species:Flounder (Med) Inspection Date:12/6/88

Day of Catch:11/29-12/2 Offload Date:12/2

Harvest Method:Trawler

			Grading Method			
Sample #	Code #	NMFS	Maine	Canadian	Bremner	Torrymeter
1	15	B	16.0	B	13	13.0
2	58	A	17.0	B	11	11.5
3	48	A	14.8	B	16	14.5
4	60	A	14.3	A	20	8.0
5	30	B	15.5	B	14	13.0
6	35	B	15.8	B	13	11.5
7	34	A	16.3	A	12	12.0
8	56	A	17.3	A	14	12.5
9	52	A	15.3	A	17	11.5
10	59	B	14.8	B	17	12.5
11	25	A	16.8	A	10	13.0
12	50	A	14.5	B	18	6.5
13	29	A	16.3	A	9	13.0
14	8	A	14.0	A	17	12.5
15	22	A	15.8	C	10	12.5
16	28	A	16.0	B	11	14.0
17	33	A	14.8	A	15	10.5
18	49	A	15.8	B	10	12.0
19	32	A	16.0	B	12	11.5
20	20	A	14.3	A	15	9.5
AVG. ± S.D.			15.6 ± 0.9		13.7 ± 3.0	11.8 ± 1.9

Grade distribution A (16) 80% A (9) 45%
B (4) 20% B (10) 50%
C (1) 5%

Table 2. Dockside grading data for flounder lot # 2.

Species:Flounder (Med) Inspection Date:12/6/88

Day of Catch:12/2-12/5 Offload Date:12/5

Harvest Method:Trawler

		Grading Method				
Sample #	Code #	NMFS	Maine	Canadian	Bremner	Torrymeter
1	21	B	19.0	A	7	16.0
2	55	A	16.3	A	11	13.0
3	26	A	17.3	A	14	13.5
4	3	A	17.5	A	11	13.5
5	27	B	18.0	B	9	16.0
6	11	B	16.3	A	12	15.0
7	2	A	16.3	B	13	12.0
8	12	A	16.3	A	17	15.0
9	4	A	15.8	A	13	12.0
10	51	A	17.3	B	8	14.5
11	9	A	16.8	A	13	12.5
12	16	A	15.3	A	18	13.0
13	17	A	17.3	B	8	15.0
14	14	A	17.3	A	7	14.0
15	24	A	not inspected	A	10	11.5
16	23	A	16.3	B	11	12.0
17	46	A	17.3	A	8	11.0
18	44	A	15.3	A	13	10.0
19	45	A	14.3	A	18	12.0
20	13	A	17.0	A	11	13.0
AVG. ± S.D.			16.7 ± 1.0		11.6 ± 3.3	13.2 ± 1.6

Grade distribution A (17) 85% A (15) 75%
B (3) 15% B (5) 25%

Inspection results of Gray Sea Trout.

Two lots of Sea Trout were inspected on 12/8/88. Table 3 lists the inspection results of lot # 3 (10 fish), which was offloaded on 12/5/88. Table 4 lists the inspection results of lot # 4 (9 fish), which was offloaded on 12/8/88. There were approximately 3 days difference in the actual harvest dates of these fish.

Inspection by the **National Marine Fisheries Service grading program (NMFS)** indicated that all of the fish in lot # 3 and lot # 4 were of grade A quality. There were however, some minor defects in both lots. Lot # 3 had a total of 13 minor defects. 60% (6) of the samples had defects due to texture, 50% (5) had appearance defects, 10% (1) had gill discoloration, and 10% (1) had surface discoloration. The total number of minor defects for lot # 4 was 11. 33% (3) had texture defects, 56% (5) had appearance defects, 22% (2) had gill discoloration, and 11% (1) had body cavity defects. Except for a slightly higher percentage of minor texture defects in lot # 3, this method of inspection did not detect any discernable difference in the overall quality.

Inspection of these lots, using the **Maine Department of Marine Resources Freshness Assurance Standards,** were unable to find any statistically significant differences in quality (ANOVA $\alpha = .05$). Lot # 3 had an average score of 15.6 ± 0.7 and a range of 13.8 to 16.5. The average score of lot # 4 was 16.2 ± 0.7 and the range was 15.3 to 17.8.

Canadian grade standards, were very critical of the quality of the skinless sea trout fillets from both lots. Lot # 3 had zero grade A fish, 4 (40%) grade B fish, and 6 (60%) grade C fish. All of the fillets were graded as grade B and C due to defects in texture. One fillet also received a grade B designation due to odor. In lot # 4 there were 3 (30%) grade A fish, 1 (10%) grade B fish, and 6 (60%) grade C fish. As with lot # 3, all of the grades below grade A, were due to defects in texture. There was also one grade B designation due to odor. Numeric scores derived with the **Bremner demerit scoring system**, although somewhat variable, did suggest differences in the overall quality of the two lots. Lot # 3 had an average score of 12.2 ± 3.0 with a range of 7 to 17. In comparison lot # 4 averaged 7.5 ± 3.2 with a range of 2 to 15. This difference was statistically significant (ANOVA, Duncan's $\alpha = .05$). From this data it is apparent that lot # 4 had better quality attributes (lower demerit scores are indicative of better quality).

Analysis of the fish with the **torrymeter** provided freshness scores which ranged from 9.0 to 13.5 for lot # 3. The average score was 11.4 ± 1.3. Lot # 4 had an average score of 11.6 ± 0.8 and a range of 10.0 to 13.0. In this case, the torrymeter readings were very similar for both lots and no significant difference was found (ANOVA $\alpha = .05$).

Table 3. Dockside grading data of gray sea trout lot # 3.

Species:Gray Sea trout (lg.) Inspection Date:12/8/88

Day of Catch:12/2-12/5 Offload Date:12/5

Harvest Method:Trawler

			Grading Method			
Sample #	Code #	NMFS	Maine	Canadian	Bremner	Torrymeter
1	12	A	15.8	C	12	10.5
2	35	A	16.0	C	17	12.5
3	16	A	15.5	B	8	11.5
4	24	A	16.0	B	7	11.0
5	44	A	15.0	C	14	13.5
6	26	A	16.5	B	12	13.0
7	58	A	15.8	C	11	10.5
8	11	A	15.8	C	11	12.0
9	2	A	16.0	B	15	10.0
10	8	A	13.8	C	15	9.0
AVG. ± S.D.			15.6 ± 0.7		12.2 ± 3.0	11.4 ± 1.3

Grade distribution A (10) 100%

A (0) 0%
B (4) 40%
C (6) 60%

Table 4. Dockside grading data of gray sea trout lot # 4.

Species: Gray Sea trout (lg.) Inspection Date: 12/8/88

Day of Catch: 12/6-12/8 Offload Date: 12/8

Harvest Method: Trawler

			Grading Method			
Sample #	Code #	NMFS	Maine	Canadian	Bremner	Torrymeter
1	60	A	16.3	C	9	12.5
2	32	A	15.8	C	7	12.0
3	55	A	17.8	C	2	12.0
4	27	A	16.0	A	9	12.0
5	59	A	15.3	A	15	11.0
6	34	A	15.8	A	8	11.0
7	25	not inspected	17.0	C	5	11.5
8	20	A	15.8	C	6	11.0
9	46	A	16.8	C	7	10.0
10	14	A	15.8	B	7	13.0
AVG. ± S.D.			16.2 ± 0.7		7.5 ± 3.2	11.6 ± 0.8

Grade distribution: A (9) 100%

A (3) 30%
B (1) 40%
C (6) 60%

Microbiological and sensory results.

On the day of inspection (Day 0) two flounder from each lot were swabbed for the enumeration of surface microorganisms (microbiological procedures are outlined in appendix V). Lot # 1 had an average plate count of 6.60 log cfu/in^2. In comparison, the average plate count of the flounder from lot # 2 was 1.5 logs lower, with a value of 5.04 log cfu/in^2. The difference between the average scores of the two lots was statistically significant (ANOVA, Fisher's LSD α = .05). Prior to inspection, fish samples were removed for processing into fillets for shelf-life determination. Under sanitary conditions the fillets were cut and traypacked for storage at 33°F. During storage, traypacks from each lot were removed for microbiological and sensory analysis. Figure 1 shows the results of the microbiological analysis through 8 days of storage. On day 3 of storage, traypacked flounder from lot # 1 had an average plate count of 7.73 log cfu/g. The flounder from lot # 2 was 1.81 logs lower with a plate count of 5.92 log cfu/g. By day 8 of storage the difference in the plate counts of the two lots was much less. The average plate counts were 9.32 cfu/g and 8.83 log cfu/g for lots 1 and 2 respectively. The differences between the average plate counts of the two lots were, however, statistically significant throughout the entire 8 days of storage (ANOVA, Fisher's LSD α = .05).

Sensory evaluation of the raw flounder fillets for appearance (Figure 2) and odor (Figure 3) indicated that while both lots had good sensory scores on day 1, the quality of lot # 1 quickly diminished upon storage. Based on raw appearance scores, the end of acceptable shelf-life (average score less than 5.0) for lot # 1 occurred at approximately 6.5 days. Lot # 2 was acceptable up to approximately 8.7 days. Raw odor sensory scores of lot # 1 were even more critical of the quality. Based on this evaluation, lot # 1 would have had only 5 days of acceptable shelf-life.

Cooked odor (Figure 4) and cooked taste (Figure 5) sensory scores of flounder from lot # 1 exhibited a similar trend, with the end of acceptable shelf-life between 5 and 6 days. On day 8 of storage the flounder from lot # 2 still had acceptable scores. Based on both raw and cooked sensory scores, lot # 2 had approximately 2 to 4 days of additional shelf-life.

Microbial and sensory evaluation of the two lots of gray sea trout also displayed differences in quality and overall shelf-life. On day 0, enumeration of surface microorganisms of trout from lot # 3 indicated the presence of 6.41 log cfu/in^2. The average plate count of trout from lot # 4 was 5.35 log cfu/in^2, a difference of approximately 1 log. Figure 6 shows the microbial counts of traypacked trout fillets through 6 days of storage at 33°F. During this time frame, the trout from lot # 4 averaged 1.22 to 1.75 log cfu/g lower than lot # 3. The differences between the average plate counts of the two lots were statistically significant throughout the entire 6 days of storage (ANOVA, Fisher's LSD α =

.05).

Sensory evaluation of the raw trout fillets for appearance (Figure 7) and odor (Figure 8) indicated that both lots had very good quality attributes (average scores of 8.0) on day 1 of storage. The quality of trout from lot # 3 however, quickly deteriorated upon further storage. The end of acceptable shelf-life for lot # 3 occurred after 5.0 - 5.8 days based on raw odor and appearance scores. Lot # 4 displayed acceptable shelf-life up to 7.7 - 9.0 days. Based on raw evaluation, therefore, the difference in shelf-life was approximately 3 days greater for lot # 4.

Cooked odor (Figure 9) and taste (Figure 10) sensory scores of lot # 3 suggested an even shorter acceptable shelf-life than the raw evaluation did. According to these attributes the end of shelf-life was reached at 4.0 - 4.5 days of storage. Lot # 4 still had acceptable scores on day 6 of storage.

Figure 1. Aerobic 20 C Microbial Counts of Flounder

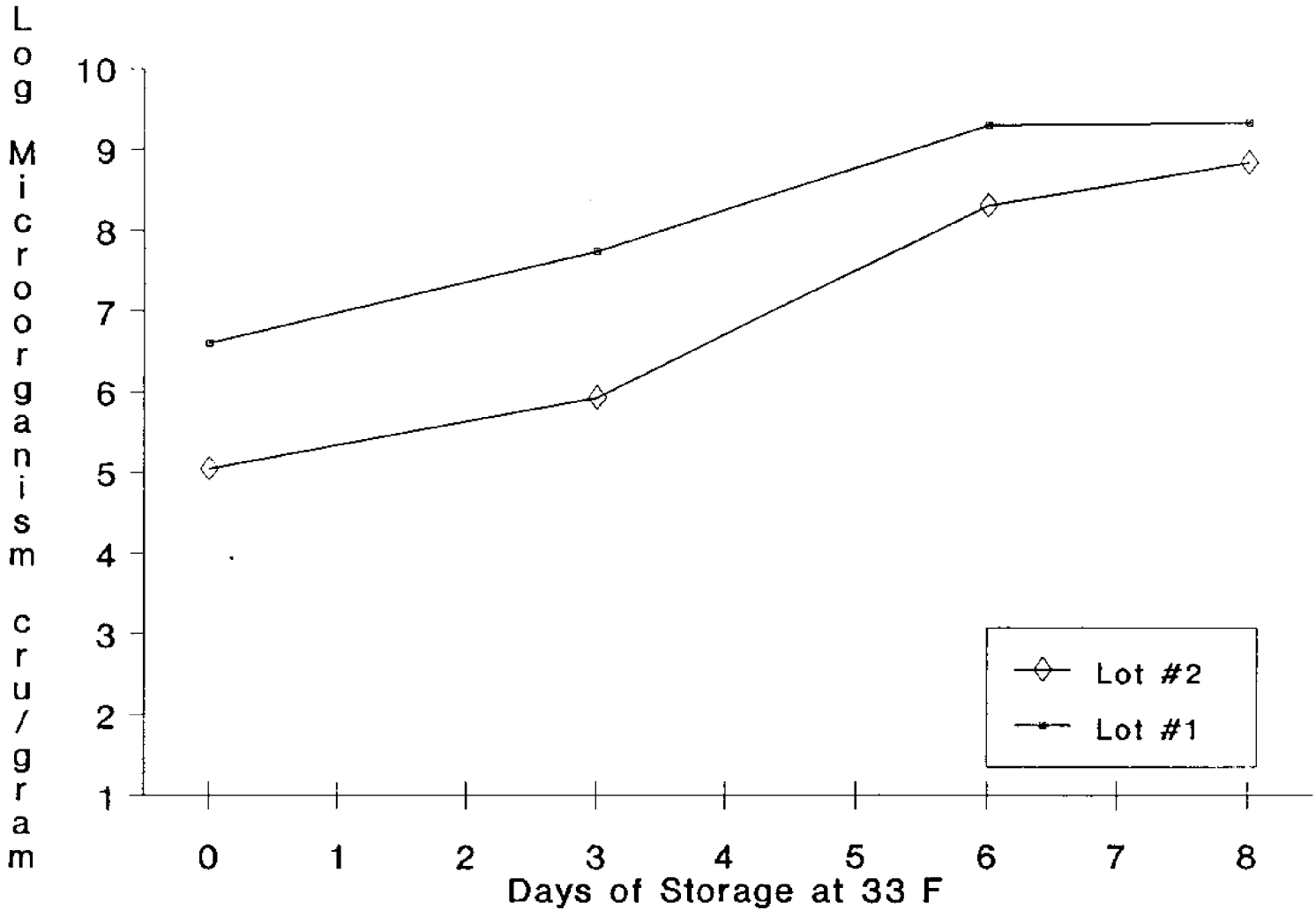


Figure 2. Raw Appearance Sensory Scores of Flounder

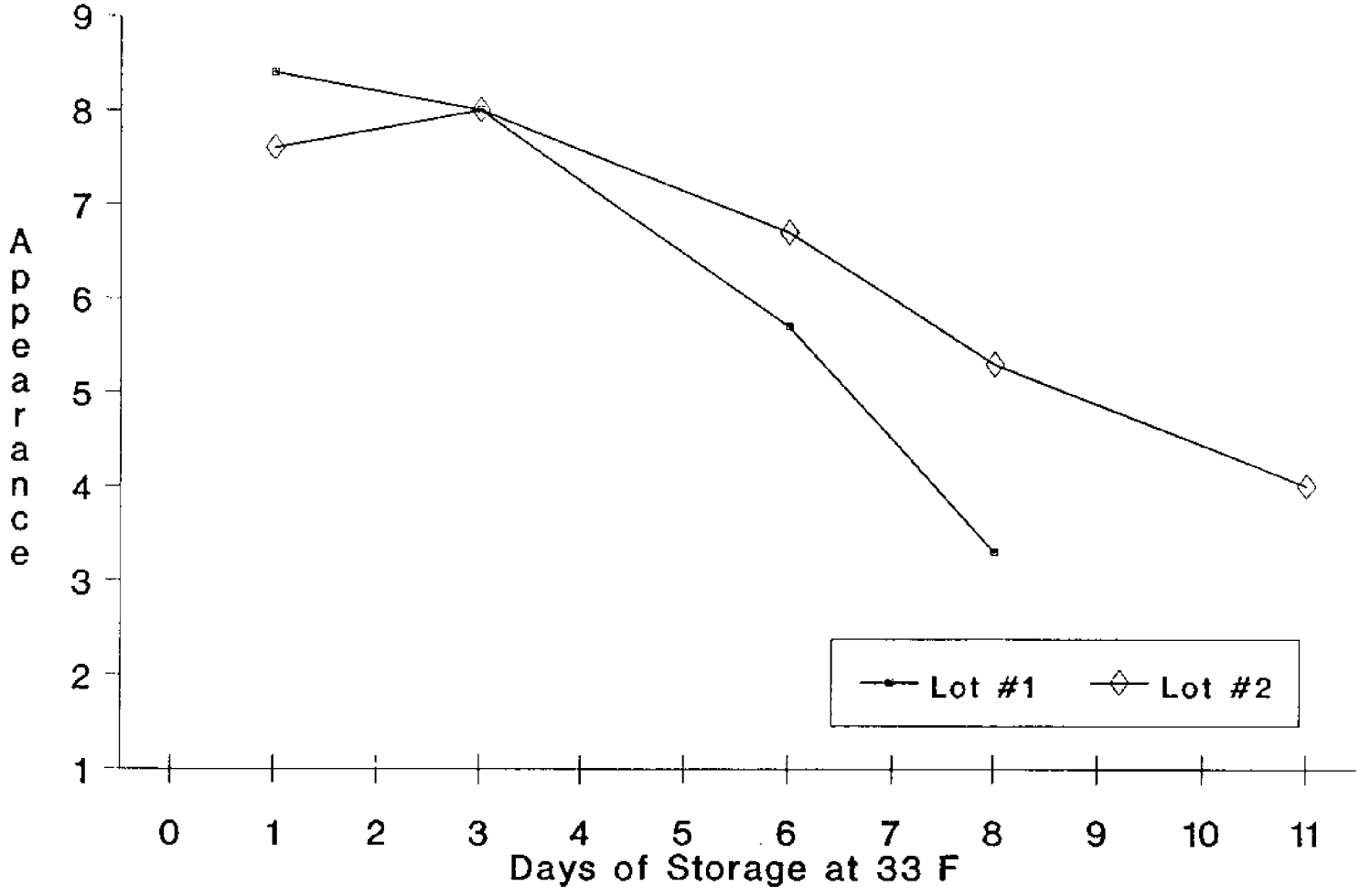


Figure 3. Raw Odor Sensory Scores of Flounder

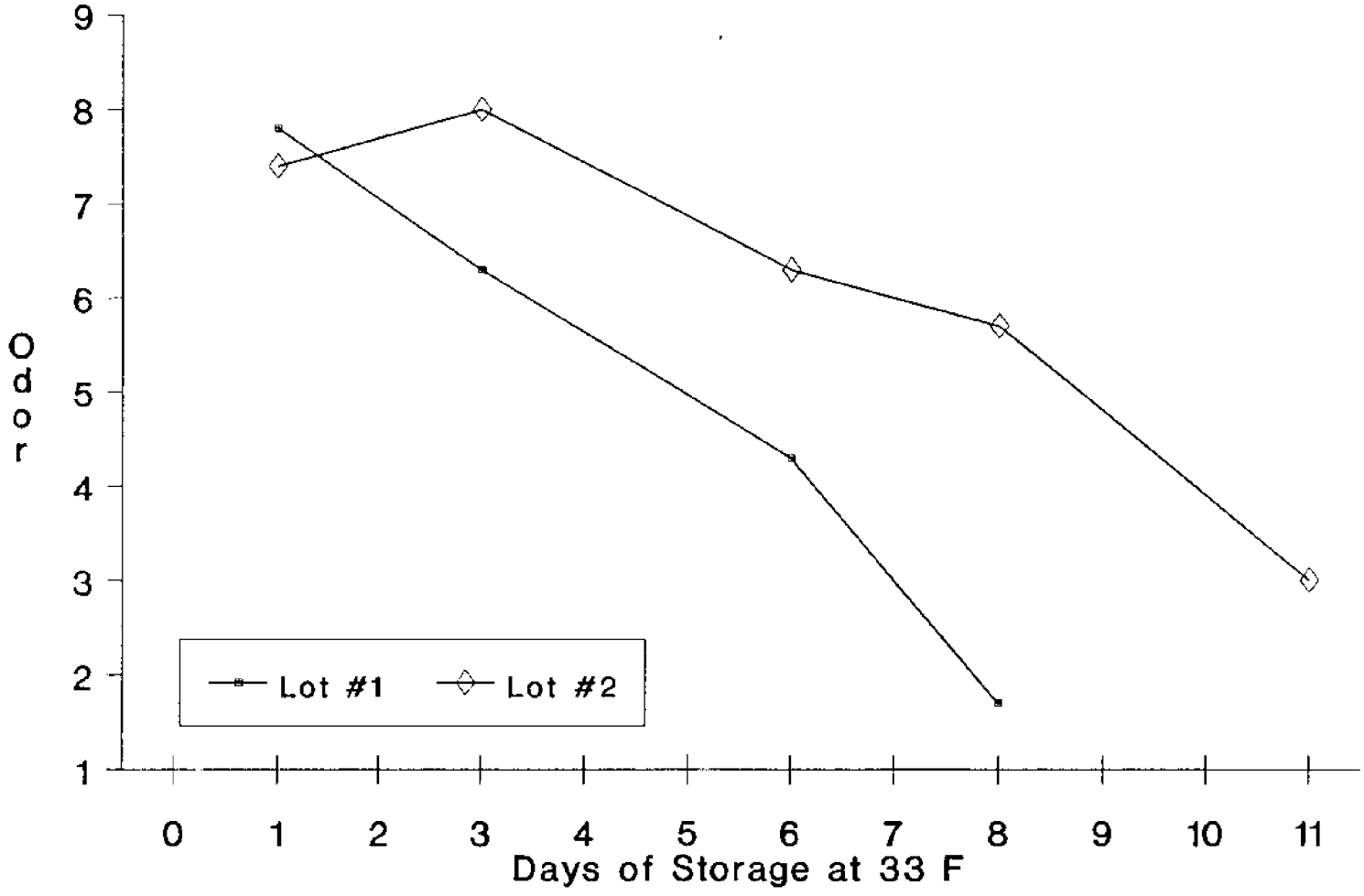


Figure 4. Cooked Odor Sensory Scores of Flounder

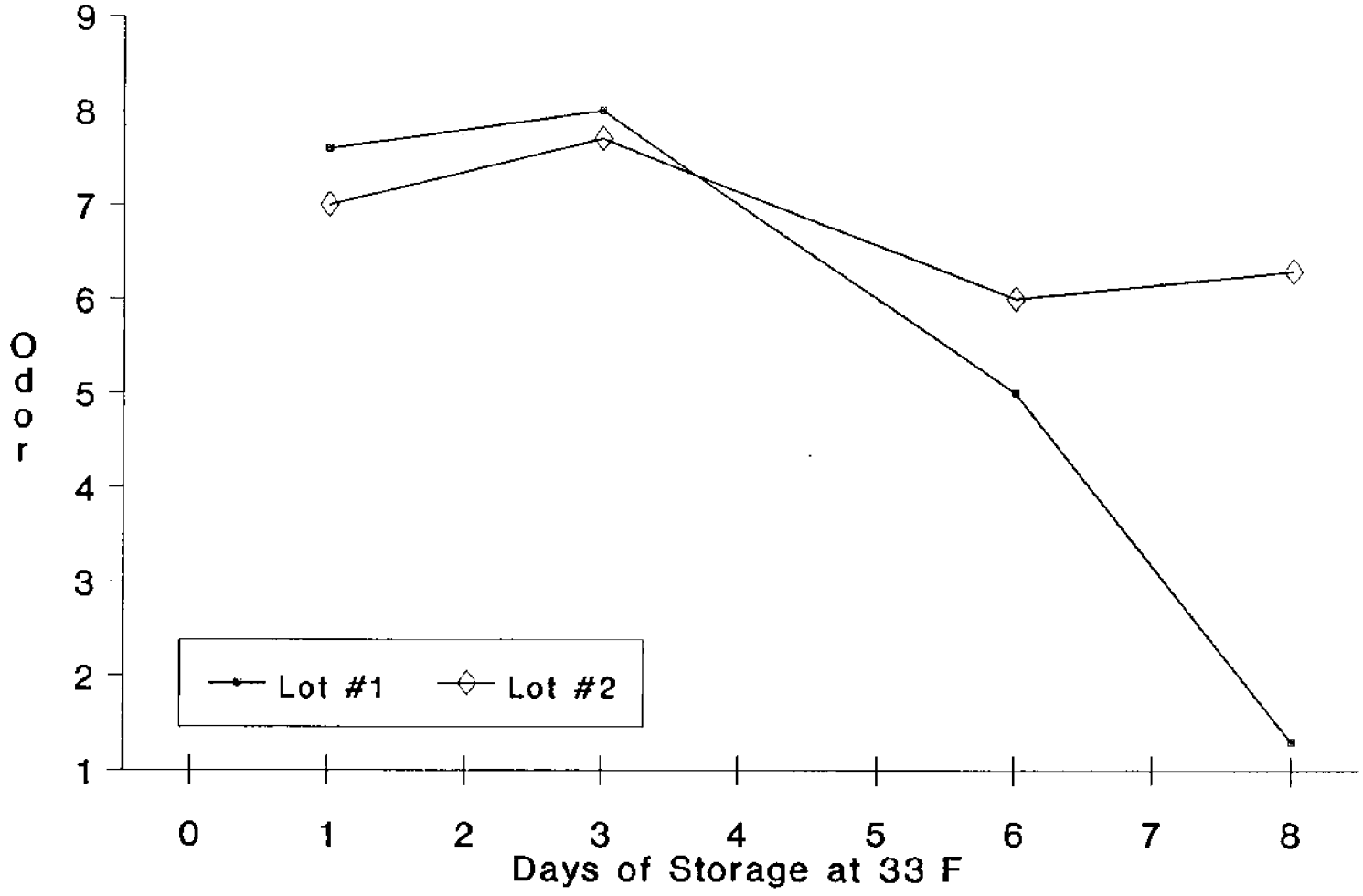


Figure 5. Cooked Taste Sensory Scores of Flounder

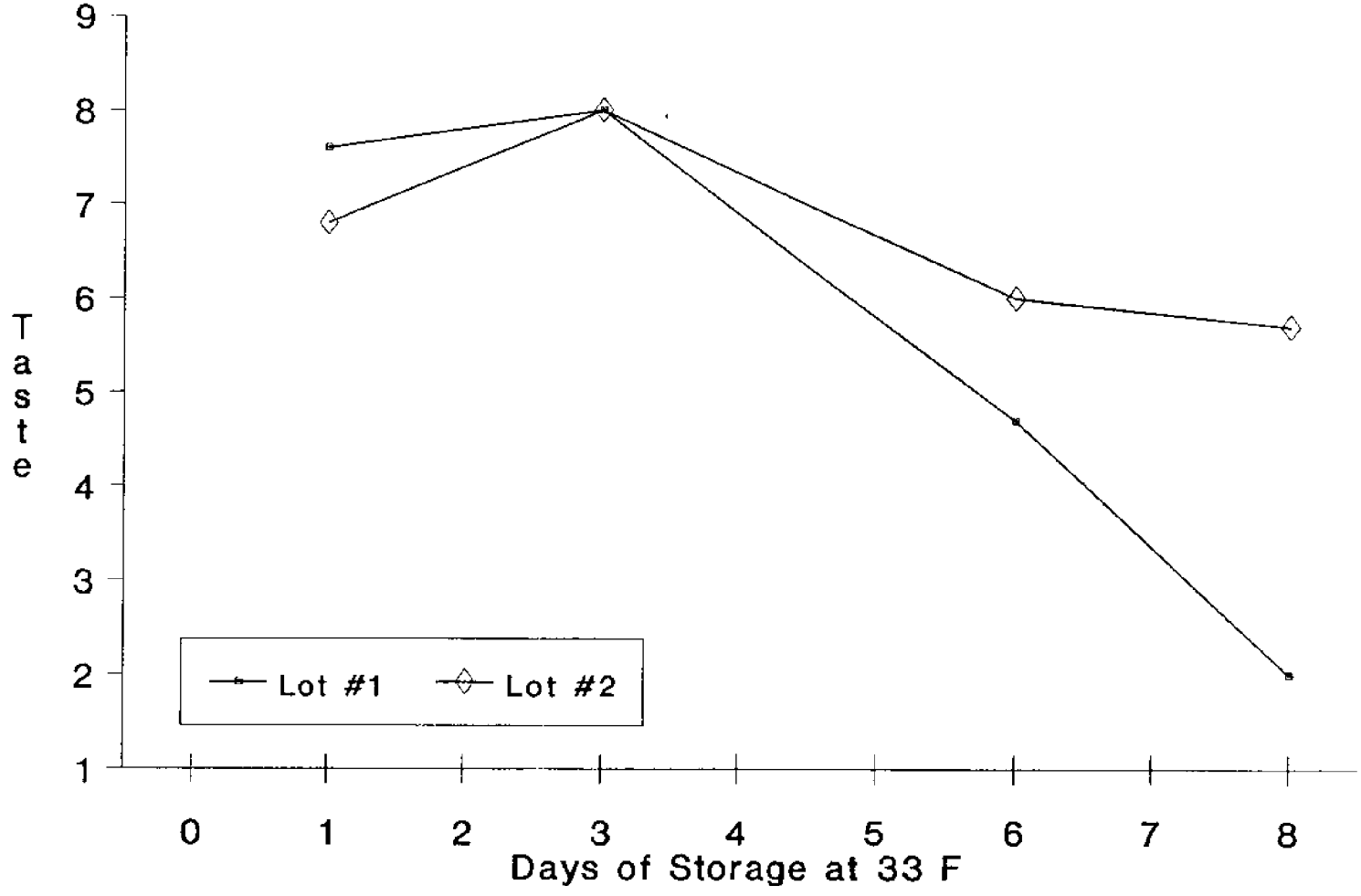


Figure 6. Aerobic 20 C Microbial Counts of Sea Trout

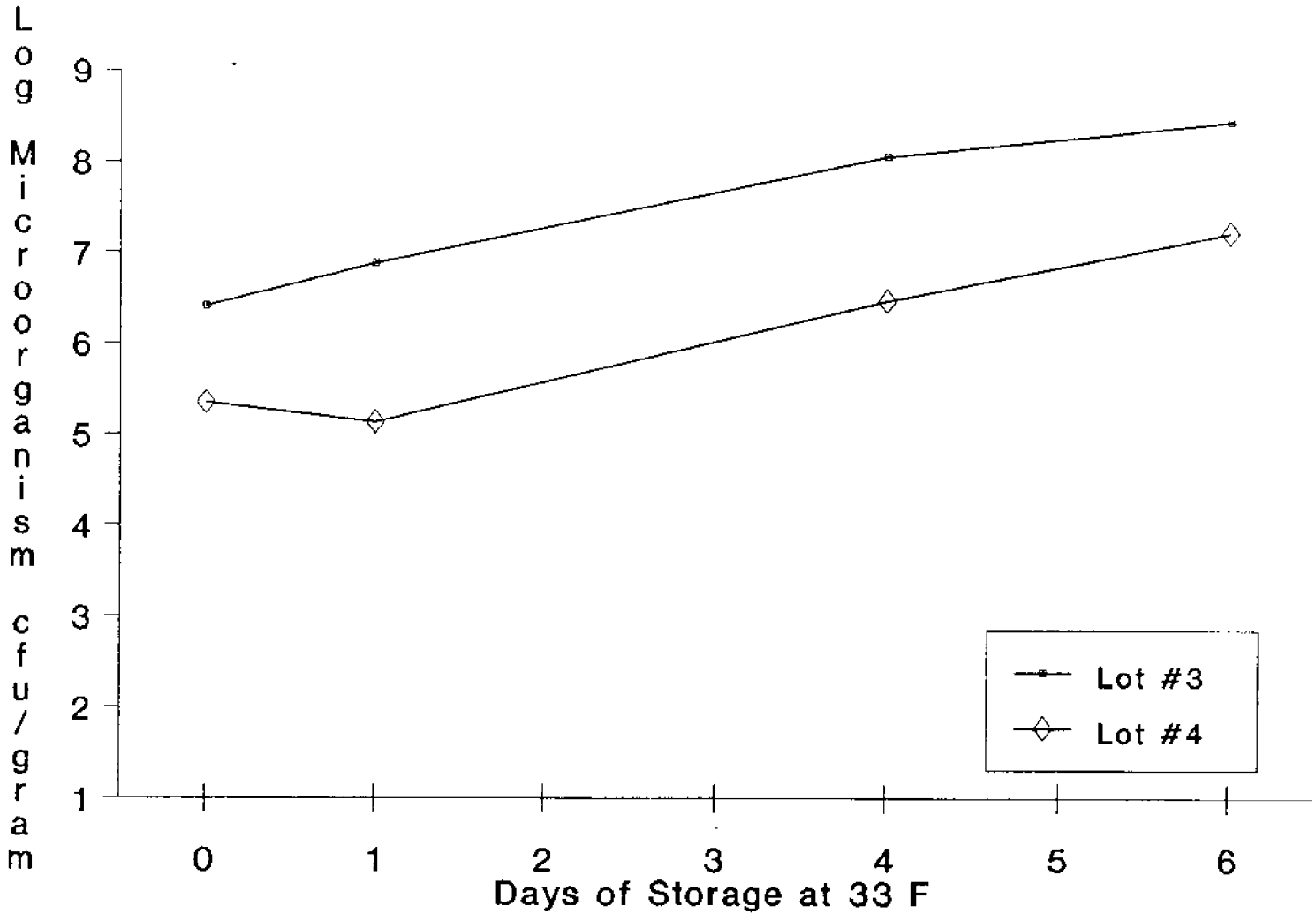


Figure 7. Raw Appearance Sensory Scores of Sea Trout

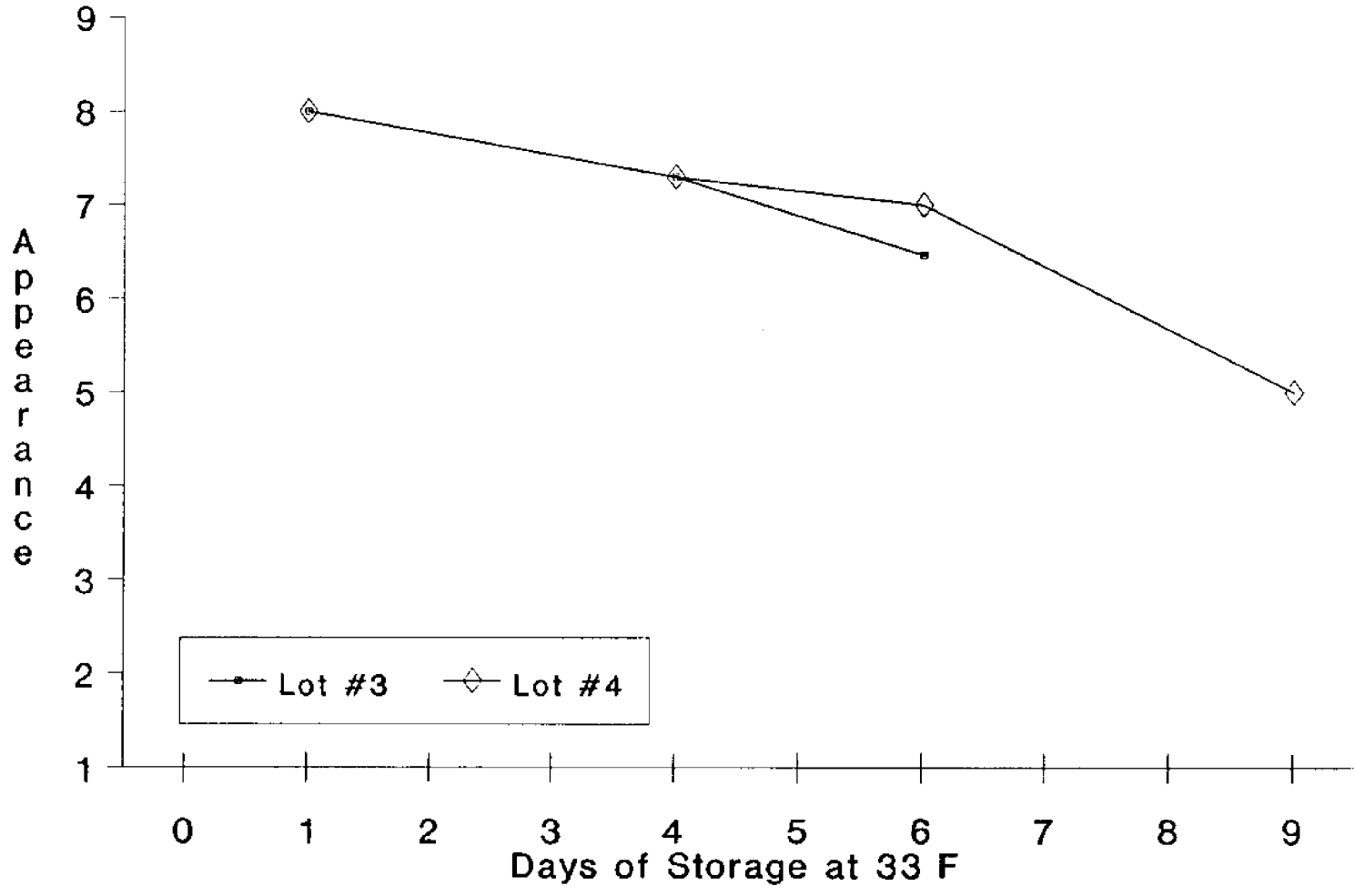


Figure 8. Raw Odor Sensory Scores of Sea Trout

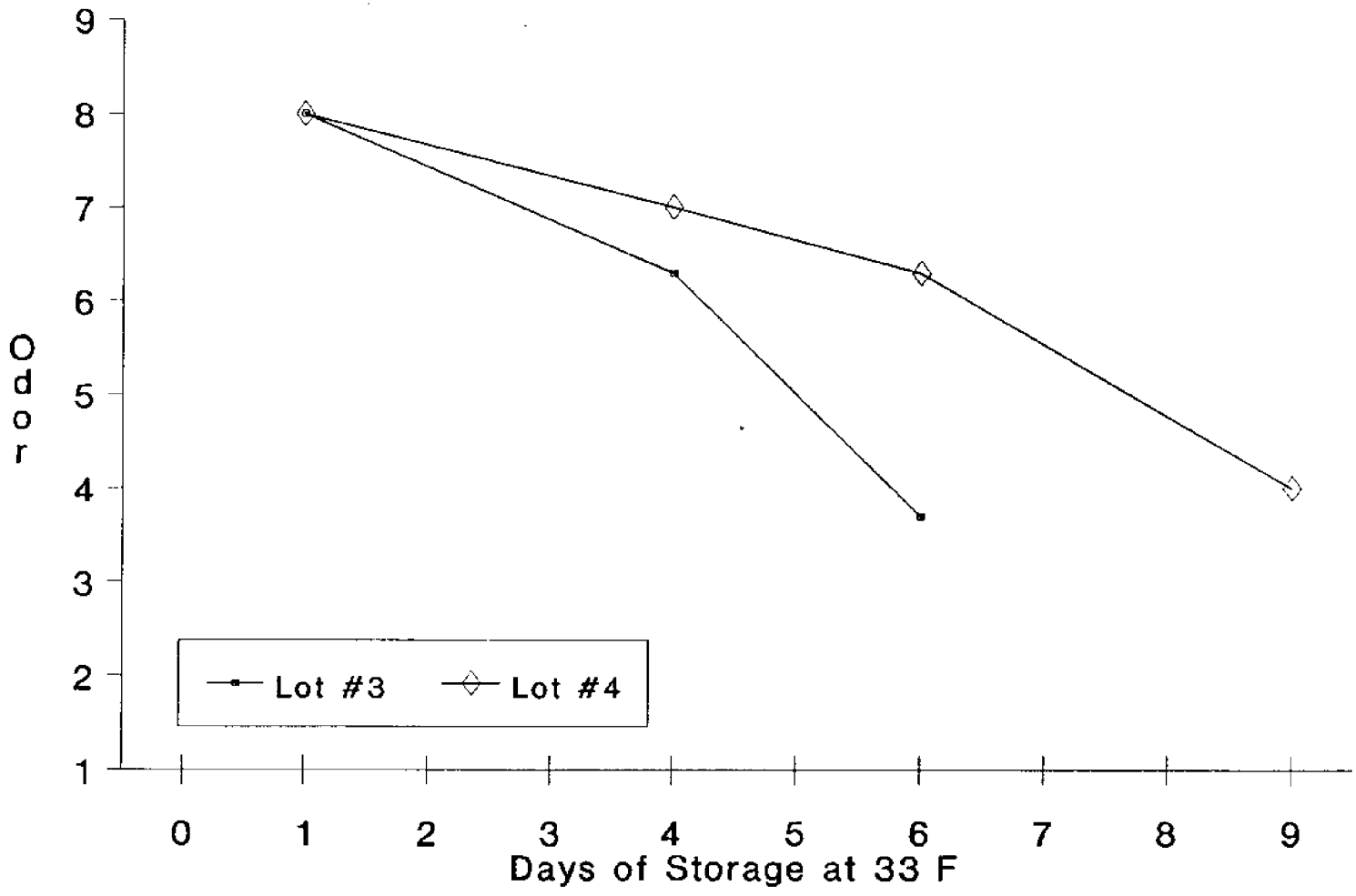


Figure 9. Cooked Odor Sensory Scores of Sea Trout

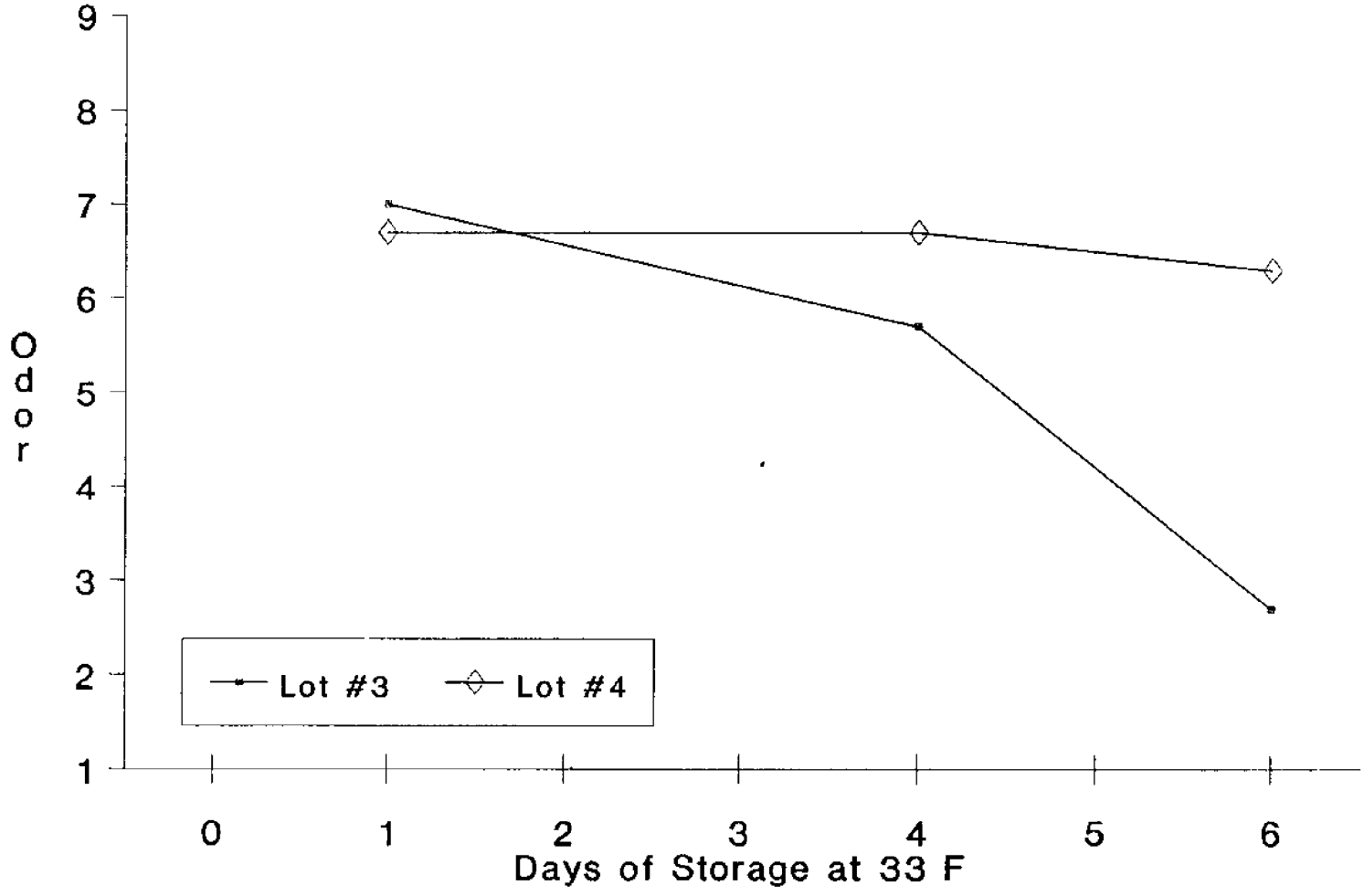
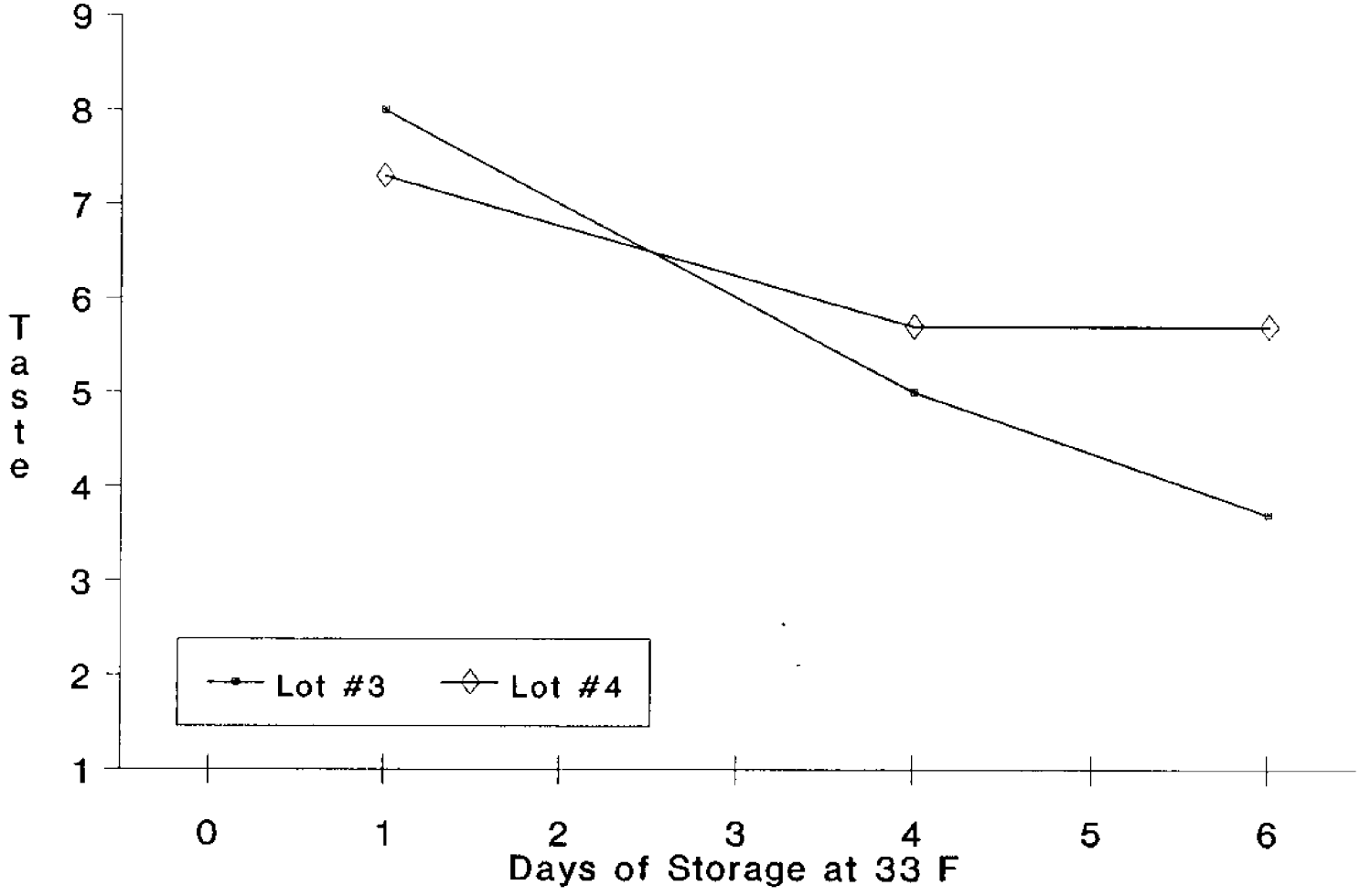


Figure 10. Cooked Taste Sensory Scores of Sea Trout



Conclusions from dockside grading project.

From the microbiological and sensory analysis data (tables 1 - 4, figures 1 - 10) it is apparent that Flounder lot # 2 was superior in quality to lot # 1 and that lot # 4 of Gray Sea Trout was superior in quality to lot # 3. The ability of the grading methods applied, to distinguish initial quality differences at dockside, varied with the species inspected.

The U.S. Department of Commerce/National Marine Fisheries Service standards were more selective in the grading of flounder than gray sea trout. While 100% of the sea trout in lots 3 and 4 were classified as grade A, 80% and 85% of the flounder in lots 1 and 2 made grade A classification. The remainder of the flounder were classified as grade B. The greater number of minor defects assigned to the flounder were mainly due to gill discoloration defects. 80% and 85% of the flounder in lots 1 and 2 had minor defects due to gill discoloration, compared to 10% and 22% (lots 3 and 4) of the sea trout. With this methodology however, differences in the overall grading of the lots, relative to quality and available shelf-life, were not discernable.

Inspection by the Maine Department of Marine Resources Freshness Assurance Standards provided numeric scores which were slightly greater for lot # 2 of flounder and lot # 4 of sea trout. However, only the difference between lots 1 and 2 of flounder was statistically significant (ANOVA, Duncan's $\alpha = .05$).

Application of the Canadian grade standards, for lot inspection, was the most critical method of assessing overall quality. Lot # 1 of flounder had 45% grade A, 50% grade B, and 5% grade C fish. In comparison lot # 2, which was determined to have a longer shelf-life, had 75% grade A and 25% grade B fish. In lot # 1, a significant number of B grades were assigned due to the presence of blood clots and bruising in the fillets. Since the other inspection methods graded whole fish and not fillets, these defects were not detected.

Inspection of gray sea trout, by the Canadian groundfish standards, also demonstrated significant differences in overall quality. Lot # 3 had 0% grade A, 40% grade B, and 60% grade C fish. Lot # 4, which had a longer shelf-life, consisted of 30% grade A fish, 10% grade B fish, and 60% grade C fish. It was apparent with this methodology, however, that the standard for assessing texture would have to be modified. All of the B and C grades were assigned because of the degree of gaping in the fillets. Gray sea trout is inherently a soft fleshed fish that is prone to gaping. The Canadian standards for texture specify that only up to 10% of the surface area can display gaping for grade A designation. Grade B fish are allowed 10% to 25% gaping and grade C fish are allowed 25% to 75%. If greater than 75% of the surface is gaping the fish is rejected. A modification of this scale, to allow a greater tolerance for gaping, would be necessary in this

case.

Inspection by the Bremner demerit scoring system assigned slightly better quality scores to flounder lot # 2 and sea trout lot # 4 (these lots displayed a longer shelf-life). The differences were statistically significant (ANOVA, Duncan's α = .05). It may be possible, however, to reduce the variability by modifying the scoring system to be more specific for mid-Atlantic fish.

Analysis with the torrymeter was also variable. While the average scores were higher for lots 2 and 4, the difference was statistically significant only between lots 1 and 2 of flounder (ANOVA, Duncan's α = .05). There may not have been enough difference in the age of the fish for the torrymeter to further distinguish between the overall quality of the lots.

II) Extending the Shelf-life of Fresh Fish

Objective

Previous studies, conducted during parts I and II of the Quality Maintenance Program, have indicated that the fresh shelf-life of processed finfish can be effectively extended by reducing surface microflora. In this study, part IV, experiments continued with the following treatments.

Summary of Treatments

1) High pressure wash.
2) High pressure washing with surfactants.
3) Bionox application.
4) Various combinations of high pressure washing with surfactants and Bionox application.

Methodology

The effectiveness of a high pressure wash in reducing the surface microflora of fresh mid-Atlantic fish was tested with a portable high pressure washer. The portable high pressure washer, which was designed for equipment cleanup (Hydro Blitz Model 610-B, Hydro-Systems Co., Cincinnati, OH.) has a single spray wand and a rating of approximately 600 psi. The spray nozzle of the washer was passed over the surface of the sample at a distance of approximately six inches. By making six passes per side, the washing action desired from a single pass mechanized high pressure washer was simulated.

High pressure washing was also tested with the following surfactants; cetylpyridinium chloride a cationic detergent (Sigma Chemical Co., St. Louis, MO.), Tergitol type 15-S-12 a nonionic detergent (Sigma Chemical Co.) and poly-tergent CS-1 (Olin Corp., Stamford, Conn.). All of these surfactants were applied at a 0.1% (v/v) concentration.

Bionox, a patented sanitizing solution, was tested to determine if its application could be effective in reducing surface microflora. Bionox is a highly concentrated hypochlorite solution (approximately 2000 ppm) which degrades rapidly after application.

Reduction in the surface microflora of fish was monitored by aerobic plate counts (APC). Whole and dressed fish were sampled by surface swabs, while fillets were sampled by taking meat samples. This methodology has been described in Appendix V.

Differences in acceptable shelf-life was determined by the National Marine Fisheries Service 9 point hedonic scale with a 5 member trained sensory panel. A grade of 9 corresponded to excellent, 5 corresponded to borderline, and a grade of 1 corresponded to inedible (Appendix V).

Results and Discussion

In an effort to determine which stages of processing are most suitable for high pressure washing, gray seatrout were high pressure washed whole (after scaling) and after filleting (skin-on). High pressure washing the whole scaled trout reduced the aerobic plate count (APC) from an average of 5.55 to 2.84 log cfu/in^2, for an average log reduction was 2.71 (Table 5a). After filleting under sanitary conditions and rinsing under tap water the APC of the processed fillets averaged 3.23 log cfu/g (Table 5b, HPW Whole).

Seatrout which were not subjected to high pressure washing during processing and simply rinsed under tap water after filleting had an average APC of 4.33 log cfu/g. The seatrout which were high pressure washed before and after filleting had an average APC of 2.47 log cfu/g (Table 5b).

Fillets from these treatments were traypacked, under sanitary conditions, and refrigerated at 33°F for shelf-life determination. Figure 11 shows the APC results though 8 days of storage. Throughout the shelf-life study, the fillets which were treated with a tap water rinse had substantially higher APC than the other treatments. The fillets which were high pressure washed before and after processing (HPW Whole/Fillet) had the lowest APC on day 1 of storage (2.50 log cfu/g). By day 4 however, the APC was very similar to the APC of the fillets obtained from the trout which were high pressure washed before processing (HPW Whole). The counts were 4.75 and 5.05 log cfu/g, respectively.

Throughout the shelf-life, the fillets were also subjected to sensory analysis (Appendix V). From the raw appearance sensory scores (Figure 12) it was evident that the fillets which were high pressure washed before and after processing (HPW Whole/Fillet) had the lowest appearance scores throughout the study. High pressure washing made the fillets appear whiter, slightly more ragged and the connective tissue was more visible (raw appearance sensory score of 7.5 on day 1 of storage). The fillets which were either rinsed or obtained from high pressure washed whole trout had very similar raw appearance scores on day 1 (8.4 and 8.5). Throughout the remainder of the shelf-life however, the rinsed fillet scores were lower.

Cooked taste sensory scores displayed a different trend (Figure 13). On day 1 of storage, the fillets from all three treatments had similar scores. The averaged scores ranged from 8.0 to 8.1. On day 4, both the rinsed fillets and the fillets which were high pressure washed before and after processing, had average scores of 6.3. The fillets obtained from high pressure washed whole trout had a slightly higher score of 6.8. On day 8, the final day of shelf-life, taste differences were reported between of all three treatments. The fillets which had the highest

average cooked taste score were those that were high pressure washed both before and after processing (6.3). The fillets which were obtained from high pressure washed whole trout were next, with an average score of 5.5. The rinsed fillets were most inferior in taste with an average score of 4.0.

Based on the data from this experiment it may be of greater benefit to the shelf-life and overall quality of the fillets to high pressure wash the fish whole before processing. While the second high pressure wash did provide slightly lower APC at the beginning of storage, the counts were very similar thereafter. The high pressure wash of the fillets did provide an extension in the quality of the cooked taste scores towards the end of shelf-life, however the raw appearance scores were consistently lower.

The effectiveness of high pressure washing with a variety of surfactants on reducing the surface microflora of whole gray seatrout has been summarized in Table 6. High pressure washing with tap water reduced the APC from an initial average of 7.22 to 5.08 log cfu/in^2, for an average log reduction of 2.14. When a 0.1% solution of cetylpyridinium chloride (CPC) was used in the high pressure wash, the average APC was reduced even further. The average APC of these treated fish was 1.19 log cfu/in^2 and the average log reduction from the initial counts was 6.03. High pressure washing with either 0.1% Tergitol 15-S-12 or 0.1% Olin SC-1 were not as effective. The average APC of the trout high pressure washed with these surfactants were both greater than 4.00 log cfu/in^2.

A second trial of high pressure washing trout with 0.1% CPC was performed and is summarized in Table 7. High pressure washing with tap water reduced the initial APC from an average of 6.32 to 4.33 log cfu/in^2, for an average reduction of 1.99 logs. High pressure washing with CPC reduced the APC an additional 0.95 log (average log reduction of 2.94). The average APC of the treated trout was 3.38 log cfu/in^2. While the surfactant CPC did provide additional microbial reduction over high pressure washing with tap water, the degree of reduction was much less than the first trial (Table 6). A possible explanation for this discrepancy may be a result of using different buffers for the swab samples. In the first trial the swabs were placed into 0.1% peptone buffer while the second trial used neutralizing buffer. CPC does have disinfectant properties which may have remained active in the peptone buffer.

The effectiveness of CPC on reducing the surface microflora of whole croaker was also tested (Table 8). A high pressure wash with tap water reduced the initial APC from an average of 6.50 to 4.39 log cfu/in^2, for an average log reduction of 2.11. High pressure washing with 0.1% CPC reduced the initial APC much further. The treated croaker had an average APC of 3.31 log cfu/in^2, for a 3.19 average log reduction from initial counts.

Dipping the croaker in 0.1% CPC for 2 minutes prior to high pressure washing with tap water provided croaker with an average APC of 3.70 log cfu/in^2, which is 0.69 log lower than the croaker that were high pressure washed with tap water alone. The last treatment in this study consisted of dipping the croaker in 0.1% CPC for 2 minutes and then rinsing with tap water. This treatment resulted in a slight reduction (0.56 log) from the initial APC. The treated croaker had an average APC of 5.94 log cfu/in^2.

In a second trial of high pressure washing croaker with 0.1% CPC the croaker were scaled prior to treatment (Table 9). Scaling and rinsing the croaker reduced the APC from an initial average of 6.50 to 5.87 log cfu/in^2, for a 0.63 average log reduction. Scaling and high pressure washing with 0.1% CPC reduced the average APC to 2.43 log cfu/in^2, for a 4.07 average log reduction. Scaling, prior to high pressure washing with CPC therefore, increased the effectiveness of reducing the APC by 0.88 log (compared to HPW CPC treatment in Table 8).

In Table 10 the effectiveness of Bionox on reducing the surface microflora of gray seatrout was tested. In this study whole seatrout were sprayed on both sides with Bionox, allowed to set for 10 minutes, sprayed again and then rinsed with tap water. This treatment reduced the APC from an initial average of 5.25 to 3.86 log cfu/in^2. The average log reduction was 1.39.

In another study, scaled and dressed croaker were subjected to a high pressure wash with 0.1% CPC followed by a Bionox spray application (Table 11). This treatment reduced the APC from an initial average of 5.57 to 1.68 log cfu/in^2 (the lowest APC obtained for croaker), for a 3.89 average log reduction.

The effectiveness of Bionox application and high pressure washing with tap water was tested in the experiment listed in Table 12. Whole flounder which were sprayed with Bionox, allowed to set for 2 minutes, and then rinsed with tap water had a 1.39 average log reduction in APC. The APC was reduced from an initial average of 4.76 to 3.37 log cfu/in^2. By following this treatment with a high pressure wash, the average APC was reduced an additional 1.15 logs to 2.22 log cfu/in^2.

Bionox application was also tested on gray seatrout fillets (Table 13). A 10 minute application of Bionox reduced the APC from an initial average of 4.18 to 2.98 log cfu/g, for a 1.20 average log reduction.

A study testing the effectiveness of reducing the surface microflora of cod fillets, by high pressure washing with 0.1% CPC, is summarized in Table 14. Here however, very little reduction was achieved. The APC of the rinsed fillets averaged 5.13 log cfu/g and high pressure washing with tap water reduced this figure by only 0.39 log. High pressure washing with 0.1% CPC was equally

ineffective. This treatment resulted in only a 0.36 average log reduction. Sensory analysis of the high pressure washed cod fillets was not favorable. These fillets appeared whiter, slightly more ragged, and the connective tissue was much more visible. One sensory panelist commented that the high pressure washed fillets had a more stringy texture and watery flavor.

FIGURE 11. THE EFFECT OF A HIGH PRESSURE WASH ON AEROBIC 20°C MICROBIAL COUNTS OF GRAY SEATROUT.

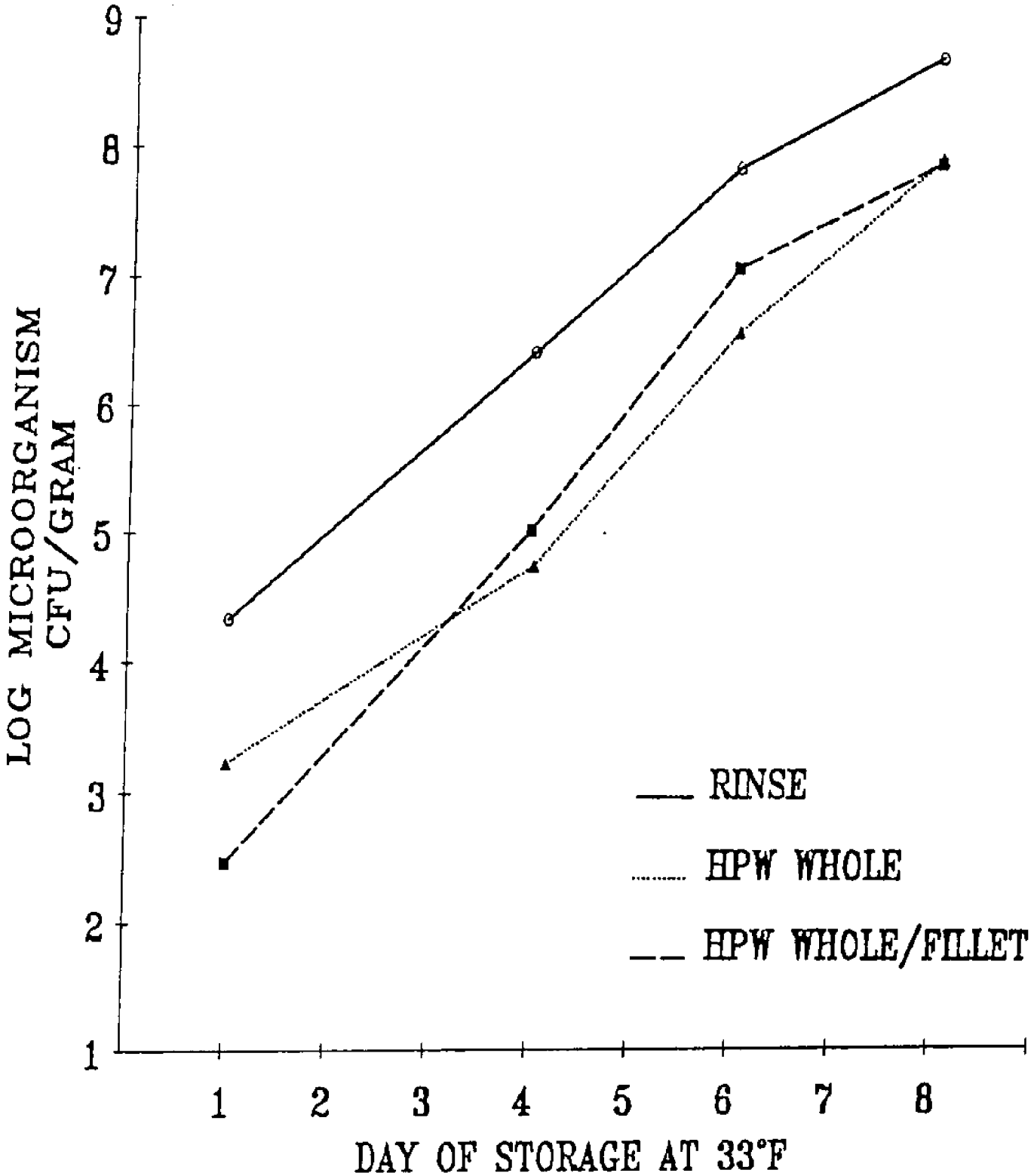


FIGURE 12. RAW APPEARANCE SENSORY SCORES OF HIGH PRESSURE WASHED GRAY SEATROUT.

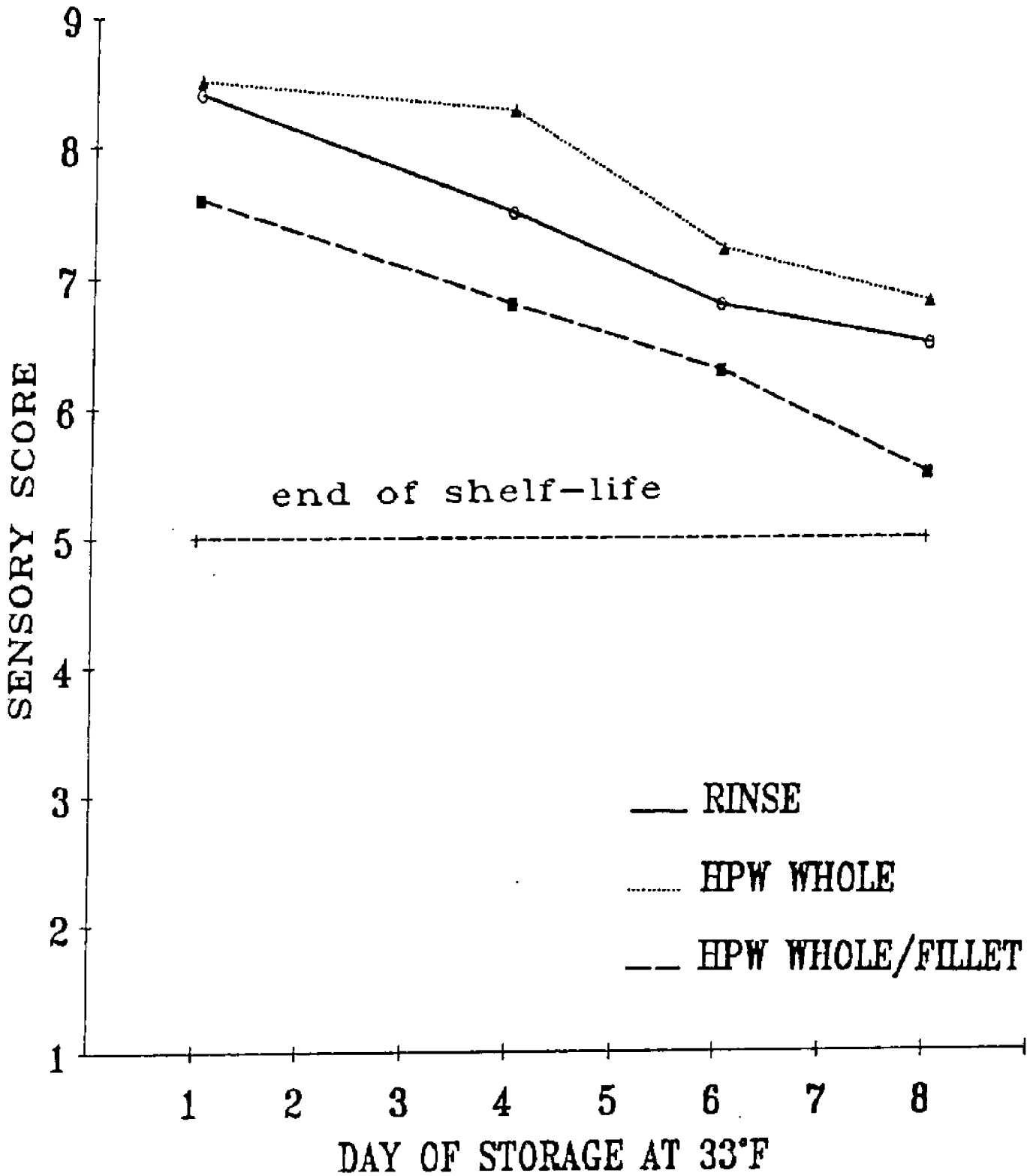


FIGURE 13. COOKED TASTE SENSORY SCORES OF HIGH PRESSURE WASHED GRAY SEATROUT.

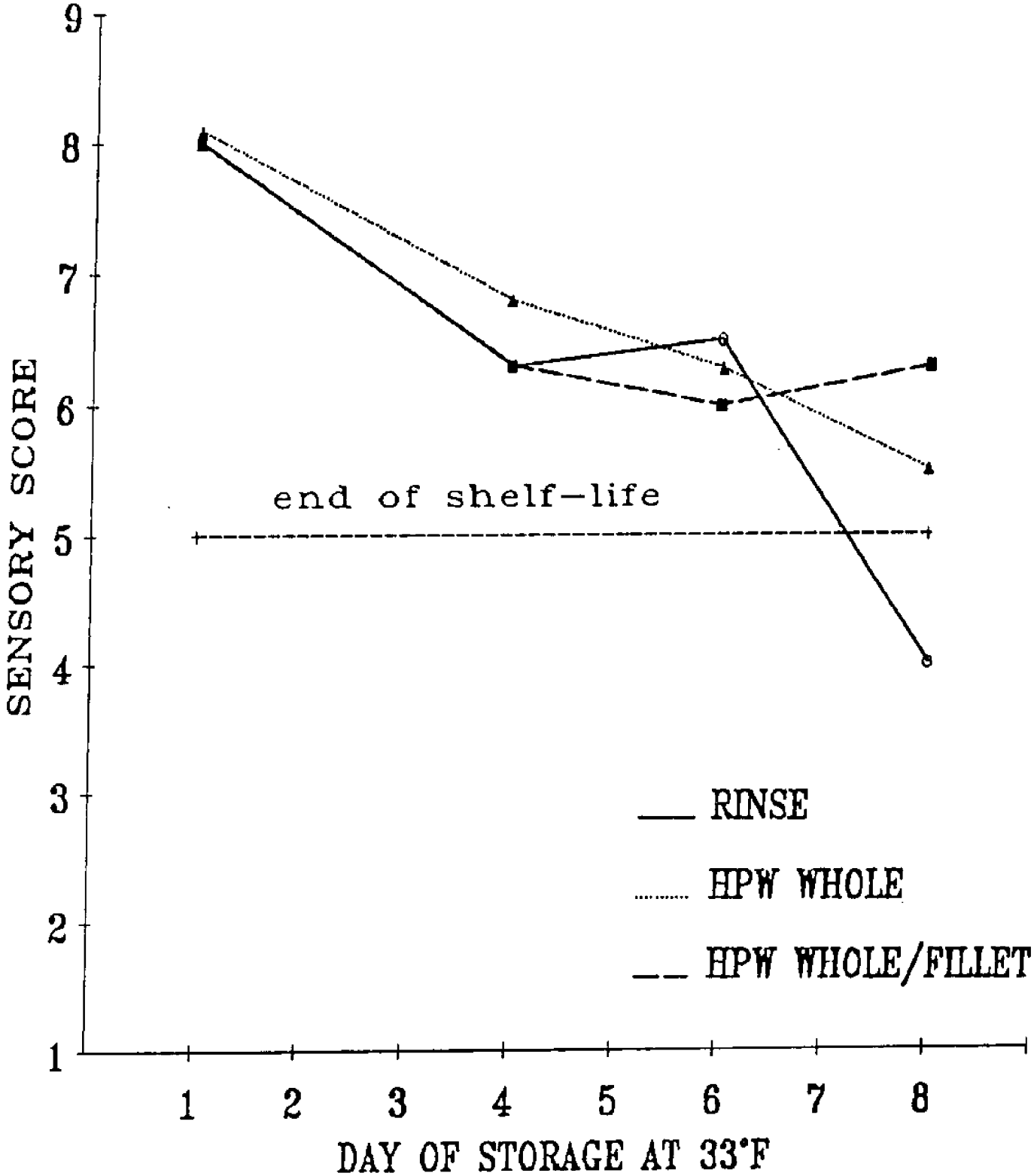


Table 5a. The Effect of a High Pressure Wash on Reducing the Surface Microflora of Whole Gray Seatrout.

Sampling Method: A 1"x3" area, on the right side of the whole fish, was swabbed with a sterile cotton swab and placed into 5ml of 0.1% peptone buffer before treatment. After treatment, the fish were reswabbed on the left side.

Treatment: Trout were scaled by hand and then high-pressure washed (6 passes/side) with a portable unit. This treatment corresponds to the treatment labelled HPW Whole in table 11b.

Results:	Initial	Treated	Log Reduction
APC 4 days @ 20°C (log cfu/in^2)	5.23	2.20	3.03
	5.74	2.72	3.02
	5.69	2.61	3.08
	5.31	3.89	1.42
	5.78	2.78	3.00
Average	5.55 +/- 0.23	2.84 +/- 0.22	2.71 +/- 0.65

Table 5b. The Effect of a High Pressure Wash on Reducing the Surface Microflora of Gray Seatrout Fillets.

Sampling Method: Gray seatrout were processed according to the treatments below. After treatment, the fillets were traypacked under sanitary conditions and refrigerated at 33°F. On day one of storage, samples were taken for microbiological analysis. 30g --> 270ml 0.1% peptone.

Treatments: Rinse: Trout were processed under sanitary conditions and the fillets were rinsed under tap water prior to traypacking.

HPW Whole: Trout were scaled by hand and then high pressure washed (6 passes/side) with a portable unit. Washed trout were then processed as skin-on fillets under sanitary conditions, rinsed under tap water and traypacked.

HPW Whole/Fillet: Trout were scaled by hand and then high pressure washed (6 passes/side) with a portable unit. Washed trout were then processed as skin-on fillets under sanitary conditions, subjected to a second high pressure wash and traypacked.

Results: APC 4 days @ 20°C (log cfu/g)

Rinse	HPW Whole	HPW Whole/Fillet
4.42	3.14	1.70
4.14	3.16	2.45
4.38	3.60	2.87
4.56	3.67	3.00
4.16	2.57	2.34
AVG +/- S.D. 4.33 +/- 0.16	3.23 +/- 0.39	2.47 +/- 0.46
Log reduction from rinse counts:	1.10	1.86

Note: The fillets appeared whiter, slightly more ragged and the connective tissue was more visible after high pressure washing.

Table 6. The Effect of High Pressure Washing with Surfactants on Reducing The Surface Microflora of Gray Seatrout.

Sampling Method: A 1"x3" area, on the side of the fish at the lateral line, was swabbed with a sterile polyester swab and placed into 5ml of 0.1% peptone buffer. All fish were rinsed under tap water prior to sampling or treatment.

Treatments: HPW = High pressure wash with tap water.

HPW CPC = High pressure wash with 0.1% cetylpyridinium chloride.

HPW Tergitol = High pressure wash with 0.1% Tergitol 15-S-12.

HPW SC-1 = High pressure wash with 0.1% Olin SC-1.

All high pressure washing was done with a portable unit (6 passes per side). The water or surfactant solution was pumped into the washer from an elevated container.

Results: APC 4 days @ 20°C (log cfu/in^2)

	Initial	HPW	HPW CPC	HPW Tergitol	HPW SC-1
	7.02	5.23	0.96	3.77	>4.00
	7.18	5.67	2.43	4.44	>4.00
	7.25	5.11	1.03	4.52	>4.00
	7.25	4.63	0.76	>4.00	>4.00
	7.38	4.78	0.52	>4.00	4.43
Avg +/- S.D.	7.22 +/-0.12	5.08 +/-0.36	1.19 +/-0.67	>4.00	>4.00
Log reduction from initial counts		2.14	6.03	<3.00	<3.00

Table 7. The Effect of a High Pressure Wash With a Surfactant on Reducing the Surface Microflora of Gray Seatrout.

Sampling Method: A 1"x3" area, on the side of the fish at the lateral line, was swabbed with a sterile polyester swab and placed into 5ml of neutralizing buffer. All fish were rinsed under tap water prior to sampling or treatment.

Treatments: HPW = High pressure wash with tap water.

HPW CPC = High pressure wash with 0.1% cetylpyridinium chloride.

All high pressure washing was done with a portable unit (6 passes per side). The water or surfactant solution was pumped into the washer from an elevated container.

Results: APC 4 days @ 20°C (log cfu/in^2)

Initial	HPW	HPW CPC
6.30	4.34	3.60
6.14	4.40	3.70
6.55	4.52	3.43
6.40	4.37	2.43
6.22	4.00	3.76
AVG +/- S.D. 6.32 +/- 0.14	4.33 +/- 0.17	3.38 +/- 0.49
Log reduction from initial counts:	1.99	2.94

Table 8. The Effect of High Pressure Washing with Surfactants on Reducing The Surface Microflora of Croaker.

Sampling Method: A 1"x3" area, on the side of the fish at the lateral line, was swabbed with a sterile polyester and placed into 5ml of neutralizing buffer. All fish were rinsed under tap water prior to sampling or treatment.

Treatments: HPW = High pressure wash with tap water.

HPW CPC = High pressure wash with 0.1% cetylpyridinium chloride -> tap water rinse.

DIP CPC HPW = 2 minute dip in 0.1% cetylpyridinium chloride -> tap water rinse -> high pressure wash with tap water.

DIP CPC RINSE = 2 minute dip in 0.1% cetylpyridinium chloride -> tap water rinse.

All high pressure washing was done with a portable unit (6 passes per side). The water or surfactant solution was fed into the washer from an elevated container.

Results: APC 4 days @ 20°C (log cfu/in^2)

Initial	HPW	HPW CPC	DIP CPC HPW	DIP CPC RINSE
6.79	4.41	3.03	3.78	5.81
7.30	4.52	2.99	3.69	6.04
6.67	3.82	3.31	3.41	5.76
6.26	4.25	3.19	3.28	5.82
5.48	4.94	4.01	4.33	6.26
AVERAGE 6.50 +/-0.61	4.39 +/-0.36	3.31 +/-0.37	3.70 +/-0.36	5.94 +/-0.19
Log reduction from initial counts	2.11	3.19	2.80	0.56

Note: HPW did not remove many of the fish scales. Swabs were taken in the direction of the scales only.

Table 9. The Effect of a High Pressure Wash with a Surfactant, after scaling, on Reducing the Surface Microflora of Croaker.

Sampling Method: A 1"x3" area, on the side of the fish at the lateral line, was swabbed with a sterile polyester swab and placed into 5ml of neutralizing buffer. All fish were rinsed under tap water prior to sampling or treatment.

Treatments: Rinse = Scale fish -> tap water rinse.

HPW CPC = Scale fish -> High pressure wash with 0.1% cetylpyridinium chloride -> tap water rinse.

All high pressure washing was done with a portable unit (6 passes per side). The surfactant solution was fed into the washer from an elevated container.

Results: APC 4 days @ 20°C (log cfu/in^2)

	Initial	Rinse	HPW CPC
	6.79	5.92	2.50
	7.30	6.30	2.93
	6.67	5.86	2.75
	6.26	5.52	2.22
	5.48	5.75	1.75
Avg +/- S.D.	6.50 +/- 0.61	5.87 +/- 0.25	2.43 +/- 0.42
Log reduction from initial counts		0.63	4.07

Table 10. The Effect of Bionox Application on Reducing the Surface Microflora of Gray Seatrout.

Sampling Method: A 1"x3" area, on right side of the whole fish, was swabbed with a sterile polyester swab and placed into 5ml of neutralizing buffer before treatment. After treatment, the fish were reswabbed on the left side. In this experiment individual fish were not labelled, therefore the swabs from the left and right sides may not correspond to the same fish. All fish were rinsed under tap water prior to sampling.

Treatment: 1) Bionox spray (set 10 minutes/spray again to wet).
2) Water spray rinse.

Results:

	Initial	Treated
APC 4 days @ 20°C (log cfu/in^2)	5.39	3.94
	5.45	4.07
	5.05	3.45
	5.15	3.83
	5.19	4.03
Average +/- S.D.	5.25 +/- 0.15	3.86 +/- 0.22
Log reduction from initial counts:		1.39

Table 11. The Effect of a High Pressure Wash with a Surfactant and Bionox Application on Reducing the Surface Microflora of dressed Croaker.

Sampling Method: A 1"x3" area, on the side of the fish at the lateral line, was swabbed with a sterile polyester swab and placed into 5ml of neutralizing buffer. All fish were rinsed under tap water prior to sampling or treatment.

Treatments: Rinse = Scale & dress fish -> tap water rinse.

HPW CPC BIONOX = Scale & dress fish -> High pressure wash with 0.1% cetylpyridinium chloride -> tap water rinse -> Bionox spray (set 10 minutes) -> tap water rinse.

All high pressure washing was done with a portable unit (6 passes per side). The surfactant solution was fed into the washer from an elevated container.

Results: APC 4 days @ 20°C (log cfu/in^2)

	Rinse	HPW CPC BIONOX
	5.52	0.70
	5.48	2.14
	5.80	1.76
	5.37	1.75
	5.68	2.05
Average +/- S.D.	5.57 +/- 0.15	1.68 +/- 0.51
Log reduction from rinse counts		3.89

Table 12. The Effect of a Bionox Application and a High Pressure Wash on Reducing the Surface Microflora of Flounder.

Sampling Method: A 1"x3" area, on the dark side of the whole fish, was swabbed with a sterile cotton swab and placed into 5ml of neutralizing buffer before treatment. A second set of fish were swabbed after treatment with Bionox spray and then again after high pressure washing with the portable unit. These swabs were taken on the dark side at different locations. All fish were rinsed under tap water prior to treatment or sampling.

Treatment:
1) Bionox spray (set 2 minutes).
2) Water spray rinse - sample.
3) High-pressure wash with portable unit (6 passes/side) - sample.

Results:

	Initial	Bionox Treated	Bionox + HPW Treated
APC 4 days @ 20°C (log cfu/in^2)	3.99	3.10	1.87
	5.30	3.15	2.35
	4.99	3.87	2.45
Average +/- S.D.	4.76 +/- 0.56	3.37 +/- 0.35	2.22 +/- 0.25
Log reduction from initial counts		1.39	2.54

Table 13. The Effect of Bionox Application on Reducing the Surface Microflora of Gray Seatrout Fillets

Sampling Method: Pan Trout were rinsed under tap water and then filleted, and skinned under sanitary conditions. For each fish tested, the right side fillet was sampled without further treatment, while the left side fillet was sampled after treatment. 30g --> 270ml 0.1% peptone.

Treatment: 1) Bionox spray (set 10 minutes/spray again to wet).
2) Water spray rinse.

Results:

	Initial	Treated	Log Reduction
APC 4 days @ 20°C (log cfu/g)	4.03	2.57	1.46
	4.62	3.03	1.59
	4.03	3.53	0.50
	4.30	2.81	1.49
	3.90	2.97	0.93
Average +/- S.D.	4.18 +/- 0.26	2.98 +/- 0.32	1.20 +/- 0.42

Table 14. The Effect of a High Pressure Wash on Reducing the Surface Microflora of Cod Fillets.

Sampling Method: Cod fillets (Canadian) were obtained from a local distributor. After treatment, samples were aseptically removed from the center of each fillet. 30g --> 270ml neutralizing buffer.

Treatments: Rinse = Tap water rinse.

HPW = High pressure wash with tap water.

HPW CPC = High pressure wash with 0.1% cetylpyridinium chloride.

All high pressure washing was done with a portable unit (6 passes per side). The water or surfactant solution was pumped into the washer from an elevated container.

Results: APC 4 days @ 20°C (log cfu/g)

	Rinse	HPW	HPW CPC
	5.13	4.84	4.85
	5.45	4.55	4.66
	5.12	4.83	4.79
	5.01		
	4.96		
AVG +/- S.D.	5.13 +/- 0.17	4.74 +/- 0.13	4.77 +/- 0.08
Log reduction from rinse counts:		0.39	0.36

Note: The fillets appeared whiter, slightly more ragged and the connective tissue was more visible after high pressure washing.

One sensory panelist commented that the high pressure washed fillets had a more stringy texture and watery flavor.

Conclusions

This data indicates that quality can be better maintained by high pressure washing whole fish, prior to filleting, rather than high pressure washing the fillets themselves. The physical appearance of the fillets, especially those from soft fleshed fish, is easily abused by high pressure spray.

A number of alternative treatments have been revealed. High pressure washing whole fish with 0.1% CPC and Bionox application were very successful in reducing the surface microflora. Dipping in CPC prior to high pressure washing with tap water was also effective. From this study the following treatment, for providing high quality fillets with low microbial counts, could be recommended.

1) Scale fish and rinse with tap water (especially important with large scaled fish).

2) High pressure wash with a 0.1% solution of CPC. As an option the fish could be dipped in CPC and then be high pressure washed with tap water.

3) Spray fish with Bionox (optional).

4) Fillet fish under sanitary conditions.

5) Spray the fillets with Bionox (optional).

III) Use of Sodium Bicarbonate in Absorbent Pads for Controlling Odors of Tray-packed seafood.

Objective

Research has continued on the effectiveness of sodium bicarbonate in controlling fish odors in tray-packed products. In previous studies (Quality Maintenance Program Part II) the processed fish were stored in jars and the headspace gas was evaluated for odor intensity. These studies indicated that the addition of sodium bicarbonate, to the absorbent pads, may be beneficial in reducing the intensity of odor. The addition of 5 grams of bicarbonate was slightly more effective than pads containing just 2 grams, while 1 gram had no noticeable effect. Since these results were not conclusive, the following study was performed, in which the fish were overwrapped as they would be for self-service retail sale. Three variables were evaluated; (1) control with a normal absorbent pad; (2) an absorbent pad containing 5 grams of bicarbonate; (3) a normal absorbent pad plus a tissue packet containing 5 grams of bicarbonate placed next to the fish. The bicarbonate was added externally in the third variable to determine if the practice of adding the bicarbonate inside the absorbent pad (where it becomes wet and matted down under the weight of the fish) restricts odor absorption.

Methodology

The fish were processed under sanitary conditions, tray-packed according to the preceding variables, and stored at 33°F. After various lengths of storage, two traypacks per variable were removed on each sampling day. The headspace gases were removed with a 1 liter syringe and evaluated by a trained panel for odor intensity on a scale from 1 to 10 (10 being representative of very fresh fish).

Results and Conclusions

In two trials with tray-packed dressed croaker (Tables 15 - 16), one trial with dressed seatrout (Table 17), and one trial with Spanish mackerel fillets (Table 18), there were no consistent differences in the odor intensities of the three variables. From these experiments, it can be concluded, that if sodium bicarbonate does help reduce odors in tray-packed seafood, the reduction is not readily noticeable or statistically significant (ANOVA $\alpha = .05$) by subjective sensory analysis.

Table 15. Effect of Sodium Bicarbonate on Odor Sensory Scores of Tray-packed Atlantic Croaker.

Day of Storage[a]	No Bicarbonate	Bicarb/Pad[b]	Bicarb/Tissue[c]
1	8.7 ± 0.9	8.3 ± 0.5	9.0 ± 1.4
2	7.0 ± 1.4	8.0 ± 1.4	7.3 ± 1.9
3	7.0 ± 1.4	5.7 ± 0.9	6.3 ± 0.5
4	6.0 ± 2.2	7.7 ± 1.2	7.7 ± 1.2
7	4.5 ± 1.5	6.3 ± 1.8	4.5 ± 1.1
8	2.5 ± 0.9	5.3 ± 1.8	4.5 ± 0.9

[a]Dressed Croaker (approximately 3/4 lb per tray-pack) refrigerated at 33°F.

[b]Sodium bicarbonate (5 grams) was added to the absorbent pad.

[c]Sodium bicarbonate (5 grams) was packaged inside a tissue and placed in the tray-pack next to the fish.

Table 16. Effect of Sodium Bicarbonate on Odor Sensory Scores of Tray-packed Atlantic Croaker.

Day of Storage[a]	No Bicarbonate	Bicarb/Pad[b]	Bicarb/Tissue[c]
1	8.5 ± 1.1	8.5 ± 1.1	8.3 ± 0.4
2	6.3 ± 2.0	7.5 ± 1.5	7.0 ± 1.9
6	3.3 ± 2.1	2.7 ± 1.2	5.7 ± 0.9
7	2.5 ± 1.5	2.5 ± 0.5	5.5 ± 0.5

[a]Dressed Croaker (approximately 3/4 lb per tray-pack) refrigerated at 33°F.

[b]Sodium bicarbonate (5 grams) was added to the absorbent pad.

[c]Sodium bicarbonate (5 grams) was packaged inside a tissue and placed in the tray-pack next to the fish.

Table 17. Effect of Sodium Bicarbonate on Odor Sensory Scores of Tray-packed Gray Seatrout.

Day of Storage[a]	No Bicarbonate	Bicarb/Pad[b]	Bicarb/Tissue[c]
1	8.3 ± 1.0	9.1 ± 0.6	8.6 ± 0.9
3	7.0 ± 0.7	6.9 ± 1.5	6.6 ± 2.2
6	3.3 ± 1.2	5.0 ± 0.8	5.7 ± 1.2
8	3.3 ± 1.8	1.3 ± 0.4	3.0 ± 1.2

[a]Dressed Pantrout (approximately 3/4 lb per tray-pack) refrigerated at 33°F.

[b]Sodium bicarbonate (5 grams) was added to the absorbent pad.

[c]Sodium bicarbonate (5 grams) was packaged inside a tissue and placed in the tray-pack next to the fish.

Table 18. Effect of Sodium Bicarbonate on Odor Sensory Scores of Tray-packed Spanish Mackerel.

Day of Storage[a]	No Bicarbonate	Bicarb/Pad[b]	Bicarb/Tissue[c]
2	5.7 ± 1.7	7.7 ± 0.5	7.7 ± 1.2
5	6.4 ± 1.5	4.8 ± 2.8	6.0 ± 0.9
8	3.8 ± 1.5	4.8 ± 2.6	3.5 ± 1.5

[a]Skin-on Spanish Mackerel fillets (approximately 3/4 lb per tray-pack) refrigerated at 33°F.

[b]Sodium bicarbonate (5 grams) was added to the absorbent pad.

[c]Sodium bicarbonate (5 grams) was packaged inside a tissue and placed in the tray-pack next to the fish.

IV) USDC/NMFS Grade A Inspection

Objective

During part III of the Seafood Quality Program, considerable effort was applied to process mid-Atlantic fish capable of receiving grade A designation. A major obstacle, to fulfilling this goal, was the lack of specifications for many of the mid-Atlantic fish species. The standards that were applied are generic standards for grading whole or dressed fish (Appendix I) and fish fillets (Appendix VI).

All dressed fish (mackerel, whiting, porgy, sea bass, and croaker) failed to pass for grade A because of the gut cavity. It was required for grade A that all traces of the kidney be removed. Although this can be accomplished by slicing the membrane, brushing and washing, the task is too tedious and cost prohibitive on a production level. Larger fish could more easily be handled. Additional minor defects had been assigned for scales, cutting defects, and discolored belly flaps.

Fillets of mackerel, bluefish, and seatrout also failed grade A approval. These species could not pass the stringent specifications for generic white boneless fish fillets. Mackerel fillets failed because of the floating pin bones which run down the center. Our best chance of acquiring grade A was with the bluefish and seatrout fillets. Our efforts also failed here, however due to pin bones, or the quality of the cut. Seatrout fillets were particularly troublesome due to the soft nature of their flesh.

The purpose of this current study, was to reevaluate the inspection of processed mid-Atlantic fish by generic standards, which appear to be designed for north Atlantic fish species.

Results

The following species and market forms of mid-Atlantic fish were sent to the USDC/NMFS Northeast Lot Inspection Office in Gloucester, MA.; dressed Atlantic croaker, dressed spot, skin-on Spanish mackerel fillets, skin-on flounder fillets, and skinless gray seatrout fillets. All fish were of excellent quality at the time of processing.

The dressed Atlantic croaker met grade A standards with zero defects (August 1 report), while dressed spot met grade A standards with a minor defect assigned for discolor-ation of belly flaps (August 18 report).

From three lots of skin-on Spanish mackerel fillets, the first lot failed to meet grade A standards due to the presence of bones. An excessive defect was assigned because over four instances of bones were found in one sample unit (August 1 report). When the majority of the pin bones were removed, by making a deep "V" cut,

a second lot of mackerel fillets did meet grade A standards for fish fillets. Minors were assigned for bones, but no major defects were found (August 18 report). A third lot of mackerel fillets, which were also processed using a deep "V" cut, met grade A standards with minor defects assigned for slightly soft texture and skin defects (September 30 report). Single lots of skin-on flounder fillets and gray seatrout fillets met grade A standards with zero defects (September 30 report). A second lot of gray sea trout also met grade A standards, however, minor defects were assigned for bones (August 18 report).

MP

NOAA FORM 89-806 (8-73)

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

MEMORANDUM – REPORT OF FISHERY PRODUCTS INSPECTION FOR UNOFFICIAL SAMPLES

M. R. NUMBER: GL-22-88

Please state this number and date when referring to this report

DATE: August 1, 1988

TO: *(Name and mailing address)*

Virginia Cooperative Extension Service
102 S. King St., P.O. Box 369
Hampton, VA 23669

FROM: ORGANIZATION

USDC/NOAA/NMFS/Northeast Inspection Staff

OFFICIAL MAILING ADDRESS

P.O. Box 1188

CITY

Gloucester, MA 01930

The unofficial fishery product sample(s) submitted by you on the date indicated has/have been examined in accordance with the applicable product specification or standard. Results of the inspection are itemized below:

DATE SAMPLES SUBMITTED: July 27, 1988

PRODUCT INSPECTED	LABEL OR CONTAINER		SAMPLES		CODE
	MARKINGS	PRINCIPAL TITLE *(If any)*	NUMBER	SIZE	
Atlantic Croaker	none	none	1	1 lb.	none
Product meets according to subpart A United States Standards for Grades of Whole or Dressed Fish. Product possesses good flavor and odor.					
Spanish Mackerel Fillets			1	1 lb.	none
Product fails according to subpart A United States General Standards for Grades of Fish Fillets. Product possesses good flavor and odor. Product fails due to bones.					

REMARKS

Sample submitted by applicant.
Bones: over 4 instances bones found in sample unit.

OFFICIAL INSPECTION

TIME AND EXPENSES		
HOURS	1	VA Tech.
FEE		
EXPENSES		

OFFICIAL INSPECTOR

Marian A. Parco

(Signature)

NOAA FORM 89-806
(8-73)

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

MEMORANDUM – REPORT OF FISHERY PRODUCTS INSPECTION FOR UNOFFICIAL SAMPLES

M. R. NUMBER
Please state this number and date when referring to this report
GL-2488
DATE
August 18, 1988

TO: *(Name and mailing address)*
Virginia Cooperative Extension Service
102 S. King Street - P.O. Box 369
Hampton, VA 23669

FROM: ORGANIZATION
USDC/NOAA/NMFS/Northeast Inspection Staff
OFFICIAL MAILING ADDRESS
P.O. Box 1188
CITY
Gloucester, MA 01930

The unofficial fishery product sample(s) submitted by you on the dateiindicated has/have been examined in accordance with the applicable product specification or standard. Results of the inspection are itemized below:

DATE SAMPLES SUBMITTED
August 18, 1988

PRODUCT INSPECTED	LABEL OR CONTAINER		SAMPLES		CODE
	MARKINGS	PRINCIPAL TITLE *(If any)*	NUMBER	SIZE	
Spot	none	none	1	1 lbs.	none

Product meets according to subpart A, United States Standards for Grades of Whole or Dressed Fish. Product possesses good flavor and odor.

Spanish Macherel fillets and Sea Trout fillets.
Product meets according to subpart A, United States General Standards for Grades of Fish fillets. Product possesses good flavor and odor.

REMARKS
Sample submitted by applicant.
Note on spot belly flaps showed slight discoloration.
Note on both fillet species minors were assigned for bones.

OFFICIAL INSPECTION

TIME AND EXPENSES		
HOURS	Virginia Tech	
FEE		
EXPENSES		

OFFICIAL INSPECTOR
Scott Dunsmore
(Signature)

NOAA FORM 89-806
(8-73)

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

MEMORANDUM – REPORT OF FISHERY PRODUCTS INSPECTION FOR UNOFFICIAL SAMPLES

Please state this number and date when referring to this report

M. R. NUMBER: GL-24-88

DATE: September 30, 1988

TO: *(Name and mailing address)*

Virginia Cooperative Extension Service
102 S. King Street
P. O. Box 369
Hampton, Va
23669

FROM: ORGANIZATION

USDC, NOAA, NMFS, Northeast Inspection Staff

OFFICIAL MAILING ADDRESS

P. O. Box 1188 - 28 Emerson Avenue

CITY

Gloucester, MA 01930

The unofficial fishery product sample(s) submitted by you on the date indicated has/have been examined in accordance with the applicable product specification or standard. Results of the inspection are itemized below:

DATE SAMPLES SUBMITTED: September 21, 1988

PRODUCT INSPECTED	LABEL OR CONTAINER		SAMPLES		CODE
	MARKINGS	PRINCIPAL TITLE *(If any)*	NUMBER	SIZE	
Spanish mackerel fillets	none	none	1	1 lbs.	none
Product meets according to Subpart A, United States Standards for grades of fish fillets. Product possesses good flavor and odor. Noted fillets were slightly soft and one fillet had some minor defects.					
Flounder fillets (Skin)					
Product meets according to subpart A United States Standards for Grades of flounder and sole. Flavor and odor: good					
Gray Sea trout fillets					
Product meets according to subpart A United States Standards for Grades of fish fillets. Flavor and odor: good					

REMARKS: sample submitted by applicant

OFFICIAL INSPECTION

TIME AND EXPENSES		
HOURS		
FEE		
EXPENSES		

OFFICIAL INSPECTOR

Marian A. Parco
(Signature)

Conclusions

While the lots of dressed fish inspected in this study did meet grade A standards for whole or dressed fish, the labor involved to adequately clean the belly cavity (slicing the membrane, brushing, and washing) of these small fish is too tedious and cost prohibitive to be done on a production level. Larger fish, which also have a higher market value, would be a better choice for inspection as grade A dressed fish.

Mid-Atlantic fish species, which can be processed into fillets, are the most likely candidates for grade A inspection. Spanish mackerel fillets were able to meet grade A standards after the majority of the pin bones were removed with a "V" cut. Seatrout and flounder fillets passed grade A standards with minors assigned for bones. In previous inspection trials, during the marketing phase of this program[4], seatrout and bluefish fillets could not pass grade A standards due to soft texture and gaping. This is especially prevalent in larger fish. For inspection of these species, on a full time basis, allowances may be required for some degree of gaping. Cutting and trimming defects, which were also encountered during the marketing phase, can be eliminated through careful handling in the cutting room. If the market will support the higher prices required for processing grade A fish, and if consistent standards are set for the inspection of mid-Atlantic fish, the availability of grade A fish can become a reality in the mid-Atlantic region.

4 A Seafood Quality Testing Program for the Mid-Atlantic Region - Part III. 1987. Mid-Atlantic Fisheries Development Foundation, Inc. Virginia Tech, Blacksburg, Va. 58 pp.

V) Storage of Menhaden and Squid in Refrigerated Water Containing Dissolved Carbon Dioxide.

Introduction

Traditionally the majority of finfish landed in the mid-Atlantic region are stored with wet ice. While storage with ice can provide high quality fish, the use of refrigerated seawater (RSW) systems have been shown to lengthen fresh shelf-life and slow down the quality degradation process[5,6]. Holding fish in RSW promotes rapid cooling and eliminates much of the crushing and bruising that occurs when fish are stored with ice in bulk. Controlling the growth of spoilage bacteria in the RSW can however be a problem, especially during extended trips[7]. The dissolved protein, slime, viscera and blood provides a medium that promotes bacterial growth which subsequently restricts quality maintenance. In an effort to reduce bacterial growth researchers have studied the effect of injecting carbon dioxide gas into the RSW[7,8]. This modified refrigerated seawater (MRSW) has a lower pH, due to the formation of carbonic acid. Upon saturation with carbon dioxide the pH of the MRSW is initially reduced from about 7.5 to 4.0. This acid condition helps to inhibit the growth of spoilage bacteria. Dissolved carbon dioxide also seems to inhibit the metabolic processes of spoilage bacteria as well as certain enzymatic spoilage.

Objectives

1. Evaluate the effect of injecting carbon dioxide into RSW, used for chilling and holding squid at sea, on quality and shelf-life.

The captain of a local mid-Atlantic fishing trawler, who is currently engaged in harvesting squid, has recently switched to a

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5. Peters, J.A., and J.A. Dassow. 1965. Improved methods of handling fresh fish in the United States. Part III.- Use of refrigerated sea water. Indo-Pac. Fish. Counc., Proc. 11th Sess. Sect. 3: 254-263.

6. Roach, S.W.., S.M. Harrison, and H.L.A. Tarr. 1961. Storage and transport of fish in refrigerated sea water. Fish. Res. Bd. Can., Bull. 126, 61 p.

7. Barnett et. al. 1971. Studies on the use of carbon dioxide dissolved in refrigerated brine for the preservation of whole fish. Fish. Bull. U.S. 69:433-442.

8. Barnett et. al. 1978. Use of carbon dioxide in refrigerated brine for the preservation of pink shrimp (Pandalus spp.). Marine Fisheries Review. 40:24-28.

RSW system for holding his catch at sea. This captain has been an important cooperator on previous quality projects. In an effort to further enhance shelf-life and maintain quality he has expressed interest in evaluating carbon dioxide injection.

2. Evaluate the effect of injecting carbon dioxide into refrigerated water (RW), used for chilling and holding menhaden, on quality and shelf-life.

Personnel at the pilot surimi production plant, in Reidville Virginia, have demonstrated that the quality of the menhaden processed at their facility is very important. Without high quality menhaden high quality surimi can not be produced.

At the dock the menhaden are pumped from the fishing vessels into bulk tank trucks. The capacity of the tank is approximately 5700 gallons. At the processing plant the tank is connected to a chiller to maintain temperature. The fish are then processed within 24 hours. The project manager has expressed interest in determining if the injection of carbon dioxide into the chill water will help maintain quality.

Methodology

These preliminary studies were conducted in the laboratory. The fish were held in 55 gallon polyethylene drums and the RSW or RW was circulated through external refrigerated chill baths to maintain temperature (32-35°F). To help maintain temperature the drums were insulated with water heater blankets and covered with polyvinyl film. The RSW was actually 3.0% sodium chloride brine. The control was set up, as close as possible, to the conditions at which the fish are currently held at sea and at the surimi plant. The experimental system was identical to the control except for the injection of CO_2 to a level of saturation. Menhaden was added at a weight of 25 pounds per drum, while squid was added at a weight of 50 pounds. In the trial with menhaden the water was recirculated at the bottom of the drums. In the squid trial the water was also recirculated from spray nozzles on top. In both trials the water level in the drums was adjusted to ½ capacity. Samples of the fish were evaluated at regular intervals to determine quality by both sensory and microbiological analysis. The chill water was also sampled for bacterial content. Each experimental trial was terminated upon spoilage, as determined by sensory analysis. During storage of the squid, a silicon based anti-foam agent was added daily to retard foaming.

Results and Conclusions

Menhaden

Aerobic plate counts (APC), of the refrigerated water, indicated that the presence of dissolved carbon dioxide (CO_2) was effective in inhibiting microbial growth (Table 19). The MRW,

which was saturated with CO_2, remained approximately 2 log cycles lower in APC than the RW without dissolved CO_2. The APC of the RW ranged from 4.74 log cfu/ml on day 1 of storage to 4.72 log cfu/ml on day 3. The MRW ranged from 2.48 log cfu/ml on day 1 to 2.70 log cfu/ml on day 3. APC of the menhaden displayed similar trends, but the differences were not as great. On day 1 of storage the menhaden taken from the RW had an average APC of 4.76 log cfu/in^2, while the menhaden from the MRW had an average APC of 3.86 log cfu/in^2 (a difference of 0.90 log). On day 3 of storage the difference in APC was greater. The menhaden stored in RW had an average APC of 4.93 log cfu/in^2 and the menhaden stored in MRW was 1.44 logs lower with an average APC of 3.49 log cfu/in^2.

Table 20 lists the pH values of the refrigerated water in the two systems. On day 1 of storage the RW had a pH of 6.89 and the MRW had a pH of 5.28. On day 3 of storage the pH of the RW increased to 7.27, while the pH of the MRW remained constant at 5.20.

Moisture content of menhaden flesh (Table 21) did show slight differences between fish stored in the two systems. The menhaden stored in the RW averaged 64.4 ± 0.5 percent moisture through 3 days, while the menhaden stored in MRW averaged 61.6 ± 1.2 percent moisture.

While the dissolved CO_2 was effective in reducing microbial growth, the raw sensory attributes of the menhaden declined rapidly in both systems. Appearance (Figure 14), odor (Figure 15, and texture (Figure 16) sensory scores were all below borderline in quality (score of 5) in less than 4 days regardless of which storage system was used. Differences in sensory scores of the 2 systems were not statistically significant (ANOVA $\alpha = .05$). On day 3 of storage it was noted in both systems that the menhaden flesh was soft, scales were loose, and the gills had a slimy white appearance. Apparently menhaden does not hold up very well after a few days of storage in refrigerated water, regardless of whether CO_2 is added. It should be noted however, that the menhaden had numerous parasites burrowed into their flesh which may have accelerated spoilage. While the menhaden were freshly caught pound net fish (caught morning of study and iced), greater differences in quality may have been noticed if the fish were stored in a MRW system as soon as they were harvested.

Squid

The addition of carbon dioxide to the refrigerated seawater did inhibit microbial growth, but not to the degree observed in the previous system with menhaden. On day 0, the RSW had an APC of 5.10 log cfu/ml and the MRSW had a similar APC of 5.04 log cfu/ml (Table 22). The APC of the MRSW remained constant through 7 days, while the APC of the RSW increased to 6.18 log cfu/ml. The APC of the squid also remained relatively constant during storage

in MRSW. The day 0 and day 7 APC was 3.75 and 3.71 log cfu/g, respectively. In contrast, the APC of the squid stored in RSW increased from 4.18 log cfu/g on day 0 to 4.92 log cfu/g on day 7.

Table 23 lists the pH values of the refrigerated seawater in the two storage systems. The MRSW had a pH value of 4.21 on day 0 (2 hours after adding squid). By day 7 the pH increased to 6.10. The RSW was significantly less acidic. On day 0 the pH was 6.87 and this value increased to 7.80 on day 7.

On day 5 of storage samples of squid mantles and fins were taken for moisture determination. The squid which were stored in the RSW had a slightly higher moisture percentage. The mantle and fin samples of the squid stored in RSW averaged 69.3 ± 1.7% and 75.0 ± 3.2% respectively. In comparison the MRSW samples averaged 63.3 ± 1.4% for the mantle and 72.5 ± 0.9% for the fin samples.

During this study samples of squid were removed from the two storage systems, skinned, rinsed under tap water, and then analyzed with a Minolta color difference meter. Table 24 lists the L scale values that were recorded. The L scale relates the black to white color range to a numerical value. The higher value indicates a greater degree of whiteness, which is a desired trait of squid. The initial average value of the squid, directly out of ice, was 73.4 ± 0.5. The squid which were stored in MRSW had slightly higher values through 7 days. On day 7 the MRSW squid averaged 76.7 ± 0.9, while the RSW squid averaged 72.3 ± 1.2.

As with the menhaden however, differences in the sensory quality of the squid in the two storage systems were not readily apparent. Appearance (Figure 17), odor (Figure 18), and texture (Figure 19) were all below borderline in quality (sensory score less than 5) between 5 and 6 days of storage. The greatest differences were seen in texture during the first 5 days of storage. The RSW squid had a more gelatinous, watery texture than the MRSW stored squid. It was noted on day 7 of storage that even though the squid in both systems were obviously spoiled, there was a more pronounced pink discoloration of the skin on the squid stored in RSW.

This study indicated that the addition of carbon dioxide to RSW storage systems for holding squid will help to restrict microbial growth. Slight benefits in overall quality can also be expected. Ideally for maximum benefit to quality, the squid should be placed into a MRSW system at the time of harvesting. These studies were done with squid which had been stored on ice. The captain of a squid trawler in the mid-Atlantic region has demonstrated that he can land superior quality squid by storing them in RSW rather than storing them in bulk on ice. The addition of carbon dioxide to this system should further enhance the maintenance of quality.

Table 19. The Effect of Dissolved Carbon Dioxide on Microbial Growth Within a Refrigerated Water Storage System Containing Menhaden.

Storage Time (Days)	Aerobic Plate Count[a] RW[b] Water[d]	RW[b] Fish[e]	MRW[c] Water	MRW[c] Fish
1	4.74	4.76	2.48	3.86
2	4.71	5.08	2.85	4.30
3	4.72	4.93	2.70	3.49

[a] Plate Count Agar with 0.5% NaCl, incubated at 20°C for 4 days.

[b] Refrigerated water.

[c] Modified refrigerated water; saturated with carbon dioxide.

[d] Log cfu/g.

[e] Log cfu/in^2. The initial count of the menhaden (iced in box) was 4.99.

Table 20. Change in pH Values of Refrigerated Water With and Without Dissolved Carbon Dioxide During Storage of Menhaden.

Storage Time (Days)	pH Values RW (Without CO_2)	MRW (With CO_2)
1	6.89	5.28
2	6.87	5.04
3	7.07	5.29
4	7.27	5.20

Table 21. Moisture Content of Menhaden Flesh During Storage in Refrigerated Water With and Without Dissolved Carbon Dioxide.

Storage Time (Days)	% Moisture RW (Without CO_2)	MRW (With CO_2)
1	64.5 ± 0.4	59.9 ± 1.4
2	64.9 ± 2.1	62.4 ± 1.2
3	63.7 ± 0.2	62.5 ± 1.7
Average ± S.D.	64.4 ± 0.5	61.6 ± 1.2

Table 22. The Effect of Dissolved Carbon Dioxide on Microbial Growth Within a Refrigerated Seawater Storage System Containing Squid (Loligo sp.

Storage Time (Days)	Aerobic Plate Count[a] RW[b] Water[d]	RW[b] Squid[e]	MRW[c] Water	MRW[c] Squid
0	5.10	4.18	5.04	3.75
3	5.26	4.21	5.04	4.12
5	5.52	4.58	5.00	4.04
7	6.18	4.92	5.08	3.71

[a] Plate Count Agar with 0.5% NaCl, incubated at 20°C for 4 days.

[b] Refrigerated water.

[c] Modified refrigerated water; saturated with carbon dioxide.

[d] Log cfu/g.

[e] Log cfu/in^2. The initial count of the squid (iced in box) was 4.60.

Table 23. Change in pH Values of Refrigerated Seawater With and Without Dissolved Carbon Dioxide During Storage of Squid.

Storage Time (Days)	pH Values RW (Without CO_2)	MRW (With CO_2)
0	6.87	4.21
3	6.42	5.49
5	7.05	6.09
7	7.80	6.10

Table 24. Color Difference Meter Readings of Squid During Storage in Refrigerated Seawater With and Without Dissolved Carbon Dioxide[a].

Storage Time (Days)	L Scale Value	
	RW (Without CO_2)	MRW (With CO_2)
3	72.2 ± 1.9	75.8 ± 0.6
5	73.1 ± 0.7	76.2 ± 0.8
7	72.3 ± 1.2	76.7 ± 0.9

The initial value of the squid was 73.4 ± 0.5.

a Readings were taken on squid mantle flesh after skinning and rinsing under tap water.

Figure 14. Raw Appearance Sensory Scores of Menhaden

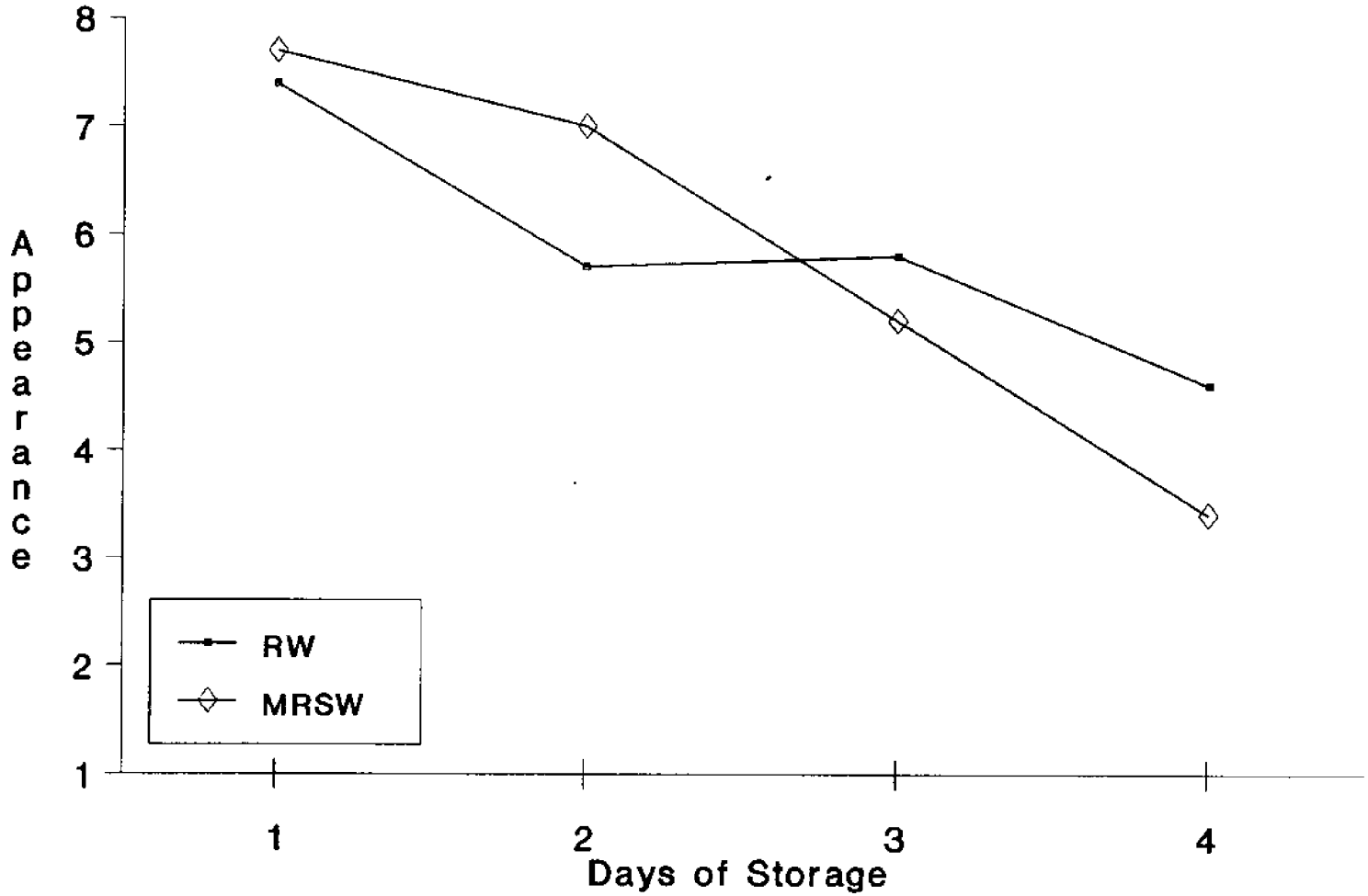


Figure 15. Raw Odor Sensory Scores of Menhaden

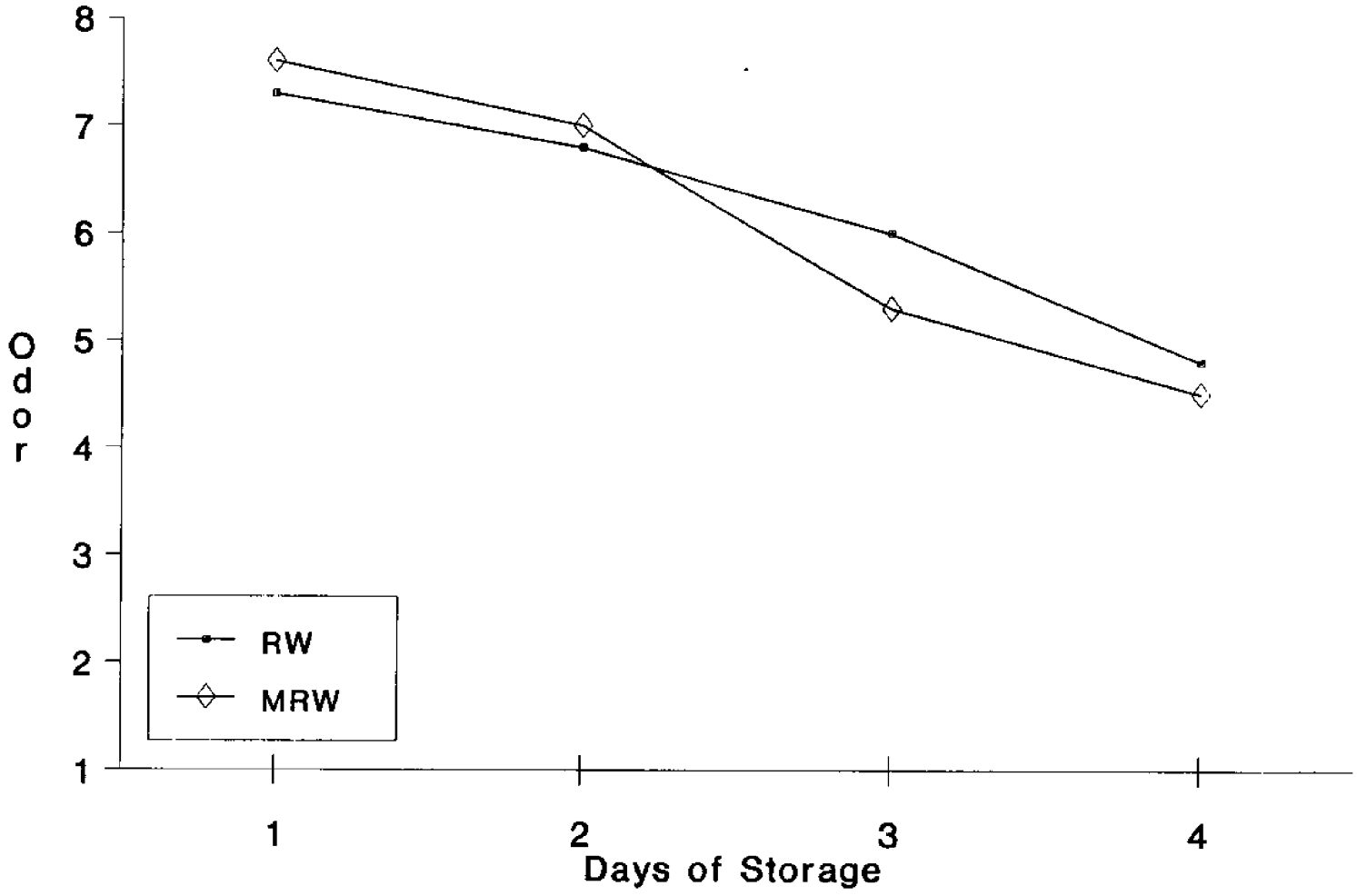


Figure 16. Raw Texture Sensory Scores of Menhaden

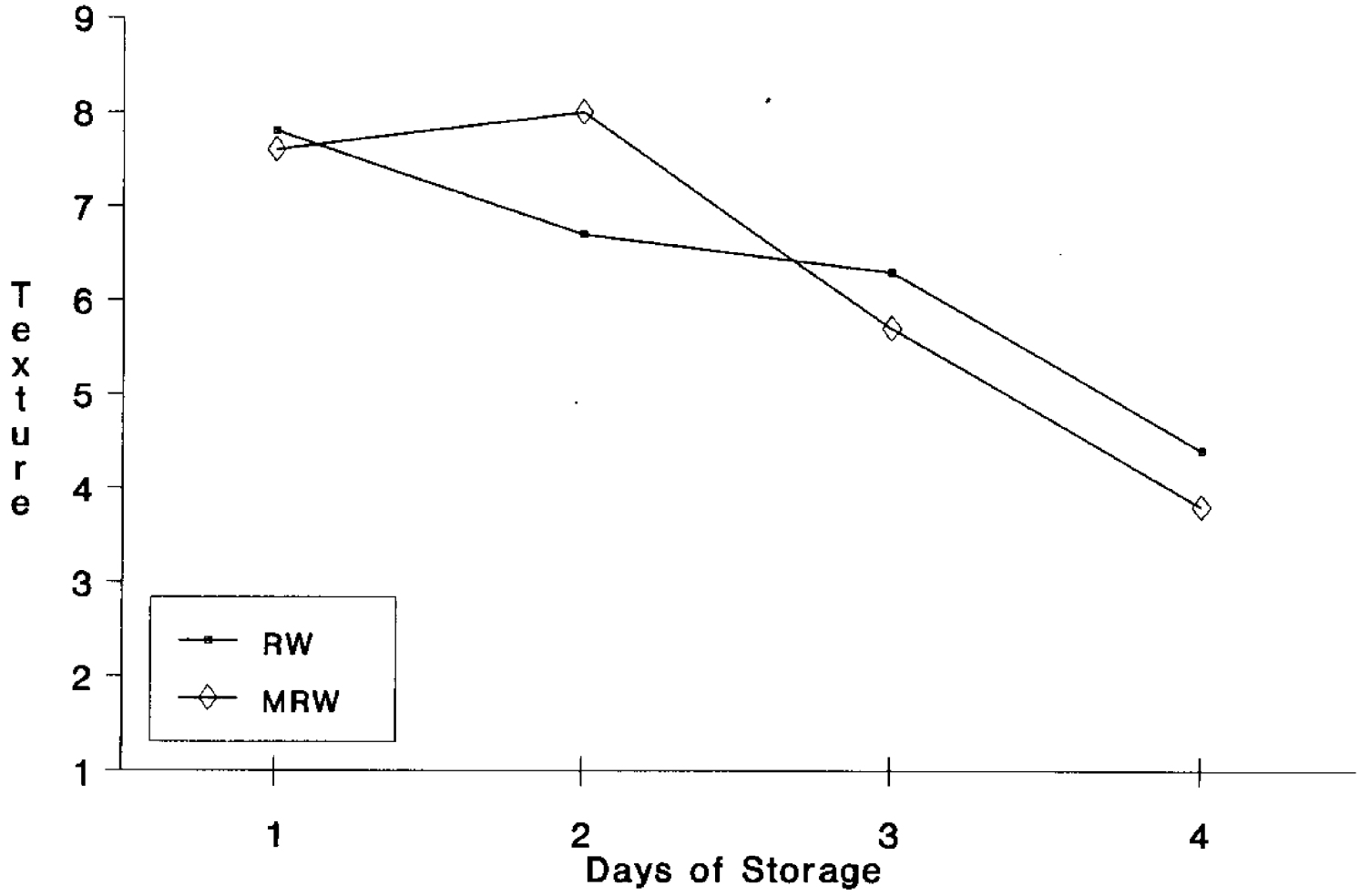


Figure 17. Raw Appearance Sensory Scores of Squid

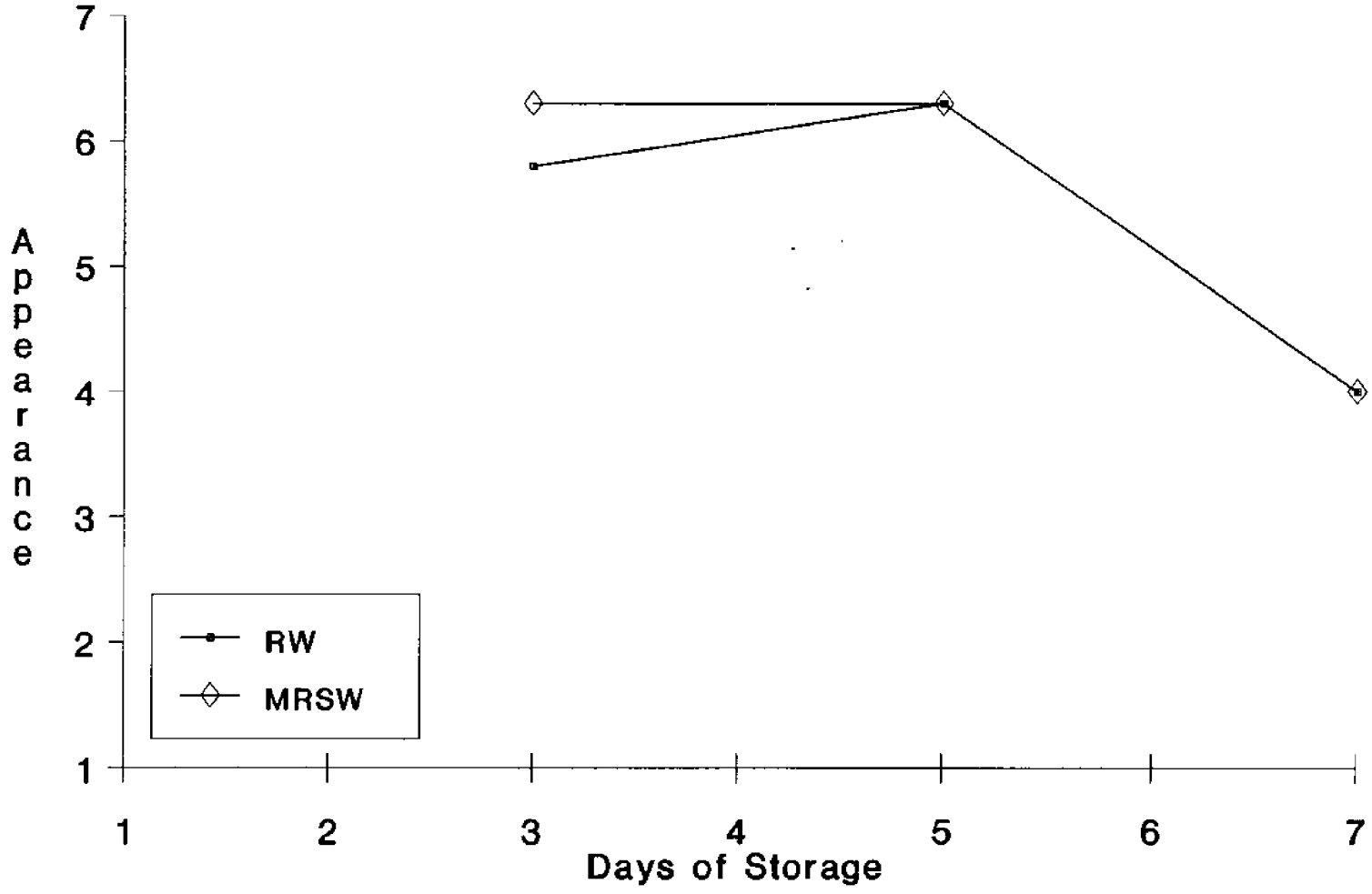


Figure 18. Raw Odor Sensory Scores of Squid

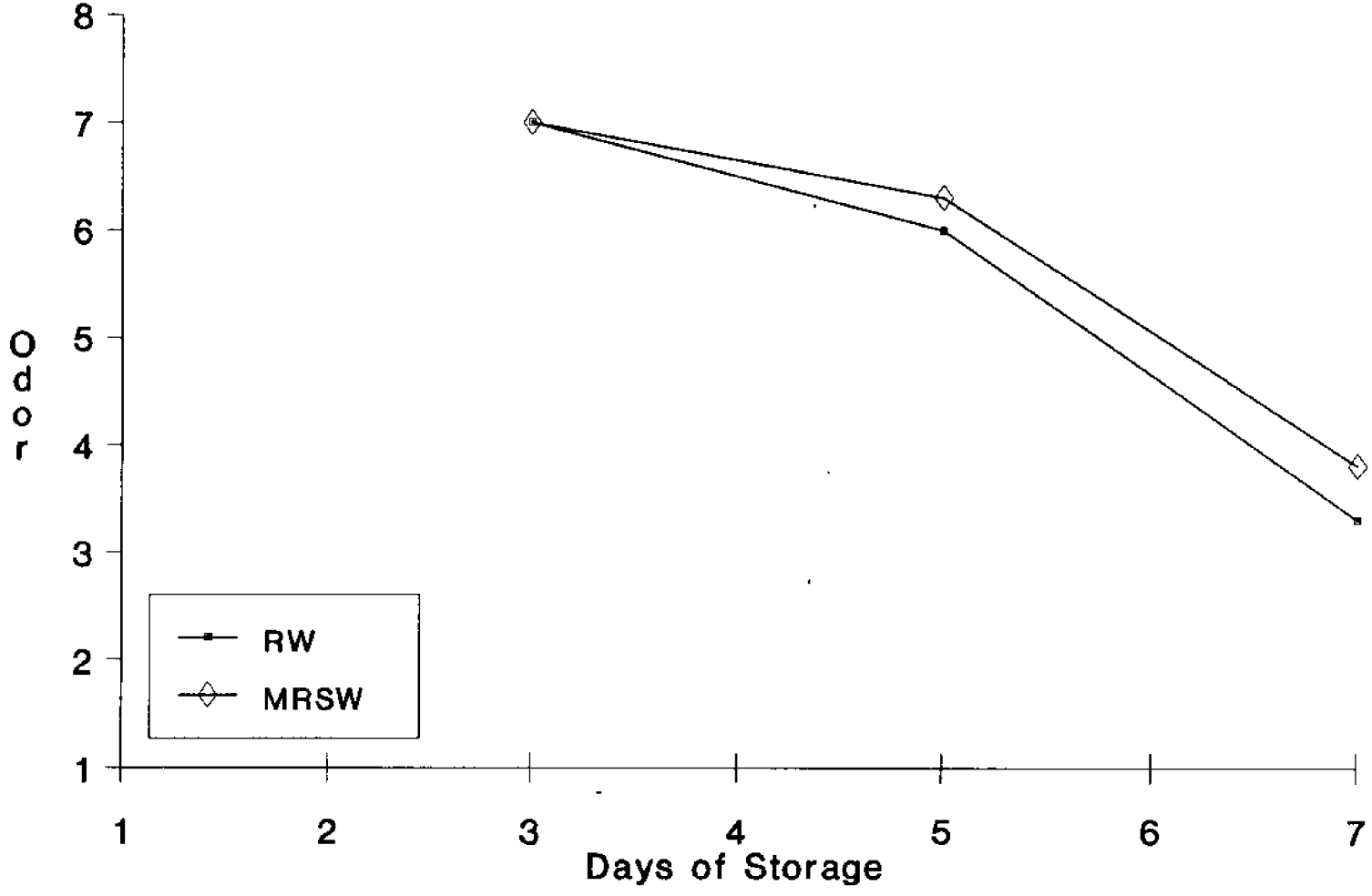
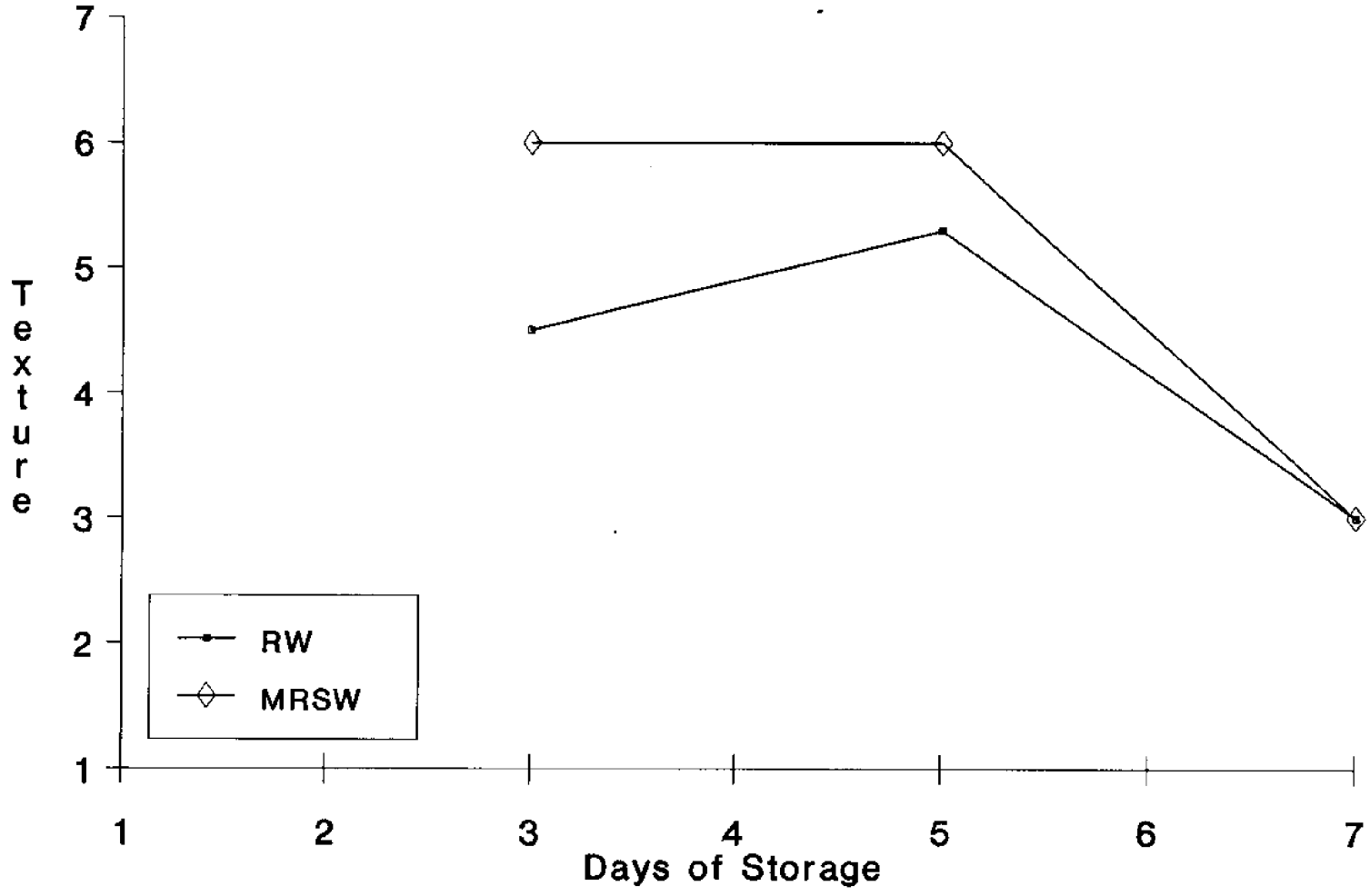


Figure 19. Raw Texture Sensory Scores of Squid



Application of Modern Food Engineering Practices for Improving Quality and Extending Shelf-life of Fresh Fish

The objective of this study was to apply modern food engineering practices to improve quality and extend the shelf-life of seafood products. J. Peter Clark, president of Epstein Process Engineering, made several visits to Virginia seafood processors (2 finfish plants, 2 crab plants, and 2 clam plants). Dr. Clark observed the processing operations at these plants and has made recommendations which address some of the problems which the Virginia seafood industry must resolve.

A major concern of the clam processing industry is the large volume of water used during processing and the large amount of waste water, which is high in BOD and suspended solids, that is generated. Dr. Clark recommended that a series of filtrations could remove a large portion of the dissolved and suspended solids. This in turn could make the water suitable for reuse in certain parts of the plant. Dr. Clark stated that great opportunities exist for water conservation through recycling and better process control.

In the crab processing plants, Dr. Clark also observed that there was opportunity for water conservation and waste water control. In the hand picking of crab meat, where workers are paid by the pound, Dr. Clark recommended setting up an incentive program to motivate the workers to optimize yield and quality.

In the finfish processing plants, Dr. Clark observed that there was opportunity for improved plant design and layout, as well as sanitation.

According to Dr. Clark, the seafood industry is an important, but somewhat neglected element of the food processing industry. He stated that there is an opportunity for engineering firms to make a positive contribution to the industry and to become, in turn a significant factor in the design and construction of seafood processing plants.

APPENDIX I

USDC/NMFS Whole Fish Inspection Standards

(See Pages 199 - 205 of the Code of Federal Regulations)

AUTHORITY: 7 U.S.C. 1621-1630.

SOURCE: 42 FR 52750, Sept. 30, 1977, unless otherwise noted.

Subpart A—United States Standards for Grades of Whole or Dressed Fish

§ 261.101 Scope and product description.

This standard shall apply to whole or dressed fish, whether fresh or frozen, of any species suitable for use as human food and processed and maintained in accordance with good manufacturing practices.

§ 261.102 Product forms.

(a) *Types.* (1) Fresh.

(2) Frozen solid packs; glazed or unglazed.

(3) Frozen individually; glazed or unglazed.

(b) *Styles.* (1) Whole.

(2) Dressed-eviscerated.

(3) Head-on or headless.

(4) With or without fins.

(5) Skin-on scaled or unscaled; semi-skinned (epidermis removed) or skinless.

(6) Other (as specified).

§ 261.103 Grades—quality factors.

(a) *U.S. Grade A.* Whole or dressed fish shall:

(1) Possess good flavor and odor and;

(2) Comply with the limits for defects for U.S. Grade A quality in accordance with § 261.104.

(b) *U.S. Grade B.* Whole or dressed fish shall:

(1) Possess reasonably good flavor and odor and;

(2) Comply with the limits for defects for U.S. Grade B quality in accordance with § 261.104.

(c) *Substandard.* Whole or dressed fish does not possess reasonably good flavor and odor and/or exceeds the limits for defects for U.S. Grade B quality in accordance with § 261.104.

§ 261.104 Determination of grade.

(a) *Procedures for grade determination.* The grade shall be determined by sampling in accordance with the sampling plan described in paragraph (b) of this section evaluating odor and flavor in accordance with paragraph (c) of this section examining for defects in accordance with paragraphs (d), (e) and (f) of this section and using the results to assign a grade as described in paragraph (g) of this section.

(b) *Sampling.* The sampling rate of specific lots for all inspections, other than for military procurement, shall be in accordance with the sampling plans contained in Part 260 of this chapter except that the sample unit is ten (10) fish for fish weighing up to 10 pounds. Fish weighing over ten (10) up to fifty (50) pounds—the sample unit shall be five (5) fish. For fish weighing over fifty (50) pounds, the sample unit shall be a minimum of three (3).

(c) *Evaluation of flavor and odor.* (1) Evaluation of the odor on each of the raw fish in the sample unit shall be carried out as follows:

(i) For the examination of small units, break the flesh or thawed sample either with the thumbs or by cutting with a knife in several places. Hold the cut or broken flesh close to the nose for evaluation.

(ii) For the examination of large units, a core may be used. Drill a hole into the hard frozen fish with a high-speed quarter inch drill. As soon as the drill is withdrawn, the hole and drillings are smelled.

(2) If the results of the raw odor evaluation indicate the existence of any off-odors, the sample shall be cooked by any of the methods set forth below to verify the flavor and odor.

(i) *Boil in bag method.* Insert the sample into a boilable film-type pouch; fold the open end of the pouch over a suspension bar and clamp in place to provide a loose seal after evacuating the air, by immersing the pouch into boiling water. Cook the contents for 20 minutes (until the internal temperature of the product reaches 160 degrees F.).

(ii) *Steam method.* Wrap the sample in a single layer of aluminum foil, and place on a wire rack suspended over boiling water in a covered container. Steam the packaged product for 20 minutes.

(iii) *Bake method.* Package the product as previously described. Place the packaged product on a flat cookie sheet or shallow flat-bottom pan of

sufficient size so that the packages can be evenly spread on the sheet or pan. Place the pan and frozen contents in a properly ventilated oven preheated to 400 degrees F. for 20 minutes.

(3) The amount of material to be cooked shall be based on the results of the raw odor evaluation. A minimum of 25 percent of the sample except that not less than 3 sample units shall be used.

(d) *Examination for physical defects.* Each of the fish in the sample will be examined for defects using the list of defect definitions, and the defects noted and categorized as minor, major, and serious in accordance with Table 1.

(e) *Definitions of defects in whole or dressed fish.* (1) "Abnormal condition" means that the normal physical and/or chemical structure of the fish flesh has been sufficiently changed so that the usability and/or desirability of the fish is adversely affected. It includes, but is not limited to, the following examples:

(i) Jellied—refers to the abnormal condition wherein a fish is partly or wholly characterized by a gelatinous, glossy, translucent appearance.

(ii) Milky—refers to the abnormal condition wherein a fish is partly or wholly characterized by a milky-white, excessively mushy, pasty, or fluidized appearance.

(iii) Chalky—refers to an abnormal condition wherein a fish is partly or wholly characterized by a dry, chalky, granular appearance, and fibrous structure.

(A) Moderate—refers to a condition that is distinctly noticeable but does not seriously affect the appearance, desirability and/or the eating quality of the product.

(B) Excessive—refers to a condition which is both distinctly noticeable and seriously objectionable.

(2) "Appearance defects" shall refer to the overall general appearance of the fish (consistency of the flesh, odor, eyes, gills, and skin) and presence of excessive blood or drip and appearance of the package.

(i) Slight—refers to an appearance defect that is slightly noticeable but does not seriously affect the appearance, desirability, and/or eating quality of the fish.

(ii) Moderate—refers to an appearance, defect that is conspicuously noticeable but does not seriously affect the appearance, desirability, and/or eating quality of the fish.

(iii) Excessive—refers to an appearance defect that is conspicuously noticeable and that does seriously affect the appearance, desirability, and/or eating quality of the fish.

(3) "Discoloration" refers to any color not characteristic of the species used.

(i) Slight—refers to the area affected by discoloration of significant intensity involving up to 10 percent of the total area.

(ii) Moderate—refers to the area affected by discoloration of significant intensity involving over 10 percent and up to 50 percent of the total area.

(iii) Excessive—refers to the area affected by discoloration of significant intensity involving 50 percent or more of the total area.

(4) "Dehydration" refers to loss of moisture from fish surfaces during frozen storage. For skin-on fish, dehydration shall be evaluated by degree of dullness and shrinkage.

(i) Slight dehydration—is surface color masking affecting more than 3 percent of the area which can be readily removed by scraping with a blunt instrument.

(ii) Moderate dehydration—is deep color masking penetrating the flesh, affecting less than 3 percent of the area, and requiring a knife or other sharp instrument to remove.

(iii) Excessive dehydration—is deep color masking penetrating the flesh, affecting more than 3 percent of the area, and requiring a knife or other sharp instrument to remove.

(5) "Surface defects" shall refer to the following where applicable:

(i) Scales. An occurrence of attached or loose scales in any sample unit (where applicable).

(ii) Blood spot. An accumulation of coagulated opaque, masses of blood on a fish.

(iii) Fins or pieces of fin. An occurrence or absence of attached or loose fins or pieces of fin in any sample unit

(where applicable). Dorsal spine shall be removed (where applicable).

(iv) Skin. The presence of the dark or light inner layers of skin for skinless. For semiskinned, reference is to the presence of the dark outside layers.

(v) Bruises. An accumulation of damaged portions of fish muscle, red and opaque in appearance (on a fish).

(vi) Damage to protective coating refers to voids in ice glaze or tears in covering membrane, also to breaks or splits in the skin which are readily discernible and not normally part of the processing.

(6) "Cutting and trimming defects" refers to the following:

(i) Body cavity cuts—refers to misplaced cuts made during evisceration.

(ii) Improper heading (as specified)—refers to the presence of pieces of gills, gill cover, pectoral fins (spine), or collarbone after the fish have been headed. No ragged cuts should be evident after heading.

(iii) Evisceration defects—refers to inadequate cleaning of the belly cavity of the fish. All viscera, kidney (where applicable), spawn, and blood should be removed.

(A) Slight degree of improper evisceration and improper heading refers to a condition that is scarcely noticeable but does not affect the appearance, desirability, and/or eating quality of the fish.

(B) Moderate degree of improper evisceration and improper heading refers to a condition that is conspicuously noticeable but does not seriously affect the appearance, desirability, and/or eating quality of the fish.

(C) Excessive degree of improper evisceration refers to a condition that is conspicuously noticeable and that seriously affect the appearance, desirability, and/or eating quality of the fish.

(iv) Improper washing—inadequate removal of slime, blood, and bits of viscera from the surface of the fish and from the body cavity.

(v) Belly burn—an enzymatic action on the flesh causing a burned or discolored appearance.

(7) "Texture defects" texture of the cooked fish; not characteristic of the species.

(i) Slight—fairly firm, only slightly tough or rubbery, does not form a fibrous mass in the mouth, moist but not mushy.

(ii) Moderate—moderately tough or rubbery, has noticeable tendency to form a fibrous mass in the mouth, moist but not mushy.

(iii) Excessive—excessively tough or rubbery, has marked tendency to form a fibrous mass in the mouth, or is very dry or very mushy.

(f) *Categorization of physical defects.*

TABLE I

Physical defects		Categories		
Types	Degree	Minor	Major	Serious
Abnormal condition	Moderate		201	
	Excessive			301
Appearance defects	Slight	102		
	Moderate		202	
	Excessive			302
Discoloration	Slight	103		
	Moderate		203	
	Excessive			303
Dehydration	Slight—more than 3 percent area affected and easily removed.	104		
	Moderate—less than 3 percent area affected but difficult to remove.		204	
	Excessive—greater than 3 percent area affected			304
Surface defects	Slight—3 to 10 percent area affected	105		
	Moderate—greater than 10 percent area affected		205	
Cutting and trimming defects	Body cavity cuts	106		
	Improper heading:			
	Slight	107		
	Moderate		206	
	Evisceration defects:			

TABLE I—Continued

Physical defects		Categories		
Types	Degree	Minor	Major	Serious
	Slight	108		
	Moderate		207	
	Excessive			305
	Improper washing	109		
	Belly burn		208	
Texture defects	Slight	110		
	Moderate		209	
	Excessive			306

NOTE: The code numbers shown in the above table are for identification of defects for recording purposes only and are keyed to the nature and severity of the defect. They are not scores.

(g) *Grade assignment.* (1) Each fish in a sample unit will be assigned the grade into which it falls in accordance with the limits for defects, summarized as follows:

Flavor and odor		Maximum number of physical defects permitted		
		Minor	Major	Serious
Grade A	Good	3	0	
Grade B	Reasonably good.	5	1	

(2) Upon determination of grade of each fish in each sample unit, the sample will be designated a grade as follows:

(i) *Grade A.*

Number of subsample units (fish)	Min. No. grade A fish	Max. No. grade B fish	Max. No. substandard
10 (up to 10 lb)	8	2	0
5 (10 to 50 lb)	4	1	0
3 (over 50 lb)	3	0	0

(ii) *Grade B.*

Number of subsample units (fish)	Minimum number of grade B fish	Maximum number of substandard
10 (up to 10 lb)	8	2
5 (10 to 50 lb)	4	1
3 (over 50 lb)	3	0

(iii) *Substandard.* Any fish not meeting the minimum requirements for Grade B quality.

(3) Upon determination of the grade for each sample unit a lot of whole or dressed fish shall be assigned that grade in which:

(i) For physical defects, the number of sample units in the next lower grade does not exceed the acceptance number for deviants prescribed in § 260.61 of the sampling plan, Table II, of Title 50; and

(ii) Not more than 5 percent of the fish in the sample (total fish examined per lot) are in the next lower grade for odor and/or flavor.

NOTE: Sampling for inspection for military procurement shall be in accordance with MIL-STD-105. Lot size shall be expressed in terms of pounds. The sample size shall be in accordance with Inspection Level S-3. Acceptable Quality Levels shall be expressed in terms of defects per hundred units. The AQL's shall be 6.5 for minor and 4.0 for major.

[42 FR 52750, Sept. 30, 1977, as amended at 51 FR 34990, Oct. 1, 1986]

§ 261.105 Hygiene.

Whole or dressed fish shall be processed and maintained in accordance with the applicable requirements of the regulations contained in §§ 260.96 to 260.103 of this chapter and of the good manufacturing practice regulations contained in 21 CFR Part 110.

[42 FR 52750, Sept. 30, 1977, as amended at 51 FR 34990, Oct. 1, 1986]

Subpart B—United States Standards for Grades of Frozen Headless Dressed Whiting

§ 261.151 Description of the product.

The product described in this part consists of clean, wholesome whiting (silver hake) *Merluccius bilineraris, Merluccius albidus;* completely and cleanly headed and adequately eviscer-

ated. The fish are packaged and frozen in accordance with good commercial practice and are maintained at temperatures necessary for the preservation of the product.

§ 261.152 Grades of frozen headless dressed whiting.

(a) "U.S. Grade A" is the quality of frozen headless dressed whiting that (1) possess a good flavor and odor and that (2) for those factors that are rated in accordance with scoring system outlined in this part, have a total score of 85 to 100 points.

(b) "U.S. Grade B" is the quality of frozen headless dressed whiting that (1) possess at least reasonably good flavor and odor and that (2) rate a total score of not less than 70 points for those factors of quality that are rated in accordance with the scoring system outlined in this part.

(c) "Substandard" or "Utility" is the quality of frozen headless dressed whiting that meet the requirements of § 261.151 but that otherwise fail to meet the requirements of "U.S. Grade B."

§ 261.161 Determination of the grade.

In a plant under USDC Contract Inspection the grade is determined by examining the product for factors 1 to 10 in the thawed state and factor 11 in the cooked state. For lot inspection, examination of the product for factors 1, 2 and 3 is carried out in the frozen state and 4 to 10 in the thawed state. Factor 11 is examined in the cooked state.

(a) *Factors rated by score points.* Points are deducted for variations in the quality of each factor in accordance with the schedule in Table 1. The total of points deducted is subtracted from 100 to obtain the score. The maximum score is 100 the minimum score is 0.

(b) *Factors not rated by score points.* The factor of "flavor and odor" is evaluated organoleptically by smelling and tasting after the product has been cooked in accordance with § 261.171.

(1) Good flavor and odor (essential requirements for a U.S. Grade A product) means that the cooked product has the typical flavor and odor of the species and is free from rancidity, bitterness, staleness, and off-flavors and off-odors of any kind.

(2) Reasonably good flavor and odor (minimum requirements of a U.S. Grade B product) means that the cooked product is lacking in good flavor and odor but is free from objectionable off-flavors and off-odors of any kind.

TABLE 1—SCHEDULE OF POINT DEDUCTIONS PER SAMPLE

[See footnotes at end of table.]

Factors scored	Method of determining score	Deduct
	FROZEN STATE (LOT INSPECTION ONLY)	
1 Arrangement of product [1]	Small degree: 10 percent of fish twisted or bellies and backs not facing the same direction.	2
	Large degree: More than 10 percent of fish twisted, void present or some fish cross packed.	5
2 Condition of packaging (overall assessment).	Poor: Packaging material has been soaked, softened or deteriorated	2
3 Dehydration	Small degree: Slight dehydration of the exposed surfaces	2
	Large degree: Deep dehydration of the exposed surfaces	5
	THAWED STATE	
4 Minimum size: Fish 2 oz. or over are of acceptable size.	Number of fish less than 2 oz. per lb:	
	Over 0—not over 0.5	5
	Over 0.5—not over 1.0	10
	Over 1.0—not over 2.0	20
	Over 2.0	30

TABLE 1—SCHEDULE OF POINT DEDUCTIONS PER SAMPLE—Continued

[See footnotes at end of table.]

Factors scored	Method of determining score	Deduct
5 Uniformity. Weight ratio of fish remaining. The 10 percent largest fish divided by the 10 percent smallest fish.	Weight ratio 10 percent smallest and 10 percent largest:	
	Over 2.0—not over 2.4	2
	Over 2.4—not over 2.8	5
	Over 2.8—not over 3.2	10
	Over 3.2—not over 3.6	20
	Over 3.6	30
6 Heading[1]	Small degree: 10 percent of fish carelessly cut	5
	Moderate degree: Over 10 percent of fish carelessly cut	15
7 Evisceration (overall assessment)	Small degree: Slight evidence of viscera	2
	Moderate degree: Moderate amounts of spawn, viscera, etc	10
	Large degree: Large amounts of viscera, spawn, etc	30
8 Scaling[1]	Small degree: 10 percent of fish not well scaled	2
	Large degree: Over 10 percent of fish not well scaled	5
9 Color of the exposed surfaces (overall assessment).	Small degree: Minor darkening, dulling	2
	Large degree: Objectionably dark, brown, dull	5
10 Bruises and split or broken skin	Presence of bruises and/or broken or split skin per pound:	
	Over 0—not over 0.5	1
	Over 0.5—not over 1.0	2
	Over 1.0—not over 1.5	4
	Over 1.5—not over 2.0	7
	Over 2.0	10
11 Texture (overall assessment)	Small degree: Moderately dry tough, mushy, rubbery, watery, stringy	5
	Large degree: Excessively dry, tough, mushy, rubbery, watery, stringy	15

[1] 10 percent of fish refers to 10 percent by count rounded to nearest whole fish.

[42 FR 52750, Sept. 30, 1977, as amended at 51 FR 34990, Oct. 1, 1986]

§ 261.171 Definitions and methods of analysis.

(a) *Selection of the sample unit.* The sample unit consists of the primary container and its entire contents. The whiting are examined according to Table 1. Definitions of factors for point deductions are as follows:

(b) *Examination of sample, frozen state.* When this product is examined under USDC Contract Inspection, the samples are examined for factors 1, 2, and 3 in Table 1 in the thawed state. When the product is lot inspected, the samples are examined for factors 1, 2, and 3 in Table 1 in the frozen state.

(1) *"Arrangement of product"* refers to the packing of the product in a symmetrical manner, bellies or backs all facing in the same direction, fish neatly dovetailed.

(2) *"Condition of the packaging material"* refers to the condition of the cardboard or other packaging material of the primary container. If the fish is allowed to stand after packing and prior to freezing moisture from the fish will soak into the packaging material and cause deterioration of that material.

(3) *"Dehydration"* refers to the presence of dehydrated (water-removed) tissue on the exposed surfaces of the whiting. Slight dehydration is surface dehydration which is not color-masking. Deep dehydration is color-masking and cannot be removed by scraping with a fingernail.

(c) *Examination of sample, thawed state.* Thawed state means the state of the product after being thawed. Thawing the sample is best accomplished by enclosing the sample in a film type bag and immersing in an agitated water bath held at 68° F., ±2° F. Allow the product to remain immersed until thawed. Alternatively when the facilities are lacking for water thawing, the sample may be thawed by slacking it out at a temperature between 30° to 40° F. on an aluminum tray from 2 hours for a 1½-pound sample to 8 hours for a 10-pound sample.

(1) *"Minimum size"* refers to the size of the individual fish in the sample. Fish 2 ounces or over are con-

sidered acceptable. Smaller fish cannot be cooked uniformly with acceptable size fish. Separate the fish of unacceptable size, divide their number by the weight of the sample in pounds, and apply to Table 1. Example—four fish of unacceptable size in a 5-pound package is ⅘=0.8, a 10 point deduction.

(2) *"Uniformity."* From the fish remaining, select by count 10 percent (minimum of one fish) of the largest and 10 percent (minimum of one fish) of the smallest and divide the largest weight by the smallest weight to get a weight ratio.

(3) *"Heading"* refers to the condition of the fish after they have been headed. The fish should be cleanly headed behind the gills and pectoral fins. No gills, gill bones, or pectoral fins should remain after the fish have been headed.

(4) *"Evisceration"* refers to the cleaning of the belly cavities of the fish. All spawn, viscera, and belly strings should be removed.

(5) *"Scaling"* refers to the satisfactory removal of scales from the fish.

(6) *"Color of the cut surfaces"* refers to the color of the cut surfaces of the fish after heading and other processing.

(7) *"Bruises and broken or split skin"* refers to bruises over one-half square inch in area and splits or breaks in the skin more than one-half inch in length which are not part of the processing.

(d) *Examination of sample, cooked state.* Cooked state means the state of the sample after being cooked. Cooking the sample is best accomplished by inserting the sample into a film type bag and submerging it into boiling water for from 18-20 minutes. A minimum of three fish per sample unit shall be cooked.

(1) *"Texture defects"* refers to the absence of normal textural properties of the cooked fish flesh, which are tenderness, firmness, and moistness without excess water. Texture defects are dryness, softness, toughness, and rubberyness.

(e) *General definitions.* (1) *Small* (overall assessment) refers to a condition that is noticeable but is only slightly objectionable.

(2) *Moderate* (overall assessment) refers to a condition that is distinctly noticeable but is not seriously objectionable.

(3) *Large* (overall assessment) refers to a condition which is both distinctly noticeable and seriously objectionable.

§ 261.175 Tolerances for certification of officially drawn samples.

The sample rate and grades of specific lots shall be certified in accordance with Part 260 Subpart A of this chapter, (Regulations Governing Processed Fishery Products).

PART 262—UNITED STATES STANDARDS FOR GRADES OF FISH STEAKS

Subpart A—[Reserved]

Subpart B—United States Standards for Grades of Frozen Halibut Steaks

Sec.

SCORE SHEET

Subpart C—United States Standards for Grades of Frozen Salmon Steaks

AUTHORITY: 7 U.S.C. 1621-1630.

SOURCE: 42 FR 52753, Sept. 30, 1977, unless otherwise noted.

NOAA FORM 89-808
(4-77)

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

TYPE INSPECTION

PAGE | PAGES OF

DATE

SCORE SHEET – WHOLE AND DRESSED FISH

COMPANY NAME OR CODE	REF. LOT NO.	NET WT.	LOT SIZE (lbs)	NO. FISH/CONT.	NO. SAMPLE UNITS	COUNTRY OF ORIGIN
LABEL TITLE OR CODE	CONTAINER CODE	TOTAL NO. CONT.	NO. CONT./MASTER	AVG. FISH WT.	NO. FISH/SAMPLE UNIT	

SAMPLE UNIT. NO.			
SUBSAMPLE UNIT NO. *(No Fish)*			
ABNORMAL CONDITION	*Moderate*	201	
	Excessive	301	
APPEARANCE DEFECTS	*Slight*	102	
	Moderate	202	
	Excessive	302	
DISCOLORATION	*Slight*	103	
	Moderate	203	
	Excessive	303	
DEHYDRATION	*Slight* – > 3%	104	
	Moderate – < 3%	204	
	Excessive – > 3%	304	
SURFACE DEFECTS	*Slight* – 3–10%	105	
	Moderate – 10%	205	
CUTTING AND TRIMMING DEFECTS	*Body Cavity Cuts*	106	
	Improperly Headed: Slight	107	
	Moderate	206	
	Eviscerated: Slight	108	
	Mod.	207	
	Excessive	305	
	Improperly Washed	109	
	Belly Burn	208	
TEXTURE DEFECTS	*Slight*	110	
	Moderate	209	
	Excessive	306	
RAW ODOR			
COOKED FLAVOR AND ODOR			
TOTAL MINOR			
TOTAL MAJOR			
TOTAL SERIOUS			
FINAL SUBSAMPLE UNIT GRADE			
TOTAL GRADE A			
TOTAL GRADE B			
TOTAL SUBSTANDARD			
FINAL SAMPLE UNIT GRADE			

FINAL LOT GRADE

OFFICIAL INSPECTOR *(Signature)*

REMARKS

APPENDIX II

Maine Freshness Assurance Standards

CHAPTER 35

MAINE FRESH GROUNDFISH QUALITY CONTROL PROGRAM

INDEX

Hearing Notice: February 3, 1988 - Secretary of State
Notice of Agency Rule Making

Hearing: None held - None requested

Rule Effective: 5/9/88

MAINE DEPARTMENT OF MARINE RESOURCES

Chapter 35 - Maine Fresh Groundfish Quality Control Program

SUMMARY: These rules provide for a voluntary groundfish quality control and freshness assessment program, administered by the Department of Marine Resources (Department). The program is designed to provide inspection services to Maine processors in order to improve the marketing of fish products. Maine processors who voluntarily comply with these quality control standards will receive a certification of program compliance from the Department of Marine Resources.

35.01. Applicability

Participation in the Maine Fresh Groundfish Quality Control Program is voluntary and available to all Maine groundfish processors. State of Maine certification of compliance with program standards will be made for filleted, steaked, or whole groundfish.

35.02. Definitions

A. Groundfish. "Groundfish" means bottom-dwelling fish, specifically: Order Gadiformes, Family Gadidae (including: cod, haddock, pollock, cusk, and hakes), Order Pleuronectiformes, Families Bothidae, Pleuronectidae (including flounders, soles, and halibut) and Family Scorpaenidae, Species Sebastes marinus (rosefish, redfish, ocean perch); Species Anarhichas spp. (wolffish, ocean catfish); Species Merlucius bilinearis (whiting); and Species Lophius americanus (monkfish).

B. Fresh Fish. "Fresh Fish" means fish held in a continously wet, unfrozen state until it ceases to be wholesome.

C. Fillet. "Fillet" means a slice of fish of irregular size and shape, with or without skin attached, removed from the carcass by cuts made parallel to the backbone.

D. Steak. "Steak" means a slice of fish of regular size and shape removed from the carcass by cuts made perpendicular to the backbone.

E. Whole Fish. "Whole fish" means fish as harvested, gutted or ungutted, with head on or off.

F. Wholesome. "Wholesome" means the minimum basis of acceptability for human food purposes of any fish or fishery product.

G. Sanitary. "Sanitary" means the condition of cleanliness which must prevail continuously in the food processing environment to prevent adulteration and assure the production of clean, safe, and wholesome foods.

H. Processor. "Processor" means a commercial establishment located in Maine which processes fish and fish products.

35.02. Definitions (Cont.)

I. Processing plant. "Processing plant" means a commercial plant located in Maine which processes fish and fish products which plant may be comprised of one or more buildings. The plant shall include landing facilities and separate storage areas (dry or refrigerated) which may be used to hold or store raw materials, packaging materials or finished products.

J. Damaged fish. "Damaged fish" means whole fish which have visible fork holes or blood spots, have been split, torn, crushed, or otherwise contaminated with foreign matter, or have been previously frozen.

K. Lot. "Lot" means all fillets or steaks of the same species, cut on the same day, for the same customer. In the case of whole fish, "lot" means all whole fish of the same species, assessed for freshness on the same day, for the same customer.

35.03. Eligibility

A. Application.

Any Maine groundfish processor holding a Maine Wholesale Seafood License may apply to the Department of Marine Resources for certification under this program on forms provided by the Department.

B. Preliminary Inspection.

The Department shall conduct a preliminary inspection of the applicant's processing plant in order to determine whether the physical plant and equipment comply with program standards as set forth in 35.50. The applicant must obtain an overall score of 90% and must comply fully with standards 35.50(A)(8), 35.50(A)(9), 35.50(A)(14), 35.50(A)(15), 35.50(A)(16), and 35.50(B)(1).

C. Exception.

Any processing plant which is inspected by the federal government pursuant to the United States Department of Commerce (USDC) National Marine Fisheries Service, Sanitarily Inspected Fish Establishment (SIFE) Program and continuously complies with the requirements of that program shall be exempted from eligibility and compliance inspections under section 35.50 and shall automatically qualify for participation in the State of Maine program. However, these federally-inspected plants must pass the preliminary compliance inspections by the Department under sections 35.51, 35.60 and 35.70.

35.05. Compliance

A. The Department shall conduct weekly, unannounced inspections of

35.05. Compliances (Cont.)

the participating processing plants in order to assure that the plants continuously comply with program standards. The Department shall provide at least five hours of inspection time weekly to each plant.

B. Participating plants must achieve minimum requirements or scores in Physical Plant and Equipment standards (35.50) as set forth therein:

1. Full compliance required with standards 35.50 (A)(8), 35.50(A)(9), 35.50(A)(14), 35.50(A)(15), 35.50(A)(16), and 35.50(B)(1).

2. A minimum average score of 90% for all standards not requiring full compliance.

C. Participating plants must acheive minimum requirement or scores indcated in each of the following inspection compliance categories:

1. Operational Sanitation Standards (35.51): a minimum average score of 70% for all standards.

2. Product Handling Procedures (35.60):
   a. Full compliance required with standard 35.60(A)(2).

   b. A minimum average score of 70% for all standards not requiring full compliance.

3. Freshness Assurance Standards and Procedures (35.70): full compliance required with all standards. With respect to 35.70(C), (D), (E) and (F), full compliance requires a minimum numeric score of 17, or 68% of 25 total scoreable points; and with respect to 35.70 (G) and a minimum numeric score of 21 or 84% of 25 total scoreable points.

   In the event a Department compliance inspection occurs at a time when the processor is processing fish which will not be represented as processed in accordance with these program standards, the processor may request a waiver of inspection for compliance with the requirements and standards of section 35.70. If a processor receives such a waiver, the Departmental inspector shall schedule an inspection for compliance with section 35.70 as soon as possible. A processor must be inspected and found in compliance with section 35.70 no less than twice per month.

35.05 Compliance (Cont.)

D. Exception.
Any participating processing plant which is also under U.S.D.C. Type 1 Continuous Inspection shall be exempt from weekly compliance inspections under Section 35.50 (Physical Plant and Equipment); 35.51 (Operational Sanitation Standards); and 35.61 (Product Handling Procedures). Weekly inspections of the plant's compliance to Section 35.70 (Freshness Assurance Standards and Procedures) will, however, continue.

35.10. Written Agreement

Each processor participating in the program shall sign a written agreement with the Department, which agreement shall require the processor to comply fully with program standards in return for participation in the inspection program. Either party may withdraw from the voluntary inspection agreement upon 30 days written notice to the other party of intent to withdraw from the agreement.

35.15. In-house Inspector

Each processor participating in the program shall designate an employee as in-house inspector under this program. The in-house inspector must be approved by the Department and must have appropriate training in application of program standards. The in-house inspector shall cooperate with Department personnel in enforcement of program standards in the processing plant.

35.20. Agreement Violations.

A. If a participating plant fails to maintain a minimum score of 90% for physical plant and equipment inspections under section 35.50, or fails to comply fully with standards 35.50(A)(8), 35.50(A)(9), 35.50(A)(14), 35.50(A)(15), 35.50(A)(16), and 35.50(B)(1), the Departmental inspector shall immediately notify the plant in writing of the failure setting forth specific violations.

1. The Department shall conduct a second inspection within five working days applying the criteria set forth in section 35.50.

2. If the participating plant fails this second inspection, the Department shall immediately withdraw program certification of the facility.

B. If a participating plant fails to maintain the required score for either of the two compliance inspection categories (35.51 or 36.60), or fails to comply fully with standard 35.60(A)(2), the Departmental inspector shall immediately notify the plant in writing of the failure, setting forth specific violations.

35.20. Agreement Violations (Cont.)

1. The Department shall conduct a second inspection within 3 working days of the initial, failed inspection, applying the criteria set forth in section 35.51 or 35.60.

2. If the participating processing plant fails this second inspection, the Department shall immediately withdraw program certification of facility.

C. If a participating plant fails to comply fully with standards 35.70, or if said plant requests a waiver of inspection in accordance with section 35.05 of this program, the Departmental inspector shall schedul a subsequent inspection as soon as possible. Participating plants must be found in compliance with standards 35.70 no less than twice per mont Upon failure to comply with this requirement, the Department shall immediately withdraw program certification of the facility.

35.22. Penalty for Breach of Agreement

Violation of any term of the written agreement (35.10) or these regulations shall be grounds for withdrawal of certification by the Department.

35.24. Misrepresentation

A. It shall be unlawful for any person who is not a participant of this program to represent themselves as a program participant.

B. It shall be unlawful for any program participant to represent that fish not processed according to program sanitation, handling procedures and freshness standards have been processed pursuant to program standards.

35.50. Physical Plant and Equipment

A. Physical Plant.

The processing plant and surrounding area must be kept free of objectionable odors, smoke, dust or other contamination. The building must be sufficiently spacious to prevent overcrowding of equipment or personnel, and must be designed, constructed, and maintained so as to prevent infestation by insects, birds or other vermin and to be adequately cleaned. Sanitation measures must be utilized to assure the lowest possible bacterial and enzyme levels.

1. Plant floors must be made of smooth, impervious materials and graded in order to drain quickly. The use of drainage cuts is permitted if they are smooth, impervious, and do not deter sanitation.

35.50. Physical Plant and Equipment (Cont.)

2. Plant interior walls must be smooth, waterproof, light colored, easily cleaned and kept in good repair.

3. Ceilings must be designed and constructed so as to prevent accumulation of dirt and condensation and must be easily cleaned.

4. Plant must be well-ventilated in order to prevent excessive heat, condensation, or any contamination.

5. Sufficient illumination in general working areas and at points requiring close examination of the product must be provided and must not alter colors.

6. Areas where fish are received or stored must be separate from areas in which final product preparation or packaging is conducted so as to prevent contamination of the finished product.

7. A separate waste room or other approved, offal storage facility must be provided on the premises.

8. An ample supply of hot and cold potable water under adequate pressure must be available at sufficient points throughout the plant for all required cleaning operations. Hot water temperatures must exceed 130°F for cleaning operations except that hot water temperatures for hand washing purposes must only exceed 100°F (full compliance required).

9. All plumbing and waste disposal lines, including sewer system, must be designed and maintained in accordance with the Maine State Plumbing Code (full compliance required).

10. Proper facilities for washing and disinfection of equipment must be provided.

11. Adequate and conveniently located toilet facilities must be provided. Notices shall be posted requiring personnel to wash their hands after using the toilets, after breaks, and after periods of work stoppage.

12. Facilities must be available in the processing areas for employees to wash and dry their hands and for disinfection of protective hand coverings.

13. Adequate facilities must be available for the proper dry storage of packaging materials.

14. Cleaning compounds, disinfectants, sanitizers and pesticides must be kept in a separate room so designated and posted as a chemical storage area (full compliance required).

35.50. Physical Plant and Equipment (Cont.)

15. Ice must be made from potable water and must be manufactured and stored so as to protect it from contamination. Ice delivered to the plant shall be obtained from a source specifically approved by the Maine Department of Human Services or the United States Food and Drug Administration (full complaince required).

16. Areas where fish are to be held to await processing or shipment shall be capable of sustaining temperatures of 29° to 35°F at all times (full compliance required).

B. Equipment and Utensils

1. All work surfaces, all filleting boards, and all containers, trays, tanks or other equipment used in processing fish must be of smooth, impervious, non-toxic, corrosion-resistent material which must be easily cleaned. Wood shall not be used for any of the above-listed items except in wooden handled filleting knives (full compliance required).

2. Candling tables shall be constructed so as to prevent excessive warming of processed fish while providing sufficient illumination.

3. Conveyor belts must be made of impervious materials which are easy to clean, including nylon, hard-finished rubber, or stainless steel.

4. Barrels or other containers used on the filleting line for the collection and disposal of offal, shall be located below the level at which the fish are processed and in such a way that there is no splash-back onto the processing line.

35.51. Operational Sanitation Standards

A. Ice shall be handled in a sanitary manner to prevent contamination of whole or processed fish.

B. Food, beverages, or personal articles shall not be located near fish cutting or holding surfaces.

C. Filleting and cutting boards must be frequently and thoroughly flushed with water, and treated with disinfectant, both at the mid-point and at the end of each eight hour production period.

D. All machines used for gutting, washing, filleting, skinning, steaking or similar operations must be disinfected and rinsed at the mid-point of each eight hour production period or more frequently in the event of high production volumes.

35.51. Operational Sanitation Standards (Cont.)

E. All machinery and equipment must be inspected before processing begins to ensure that it has been properly cleaned, disinfected, rinsed and reassembled.

F. Machinery and equipment must be checked periodically and cleaned of any accumulated fish matter.

G. Within two hours of the end of each production day, sanitation of plant and equipment must be initiated. The plant and equipment must be thoroughly cleaned, disinfected, and rinsed before commencement of the next production day.

H. All re-usable market containers and fish totes must be cleaned after use. Any re-usable containers used specifically for internal plant product movement must be cleaned and disinfected after each use.

I. At no time shall knives or other utensils be sharpened so as to cause metal filings to fall upon cutting boards or other fish contact surfaces.

J. All brands of chemicals and detergents, and the manner of their use, used for cleaning or sanitation must be approved by the Department.

35.60. Product Handling Procedures

A. General Provisions

1. Fresh fish shall be chilled and processed with minimum delay in a hygienic manner.

2. At no time shall forks or hooks be used to move fish (full compliance required).

3. Temperatures of 29° to 35°F are required in all product holding areas. Temperatures of less than 50°F should be maintained in processing areas, but in any case, increases in fish temperatures during processing should be minimized.

4. Operation of the filleting line must be regulated so as to ensure continuous processing, with all operations arranged sequentially, and with fish moving at a uniform pace, without stoppages.

5. No fish except flatfish and redfish (Families Bothidae, Pleuronectidae, and Species Sebastes Marinus) will be accepted under this program unless gutted prior to arrival in the plant.

6. Packaging materials must be sufficiently strong and durable to withstand stresses during processing, handling, storage and distribution.

35.60. Product Handling Procedures (Cont.)

7. Packaging shall utilize materials which prevent leakage or contamination of product during shipment.

B. Processing Procedures

1. Fish which cannot be processed immediately on arrival at the facility shall be well iced in clean containers and stored in specially designated areas within the plant, where they will be protected from heat and weather conditions, and will not be contaminated by dust, insects or vermin.

2. All whole fish shall be thoroughly washed during or before filleting operations. Some species may require scaling in which case they shall be washed afterwards.

3. Water used to wash fillets or steaks shall be completely replenished or replaced with clean water at least once every four hours. Ice or refrigeration should be used to minimize temperature increases of such water above 32°F.

4. After cutting, the fillets must be placed directly onto clean conveyors or into clean containers. Piling of large quantities of fish in one container shall not be permitted.

5. Filleting personnel must use filleting techniques which minimize contact between cut surfaces of the fillet and the filleting board.

6. Sufficient quantities of finely divided ice or other coolants will be used to stabilize temperatures or minimize fish temperature increases during shipment. Ideal shipping temperatures are 29° to 35°F.

7. Brine solutions for the washing of fillets or steaks should not exceed concentrations of 8% sodium chloride by weight. Brine solution fillet or steak immersion times should not exceed 30 seconds.

8. All persons working in a fresh fish plant shall be clean while on duty and shall take all necessary precautions to prevent the contamination of fish products. All processing personnel must wear sanitary headgear and clean aprons. All long hair must be contained.

DEPARTMENT OF MARINE RESOURCES

Chapter 35 - Maine Fresh Groundfish Quality Control Program

35.70. Freshness Assurance Standards and Procedures (full compliance required).

A. The freshness of whole fish to be processed under this program shall be evaluated by the in-house inspector prior to cutting the whole fish and according to the following procedures:

1. Using the culling procedure required in paragraph (B) below and the scoring criteria set forth in paragraphs (C), (D), and (E) below, the in-house inspector shall assign a freshness score for each lot of fish. The score shall indicate the average freshness condition of those whole fish which comprise a single lot of fillets, steaks, or whole fish.

2. It shall be the responsibility of the in-house inspector to assure that each lot of fish complies with the minimum freshness requirements of 35.05(C)(3)(4) and that the proper distinction as given in 35.70(A)(3) is made between fish that will receive a six or nine day expiration date.

Processors who desire to use a nine day expiration date must demonstrate that the following conditions are met on a continuous basis:

a. Processed product must be chilled to 33°F within four hours of initial processing.

b. A microbiological standard for processed product of less than 10,000 CFU/g as determined by standard plate count methods with an incubation temperature of 21-23°C must be met. Three samples per week are required. These samples may be collected in accordance with the processor's in-house quality control but must be representative of product that meets this requirement and will be subject to verification by the Department.

c. Full compliance for fish represented as meeting freshness standards for a nine day expiration date requires a minimum score of 21 out of 25 total scoreable points for all species except whiting. Whiting will not be eligible for this provision.

3. The in-house inspector shall ensure that each shipping container of fish processed under program standards, whether individual bulk fillet container or master shipping carton containing individually tray overwrapped fillets, steaks, or whole fish, bears a label including the following required lot information:

a. processor identification number;

b. species of fish contained in lot; and

35.70. Freshness Assurance Standards and Procedures (Cont.)

c. expiration date for product certification. The expiration date will be assigned on the basis of the freshness of the whole fish using the procedures given in 35.70 (A)(1). A date of either six or nine days from the date of the freshness assessment, will be used. The date will be arrived at by adding the appropriate number of days to the processing date.

4. For certification purposes the in-house inspector shall maintain records of the freshness score of each lot of fish processed under this program. Records shall include the lot information required in 35.70(A)(3).

5. For certification purposes, the in-house inspector shall indicate to Departmental inspection personnel the lot identity of any fish undergoing processing at the time of inspection. The in-house inspector shall disclose or convey, upon request, to the Departmental inspector any or all records required in 35.70(A)(4).

B. It shall be the responsibility of the in-house inspector to ensure that any whole fish which are damaged are not processed under this program. The in-house inspector shall cull damaged whole fish prior to cutting.

C. Raw, round; Cod family (Family Gadidae)

	Score Points
1. Eyes perfectly fresh, convex black pupil, translucent cornea; bright red gills, no bacterial slime, outer slime water white or transparent; bright opalescent sheen, no bleaching.	5
Eyes slightly sunken, black pupil, translucent cornea; very slight discoloration of gills, no bacterial slime; slight milkiness of outer slime; slight loss of opalescence and very slight bleaching.	4
Eyes slightly sunken, grey pupil, slight opalescence of cornea; some discoloration of gills and some mucus; outer slime opaque and somewhat milky; loss of bright opalescence and some bleaching.	3
Eyes sunken; milky white pupil, opaque cornea; thick knotted outer slime with some bacterial discoloration.	2

35.70. Freshness Assurance Standards and Procedures (Cont.)

	Score Points
Eyes: completely sunken pupil; shrunken head covered with thick yellow bacterial slime; gills showing bleaching or dark brown discoloration and covered with thick bacterial mucus; outer slime thick yellow-brown; bloom completely gone; marked bleaching and shrinkage.	0
2. Flesh including belly flaps	
Bluish translucent flesh, no reddening along the backbone and no discoloration of the belly flaps; kidney bright red.	5
Slight loss of translucency, no reddening along backbone, slight loss of original brillance of kidney blood; no discoloration of belly flaps.	4
Waxy appearance, no reddening along backbone, loss in original brilliance of kidney blood, some discoloration of belly flaps.	3
Some opacity, some reddening along backbone, brownish kidney blood and some discoloration of the flaps.	2
Opaque flesh, marked red or brown discoloration along the backbone, very brown to earthy brown kidney blood, and marked discoloration of the flaps.	0
3. Odors	
Fresh seaweedy.	10
Loss of fresh seaweediness, shellfish.	9
No odors, neutral.	8
Slight musty, mousy, garlic peppery, milky or caprylic and like.	7
Bready, malty, beery, yeasty.	6
Lactic acid, sour milk, or oily.	5
Some lower fatty acid (for example acetic or butyric acids), grassy, 'old boots', slightly sweet, fruity or chloroform-like.	4
Stale cabbage water, turnipy, 'sour sink', wet matches; phosphene-like.	3
Ammoniacal (trimethylamine and other lower amines) with strong 'byre-like' (o-toluidine).	2
Hydrogen sulphide and other sulphide, strong ammoniacal.	1
Indole, ammonia, faecal, nauseating, putrid.	0

35.70. Freshness Assurance Standards and Procedures (Cont.)

	Score Points
4. Texture	
Firm, elastic to the finger touch.	5
Slight softening of flesh, elastic to the finger touch. Rigor may or may not be present.	4
Softening of the flesh, some grittiness.	3
Softer flesh, definite grittiness and scales easily rubbed off the skin.	2
Very soft and flabby, retains the finger indentations, grittiness quite marked and flesh easily torn from the backbone.	1

D. Raw flat fish; Flounder and Sole Families. (Families Pleuronectidae)

1. General Appearance	
Eyes full, bright or very slightly cloudy; gills bright red or very deep pink, with slight clear slime; slime on body clear to slightly milky.	5
Eyes slightly sunken, some opacity; gills pale pink, bleached, with thick opaque slime; slime on body thick and opaque; edge of gill cover slightly bleached and pinking in regions on underside of body.	4
Eyes sunken and opaque; gills bleached with thick grey or brown slime (on body, yellow and watery); bleaching on back, particularly in head region and gill cover, inking on underside.	3
Eyes completely sunken or bloated and opaque; gills very bleached with dirty grey or brown-yellow slime; slime on body watery with yellow bacterial discoloration; marked bleaching and pinking on body.	2
Eyes totally collapsed; gills badly bleached and badly discolored with bacterial slime; body slime watery or scarce with marked bacterial discoloration, in head region, particularly. Gill cover very bleached, and marked pinking on the underside.	1
2. Flesh, including the body cavity	
Translucent with blue or pink tinge. Dark purple blood in backbone.	5
Loss of translucency; bluish or pinkish white; slight waxy. Backbone still purple.	4

35.70. Freshness Assurance Standards and Procedures (Cont.)

	Score Points
Waxy, slight yellowing, slight discoloration of body cavity. Backbone still well colored (red-blue or purple).	3
Some opacity, yellow or brownish discoloration extending in from fin rays. Discoloration of body and reddening on backbone.	2
Marked opacity, yellow or brown discoloration and marked reddening on backbone.	1
Marked discoloration, particularly in body cavity. Blood almost completely diffused in backbone.	0

3. Odors

Fresh oil, metallic, roses, fresh-cut grass ("lawn-mower").	10
Metallic, oily, earthy, peppery.	9
Oily, seaweedy, aromatic.	8
Oily, citric, musty, mousey.	7
Oily, bready, biscuity, malty, out-flower stems.	6
Sour beer, slight rancidity, painty, cod-liver oil.	5
Muddy, grassy, meaty, stale vegetables, "old-boots", fruity, sweaty, lower fatty acids.	4
Rotten cabbages, sour sink, wet matches, rotten meat, rancid butter.	3
Byre-like, singed hair, ammonia.	2
Hydrogen Sulfide, strong ammonia, sulphides.	1
Faecal, nauseating, indole.	0

4. Textures

Firm, smooth and slimy.	5
Loss of slime but no marked grittiness.	4
Grittiness towards the tail.	2
Marked general grittiness.	1

E. Monkfish (Lophius americanus) - Headless and Gutted

1. General Appearance

End cut fresh clean appearance, blood still flowing; slime thick and stringy, clear to milky/brown; berries reddish, still bloody if cut.	5
End cut clean and bright with blood rinsed off; fresh scallop appearance; slime still white to brown, thick; berries turning pinkish.	4

35.70. Freshness Assurance Standards and Procedures (Cont.)

	Score Points
End cut beginning to darken, slightly stained; slime becoming semi-clear, thinner; berries beginning to fade towards brownish/pink.	3
End cut heavily stained, darker than rest of flesh; slime watery, thinning out; berries light brown.	2
End cut darker, deeply discolored; slime non-existent, yellow slime on tail or ice; berries color fading into surrounding flesh.	1

2. Flesh/Blood

Flesh has natural, fresh coloration, white to creamy, blueish translucency; blood has fresh, bright red appearance, flowing or nearly so..	5
Flesh has loss of translucency, slight pinkening in bloody areas; blood still red with some loss of brightness.	3
Fresh had definite pinkening or browning; blood has faded to pinkish/brownish color.	2
Flesh discolored, yellow slime forming at surface; blood becoming non-distinguishable from surrounding flesh.	0

3. Odor

Fresh seaweed or natural odor	10
No odor, neutral	9
Slight shellfish odor	8
Strong shellfish odor	7
Sour odor	5
Objectionable odor	0

4. Texture

Extremely firm, in prerigor or rigor state; tail is rigid when held horizontal.	5
Firm.	3
Softening of flesh, floppy; muscles beginning to separate into top and bottom segments on side of tail.	2

35.70. Freshness Assurance Standards and Procedures (Cont.)

	Score Points
Able to puncture flesh with finger; muscle segments easily separated.	0

F. Redfish, Ocean Perch (Family Scorpaenidae, Species Sebastes marinus).

Scored using 35.70 C, 17 of 25 points required.

G. Whiting (silver hake), Merluccius bilinearis scored using 37.50 C., 21 of 25 points required. Only fillets will be represented as meeting program standards.

H. Prior to packaging a final product quality check will determine the following:

1. That weight and size assortments packed are accurate and consistent with information on the label or packing invoice.

2. The absence of bones in accordance with customer requirements.

3. Freedom from bruises, bloodspots, and worms or other defects.

4. That the cut and trim of the fillet are in accordance with customer requirements.

GRADING SHEET

WHOLE FISH

SAMPLE	GENERAL APPEARANCE	FLESH INCLUDING BODY CAVITY	ODOR	TEXTURE	TOTAL SCORE

APPENDIX III

Canadian Groundfish Standards

November 20, 1985

GRADE STANDARD

RAW, FRESH OR FROZEN ATLANTIC GROUNDFISH INTENDED FOR PROCESSING, FURTHER PROCESSING OR FOR EXPORT IN THE WHOLE, DRESSED OR SPLIT FORM

INTRODUCTION

This document describes and is extracted from the Canadian Grade Standard for raw, fresh or frozen Atlantic groundfish intended for processing or further processing or for export in the whole, dressed or split form. The Standard was developed by the Department of Fisheries and Oceans and tested and modified as a result of consultations with fishermen, fish buyers and processors and Provincial government officials and through the conduct of pilot projects during the period 1981 to 1985.

The Standard was designed to provide the Atlantic groundfish industry with a common means of measuring and identifying raw material quality. Since the quality of finished product, product mix and control of processing costs are dependent on the quality of raw material, it is essential that raw material quality be identified before processing in order for processors to plan production for uniform quality products and maximum economic advantage, and to grasp marketing opportunities provided by improved product mix. The grading and identification of raw material quality will also facilitate in-plant quality control programs and costing systems and increase production efficiency. Most importantly, it provides a division of responsibility between, and imposes a discipline on, fish buyers and fishermen to implement and maintain procedures for protection and enhancement of fish quality, reduction of waste and increase of yield and productivity.

The examination procedure for determining quality levels differs substantially from traditional methods used to assess the quality of raw material. No reference is made to the external characteristics of the whole or dressed fish, eg. conditions of the eyes, odour and colour of the gills, general appearance, odour at the neck when broken, etc. The determination of quality level is based solely on the examination of the edible portion of the fish, i.e. fillet or internal surface of the split fish. Most of the quality attributes which determine final product quality and product mix and which influence yields and productivity, e.g. texture, blood clots, bruises, physiological abnormalities in the flesh and flesh colour, can be determined only by examining the flesh. These factors also measure the effects of correct fish handling practices at sea and onshore which contribute to the maintenance and enhancement of fish quality. In addition, extensive testing has shown that the external characteristics of

the fish have no impact whatsoever on the assigned grade (beyond that found by examining the cut surface) and examination thereof unnecessarily increases the time required for grading.

Nothing in this Standard requires a buyer to purchase any or all fish offered for sale. A buyer may require a minimum percentage of grade "A" in a lot or may add additional specifications to any purchase agreement. This Standard does not incorporate any reference to size, nematode or copepode parasites, melanin spots or workmanship defects in dressing or bleeding. Although these factors adversely affect processing productivity, yields and product mix and, consequently, may reduce the value of such raw material, it is recognized that the presence of these factors is largely beyond the control of fishermen. Accounting for these factors, if necessary, will have to be between the buyer and seller through purchase agreements.

SCOPE

This Standard applies to raw fish, in a fresh or frozen state, of the following families of Atlantic groundfish, landed in Quebec, Nova Scotia, New Brunswick, Prince Edward Island or Newfoundland and destined for processing or further processing or for export from a province or from Canada:

a) the family Gadidae, including cod, haddock, pollock, hake, cusk and grenadier,
b) the family Anarhichadidae, wolffish,
c) the family Scorpaenidae, including ocean perch (redfish) and blackbelly rosefish, and
d) the order Heterosomato (Pleuronectiformes), including flounder, sole, greysole, turbot and other related flatfish species, excluding halibut.

FORMS OF PRESENTATION

Raw fish in the fresh or frozen state to which this Standard applies may be presented as either unbled or bled fish. Fish are bled if the main (ventral) artery between the gill covers where it leads from the heart forward to the gills and/or the caudal vein where it is up against the backbone upward to the opening of the gills have/has been severed, preferably in either case without inactivating the heart, or for flatfishes, catfish, wolffish or monkfish, if the artery in the backbone close to the tail has been severed.

Fish may be presented in the following forms:

a) **Whole** - as captured, ungutted or
b) **Dressed** - gutted by cutting from the head through the centre of the belly to the anal opening and removing the contents fo the belly cavity (all viscera and parts thereof); head-on ro head-off with collarbone in or off, or
c) **Split** - cut form throat to tail or from nape to tail; gills, guts and roe removed; head generally removed; backbone left in or removed, except for a portion at the tail for strength, or
d) In **any other presentation**, provided that it is sufficiently distinctive from the forms of presentation set out in a, b, or c and meets all other requirements of this Standard.

GRADERS

Grading shall be conducted in accordance with the requirements, methodology and Standards set out in this Standard by an Inspector appointed under the Fish Inspection Act or by a Fish Grader licenced by the Minister of Fisheries and Oceans, as provided for in the Fish Inspection Regulations. The Grader and Inspector will have successfully completed a fish grading training program approved by the Minister and the licence will indicate the species or groups of species that the licensee is entitled to grade. A temporary licence may be issued by a licenced Inspector to a person who demonstrates the ability to grade fish.

The Minister may cancel a Grader's licence where it has been demonstrated that the Grader has not graded fish in accordance with this Standard. The holder of a cancelled licence may apply for, and the Minister may issue, a new licence if the person again demonstrates the ability to grade in accordance with the Standard.

It is unlawful for any person to willfully obstruct a licenced Grader in the execution of his duties or to give directly or indirectly a reward, advantage or benefit of any kind to a Grader for the purpose of influencing the grader. A grader shall not accept directly or indirectly a reward, advantage or benefit in consideration for or for misgrading fish.

SAMPLING

A sample will consist of a number of sample units of individual fish of the same species selected at random from throughout the lot being examined.

The number of sample units to be examined depends upon both the average weight and the number of fish in the lot and is determined by applying Table 1.

A lot will consist of fish of the same species, presented in the

same form, caught by the same type of gear, and identified by day of catch. However, the owner and buyer of the fish may agree not to separate lots by gear type or day of catch. They may also agree to identify lots by size of fish, i.e by length or weight categories.

The sampling will be performed by the Grader or Inspector or by another person provided the Grader or Inspector and owner of the fish are satisfied that the sampling is conducted in a random and correct manner.

Under no circumstances should sample units be withdrawn after fish have been unloaded by devices which may cause physical damage to the fish, eg. vacuum and some bucket unloaders unless, of course, these are owned and operated by the owner of the fish and as such is willing to accept downgrading of the lot.

EXAMINATION OF THE SAMPLE UNIT

Each sample unit, i.e. individual fish, will be prepared and examined individually as described below and the grade assigned in accordance with both the procedure described below and the definitions, procedures and grade descriptions given in Annex "A". For ease of reference the grade descriptions are summarized in Table 2.

Frozen units must be completely defrosted using either commercial practices utilized in processing this material or by a means mutually agreed to between the owner and buyer of the fish, and examined within a period of time such that no deterioration of the texture and/or odour characteristics of the fish occurs. Care should be exercised in defrosting frozen fish to avoid overheating; and the thawing should be complete, to avoid the possibility of tearing or mutilating the sample unit when it is prepared for examination.

For fish in the whole or dressed form destine for export in that form or for processing into products not presented in the split form, a fillet is removed from the sample unit, skinned and examined. Either a full or napeless fillet is cut, as agreed to by the owner and buyer of the fish; the choice is generally dependent on the intended use of the nape portion of the fish. Fillets of ocean perch and related species and of pollock are not examined in the skinned state. If the raw fish is destined for splitting by the buyer, the fish may be filleted or split by the Grader, as mutually agreed but the workmanship criteria for split fish defined in the standard shall not be applied. Fish sold/purchased in the split form is to be graded in that form using the workmanship criteria. In most cases the filleting/skinning or splitting of the sample unit will be performed by the Grader. However, at high volume landing sites, another person, eg. the

person who samples the lot, may be utilized for this purpose, provided the owner and buyer of the fish agree. Also, it may be advantageous to use skinning and/or splitting machines, provided such machines are under the control of the Grader and cause no damage to the sample unit.

Each sample unit is examined for the grade factors to determine:

a) whether the colour of the flesh is characteristic of bled fish;
b) the odour and texture characteristics of the unit;
c) the absence, or presence and degree of blood clots and of bruising and discolouration in the flesh;
d) the absence, or presence and degree of the physiological abnormalities known as jelliness and chalkiness; and
e) for split fish only, workmanship defects in splitting.

Each grade factor is assigned a grade level defined in Annex "A". The overall grade of the sample unit cannot be higher than the lowest grade given for any of the grading factors. For example, if colour, odour and texture are each "A"; blood clots, bruising and chalkiness "B"; and jelliness "C"; then the grade to be assigned to the sample unit is "C".

The fillets or split fish used as sample units may be used for processing provided they are protected from contamination and the weather, chilled, and held separately from the fish.

ASSIGNING LOT GRADE

The grade(s) assigned to the lot is/are determined by the percentage (generally rounded to the whole number) of each grade assigned to the sample units in the lot. For example, if a lot consists of 475 fish of less then 1 kg (2.2 lb) average weight, 10 fish would be withdrawn and examined and a grade would be assigned to each. If 8 of the fish are found to be grade "A", 1 grade "B", and 1 grade "C", then the lot is graded 80% grade "A", 10% grade "B", and 10% grade "C". Alternately, if a lot consists of 10,000 kg (22,000 lb) of fish which have an average weight of 1.5 kg (3.3 lb), the number of fish in the lot would be 6666 and the sample size would be 45 fish. If 39 fish are found to be grade "A", 3 grade "B", 2 grade "C", and 1 reject, then the lot is graded 87% grade "A", 7% grade "B", 4% grade "C", and 2% reject.

A lot will be rejected for human food purposes if the percentage of reject fish exceeds 10% of the number of fish in the sample, except that a 15% level will apply to fish rejected for reason of jelliness. When a lot is rejected, the owner may cull the fish and request a regrading, the results of which are final.

After grading has been completed, the owner of the fish should be

given a summary result of the grading indicating the grade of the lot and the reason why any sample units were graded "B", "C", or reject. In all cases, the DFO Purchase Slip, provided as a receipt of the transaction by the fish buyer, shall show the actual weight by grade and reject amounts of the fish purchased.

GUIDELINES FOR IMPLEMENTATION OF RAW MATERIAL GRADING PROGRAM

Licencing of Graders

Candidates for fish grader training should possess good sensory perception, including full colour vision, and should be able to communicate effectively both orally and in writing and to perform mathematical calculations.

Candidates must successfully complete at least a four-week training session comprised of a two-week training program containing the following elements: principles of fish spoilage including microbiological and chemical aspects; grade factors used in the Standard; sampling techniques and familiarization with regulations pertaining to the use of the Standard; personal conduct and legal rights of graders; proper at-sea and onshore fish handling procedures; filleting, skinning and, where necessary, splitting procedures; calculation of results and determination of grades, and communication of grading results to fishermen; and a two-week apprenticeship program where the candidate's ability to consistently apply the Standard is assessed by an Inspector.

Upon successful completion of the approved training course and apprenticeship a candidate will be recommended for a Grader's licence. A temporary licence may be issued to a person who demonstrates an ability to grade fish. A list of licensed graders will be available from Regional offices of the Department of Fisheries and Oceans.

Licence Cancellation

A Grader's licence may be cancelled after notice has been given of improper grading on three different occasions during a calendar year. Improper grading included errors in procedure and/or grading which affect the accuracy of the final grade as determined during an audit of a grader. The procedure for monitoring and audit are described below. Reinstatement of a Grader's licence will be recommended when the grader submits a written request for reinstatement and demonstrates to an Inspector the ability to accurately apply the Standard.

Monitoring and Audit Procedure

The Inspector will monitor, i.e. observe, the Grader for the ability to maintain lot identification, sample correctly, fillet

and/or split properly, apply the grading criteria, and calculate and communicate effectively the results of the grading.

If, during the monitoring process, the Inspector identifies any irregularity in grading procedure or determining of grades, the Inspector will conduct an audit. The audit will consists of assessing the Grader's ability to apply the Standard. The failure of the Grader to properly apply the Standard will result in a written notice of improper grading sent to the Grader.

Attributes of Disputes

Disputes between fishermen and/or buyers and the Grader arising from the grading of fish are to be resolved by an Inspector only when issues involve the grade Standard. Disputes involving incorrect sizing, weights, etc. must be resolved between buyer and seller and are not subject to arbitration. Where possible, every reasonable effort shall be employed between fisherman and/or buyer and Grader to resolve their differences. If agreement cannot be reached, the services of an Inspector can be requested.

The Inspector must have full knowledge surrounding any dispute before agreeing to its arbitration. The decision of an Inspector shall be final.

When it is mutually agreeable to buyer and seller, the arbitration may be conducted on the original lot of disputed samples. If not, and the quality and identity of the lot of fish has been maintained, the Inspector shall monitor the collection and examination of a second sample by the Grader. If the quality and identity of the lot has not been maintained or if the Inspector is not immediately available, then the Inspector will make every reasonable effort to monitor the next fish grading transaction between the two parties.

Infrastructure

The introduction of dockside grading at some landing sites in Atlantic Canada may be made difficult by the lack of any type of facility and, in some cases, the lack of approved water supplies. For the interim it is recommended for those sites with landings of 250 MT or more that grading facilities be installed immediately to ensure the attainment of minimal requirements for sanitary conditions for grading fish. The minimal requirements recommended for the introduction of the program are an acceptable supply of approved water, satisfactory protection from the elements for grading and, where needed, approved lighting.

Existing facilities considered acceptable may include processing establishments, community stages, fresh fish holding units and

feeder plants. In the absence of any type of enclosed facility, the minimum requirement will be a canopy or other overhead structure. This condition will be permitted only for a period of two years after which time a permanent enclosed facility will be required.

The permanent facility should include approved lighting, walls and ceilings covered with approved material, watertight floors free of cracks and crevices and sloped for proper drainage, approved water supply, a grading table constructed of an approved material and easily cleaned, weigh scales suitable for weighing fish for sampling purposes, and a sufficient quantity of approved containers for holding round fish, fillets and offal. Fishermen or buyers at low volume landing sites should be encouraged to transport landings to centralized grading stations or registered processing establishments.

ANNEX "A"

RAW FISH GRADES - ATLANTIC GROUNDFISH
USE, DEFINITION AND PROCEDURES FOR GRADE FACTORS DETERMINING GRADE

COLOUR

Use: To class sample units as grades A or B.

Definition: Flesh colour is characteristic of bled fish. This factor is not applied to the family Scorpaenidae (Ocean Perch).

Procedure: Examine the cut surface of the skinned fillet or the internal surface of the split fish with the black membrane removed, i.e. white naped.

Grade "A": Flesh has a colour characteristic of bled fish.
"B": Flesh has a colour which is not characteristic of bled fish.

ODOUR

Use: To class sample units as grades A or B or as reject.

Definition: Odours which are fresh are characteristic of the species; offensive or objectional, associated with spoilage; abnormal, (taint), not characteristic of the species; and feedy.

Procedure: Each sample unit is evaluated for indications of decomposition or taint, the absence of any odour, the presence of fresh odours characteristic of the species and feedy odours.

Grade "A": Odour is fresh, characteristic of the species or there is no odour present (neutral).
"B": Abnormal odour characteristic of slight feed.
Reject: Odour indicative of taint or decomposition or any other abnormal odour other than that associated with slight feed.

TEXTURE

Use: To class sample units as grades A, B, C or as reject.

Definition: The degree of firmness and gaping, the latter being separations or breaks in the muscle mytomes, excluding natural longitudinal separations in the loin portion of the flesh.

Procedure: The fillet or split fish is placed on a flat surface and the cut surface of the skinned fillet or the internal surface of the split fish is examined. Sample units should be carefully handled to avoid increasing the extend of gaping. The percentage of surface area showing gaping is categorized as 10% or less, greater than 10% to 25%, greater than 25% to 75%, and greater than 75%. The degree of firmness of the flesh is determined to be firm and resilient, slightly soft, soft or extremely soft.

Grade "A": Flesh is firm and resilient, up to 10% of surface area may show gaping.

"B": Flesh is slightly soft and/or more than 10% and up to 25% of the surface area shows gaping.

"C": Flesh is soft and/or more than 25% and up to 75% of the surface area shows gaping.

Reject: Flesh is excessively soft and more than 75% of the surface area shows gaping. (Flesh with these characteristics is of no commercial value).

BLOOD CLOTS

Use: To class sample units as grades A, B or C.

Definition: Lumps or masses of clotted blood, generally caused by puncturing the flesh with forks or other sharp instruments.

Procedure: Each clot on the cut and skinned sides of the fillet or on the internal surface of split fish is measured along its longest dimension and the total length of all blood clots is determined. A clot which completely penetrates the fillet is counted only once.

Grade "A": No single clot or combination of clots exceeding 0.5 cm in total maximum dimension.

"B": Any single clot or a combination of clots exceeding 0.5 cm and up to 4.0 cm in total maximum dimension.

"C": Any single clot or a combination of clots exceeding 4.0 cm in total maximum dimension.

BRUISING AND DISCOLORATION

Use: To class sample units as grades A, B, or C or as reject.

Definition: Bruise: significant, objectionable discolouring of the flesh by blood. Discolouration: significant

colour abnormality, including browning, yellowing, greening, or discolouring by any other adverse colour.
Slight pink or similar colouring caused by failure to bleed fish is not considered bruising.

Bruising is not evaluated on the skin side of perch or pollock; only the more intense reddish to dark brown colour on the cut surface is considered significant. The brown colour occurring in the anterior loin portion of haddock and yellowtail flounder is natural and is not considered a discolouration.

Procedure: Each bruise and discolouration on the cut and skinned surface of the fillet or on the internal surface of split fish is measured along its longest dimension and the total length of all bruises and discolourations is determined. A bruise which completely penetrates the fillet is counted only once.

Grade "A": No single instance or combination of instances exceeding 2.0 cm in total maximum dimension.

"B": Any single instance or a combination of instances exceeding 2.0 cm and up to 5 cm in total maximum dimension.

"C": Any single instance or a combination of instances exceeding 5.0 cm in total maximum dimension but does not exceed 50% of the total surface area of the fillet or split fish.

Reject: Any instance or a combination of instances the total surface area of which exceeds 50% of the total surface area of the fillet or split fish.

JELLIED FLESH

Use: To class sample units as grades A, B, or C or reject.

Definition: Flesh which has a gelatinous, glossy, translucent appearance caused by an abnormally high moisture content. This condition is generally found only in flatfish and species of the family Anarhichadidae.

Procedure: Skinned fillets are examined and their degree of jelliness categorized as free: moisture content 82% or less; slight: moisture content more than more than 84%; moderate: moisture content more than 84% but not more than 86%; and

excessive: moisture content is more than 86%, by weight.

Grade "A": flesh is not jellied.
"B": Flesh is slightly jellied.
"C": Flesh is moderately jellied.
Reject: Flesh is excessively jellied.

CHALKY FLESH

Use: To class sample units as grades A, B, or C.

Definition: Flesh which has an appearance of being dry, chalky white, dull, putty-like and/or granular. This condition is generally found only in flatfish.

Procedure: Skinned fillets are examined and the degree of chalkiness categorized as free, slight, moderate or excessive.

Grade "A": Flesh is free from or slightly chalky.
"B": Flesh is moderately chalky.
"C": Flesh is excessively chalky.

WORKMANSHIP DEFECTS (split fish only)

Use: To class split fish into grades A, B, or C.

Definition: Well Split: the fish is split close to the vent and fins; the backbone is removed from at least three joints below the vent, without gouging; the spinal cord remains intact; and not more than one of either slivers, cut throughs, split tails up to 5% of length of the fish or roundtails, (up to 2.5 cm from the round of the tail left unsplit) may be present.

Fairly well split: the fish is split fairly close to the vent and fins; the backbone is removed from at least three joints below the vent; slight dipping or gouging is present; and not more than one of the following: slivers greater than 5% up to 20% of the length of the fish, cut throughs greater than 5% up to 15% of the length of the fish, split tails greater than 5% up to 10% of the length of the fish or roundtails not exceeding 10% of the length of the fish may be present.

Improperly split: not split close to the vent and anal fins; backbone removed well above or below the vent; definite gouging or dipping and exceeds the "fairly well split" criteria for slivers, cut throughs, split tails or roundtails.

Sliver: caused by failure to split the fish close to one side of the pelvic and anal fins.

Roundtail: caused by failure to split the fish close up to the caudle peduncle (round of the tail).
Cut through: a cut into the flesh at the tail made during splitting.
Split tail: a cut into the tail made during splitting which continues to the end of the tail.

Procedure: Sample units of split fish are examined for the defects in workmanship described above.

Grade "A": The fish is well split.
"B": The fish is fairly well split.
"C": The fish is improperly split.

Table III-1

SAMPLING SCHEDULE

RAW FISH GRADES - ATLANTIC GROUNDFISH

(whole, dressed or split form, bled or unbled)

NUMBER OF FISH IN THE LOT	NUMBER OF SAMPLE UNITS TO BE EXAMINED	
	WEIGHT OF AVERAGE FISH LESS THAN 1 KG	WEIGHT OF AVERAGE FISH MORE THAN 1 KG
100 FISH OR FEWER	5	5
101 - 130	5	6
131 - 160	5	7
161 - 190	5	8
191 - 220	5	9
221 - 250	5	10
251 - 300	6	11
301 - 350	7	12
351 - 400	8	13
401 - 450	9	14
451 - 500	10	15
501 - 600	11	16
601 - 700	12	17
701 - 800	13	18
801 - 900	14	19
901 - 1000	15	20
1001 - 1200	16	21
1201 - 1400	17	22
1401 - 1600	18	23
1601 - 1800	19	24
1801 - 2000	20	25
2001 - 2200	21	26
2201 - 2400	22	27
2401 - 2600	23	28
2601 - 2800	24	29
2801 - 3000	25	30
3001 - 3200	26	31
3201 - 3400	27	32
3401 - 3600	28	33
3601 - 3800	29	34
3801 - 4000	30	35
4001 - 4200	31	36
4201 - 4400	32	37
4401 - 4600	33	38
4601 - 4800	34	39
4801 - 5000	35	40
Each ADDITIONAL 200 FISH	ADDITIONAL 5	ADDITIONAL 5

Sampling and Sample Size

The sample size, that is the number of fish to be graded, is determined by randomly sampling 10 fish from the lot to determine the average weight of each fish. Divide the average weight into the estimated or actual weight of the lot to be examined to determine the total number of fish in the lot. Based on the total number of fish, the above sampling schedule shall be applied.

Table III-2

RAW FISH GRADES - ATLANTIC GROUNDFISH

(Whole, dressed or split form, bled or unbled)

Grades are assigned to each sample unit examined as skinned fillets or split fish using the combination of factors given below. The assigned grade cannot be higher than the lowest grade given for any of the grading factors. The number of sample units required for lots of different size is given in Table 1. The grade(s) assigned to the lot are determined by the percentage of each grade of the sample units in the lot. A lot of fish shall be rejected if the percent of reject fish exceed 10% of the number of fish in the sample, except that a 15% level will apply to fish rejected for jelliness. Where a lot is rejected, the owner may cull the fish and request a regrading, the results of which are final. (See Grade Standard for additional information).

GRADE FACTORS	GRADE "A"	GRADE "B"	GRADE "C"	REJECT
Colour	Flesh colour characteristic of bled fish	Flesh colour not characteristic of bled fish	Not assigned	Not assigned
Odour	Fresh, characteristic of the species or neutral	Abnormal, characteristic of slight feed	Not assigned	Indicative of taint or decomposition or any other abnormal odour other than slight feed
Texture	Firm and resilient; up to 10% of surface area may show gaping	Slightly soft and/or more than 10% and up to 25% of surface area may show gaping	Soft and/ or more than 25% and up to 75% of surface area may show gaping	Excessively soft and more than 75% of the surface area shows gaping
Blood Clots	No single clot or combination of clots exceeding 0.5cm in total maximum dimension	Any single clot or a combination of clots exceeding 0.5cm and up to 4.0cm in total maximum dimension	Any single clot or a combination of clots exceeding 4.0cm in total maximum dimension	Not assigned

	Grade "A"	Grade "B"	Grade "C"	Reject
Bruising and Discolourations	No single instance or combination of instances exceeding 2.0cm in total maximum dimension	Any single instance or combination of instances exceeding 2.0cm and up to 5.0cm in total maximum dimension	Any single instance or combination of instances exceeding 5.0cm in total maximum dimension but does not exceed 50% of total surface area of the fillet or split fish	Any instance or combination of instances the total surface area of which exceeds 50% of the total surface area of the fillet or split fish
Jellied Flesh	None	Slightly jellied	Moderately jellied	Excessively jellied
Chalky Flesh	None, or slightly chalky	Moderately chalky	Excessively chalky	Not assigned
Workmanship Defects (Split fish only)	Fish is well split	Fish is fairly well split	Fish is improperly split	Not assigned

APPENDIX IV

Bremner Demerit Scoring System

Date_____ Species_____ Code #_____ Inspector_____

Sensory Assessment Score Sheet

Fish identification

Appearance		V.bright 0	Bright 1	Sl.dull 2	Dull 3
Skin		Firm 0	Soft 1		
Scales		Firm 0	Sl.loose 1	Loose 2	
Slime		Absent 0	Sl.slimy 1	Slimy 2	V.slimy 3
Stiffness		Pre-rigor 0	Rigor 1	Post-rigor 2	
Eyes	Clarity	Clear 0	Sl.cloudy 1	Cloudy 2	
	Shape	Normal 0	Sl.sunken 1	Sunken 2	
	Iris	Visible 0	Not visible 1		
	Blood	No blood 0	Sl.bloody 1	V.bloody 2	
Gills	Color	Characteristic 0	Sl.dark Sl.faded 1	V.dark V.faded 2	
	Mucus	Absent 0	Moderate 1	Excessive 2	
	Smell	Fresh oily, Metallic, Seaweed 0	Fishy 1	Stale 2	Spoilt 3
Belly	Discoloration	Absent 0	Detectable 1	Moderate 2	Excessive 3
	Firmness	Firm 0	Soft 1	Burst 2	
Vent	Condition	Normal 0	Sl.break Exudes 1	Excessive Opening 2	
	Smell	Fresh 0	Neutral 1	Fishy 2	Spoilt 3
Belly cavity					
	Stains	Opalescent 0	Grayish 1	Yellow-brown 2	
	Blood	Red 0	Dark red 1	Brown 2	

APPENDIX V

Microbiological and Sensory Analysis Methodology

I. Microbiology

A. Sampling

1. Whole fish

Using sterile 1 square inch templates, swab a 5 square inch area on the surface of each whole fish. The swabs are placed into tubes containing 5 ml of 0.5% peptone and further diluted for plating.

2. Fillets

a. Aseptically remove a 30 gram sample anywhere on the fillet.

b. Samples should be weighed directly into Stomacher bags, diluted 1:10 with sterile 0.5 % peptone and blended in a Stomacher Lab-Blender 400 (A. J. Seward, London) for 2 minutes.

B. Plating and liquid medium (Aerobic Plate Count 20°C)

a. Plate Count Agar with 0.5% NaCl.

b. For dilution use sterile 0.5 % peptone.

c. Use pour plate technique.

d. Incubate 20°C for 4 days.

e. Express counts as colony forming units per square inch (cfu/in^2) or colony forming units per gram (cfu/g) of fish sampled.

II. Panel Testing

A. Sample preparation

1. Wrap sample in aluminum foil and label with code.

2. Steam 10 minutes.

B. Reference Sample

1. Must be of high quality.

2. Wrap tightly in plastic food wrap - no air.

3. Place in polyethylene whirl pack.

4. Freeze quickly in blast freezer.

5. Maintain frozen storage at -15 F.

C. Sensory Panels

1. Serve fish to 8 - 10 experienced panelists.

2. Evaluate raw product for appearance, odor and texture according to a nine point hedonic scale (National Marine Fisheries Service's method). A previously frozen, raw reference sample of highest quality will be available for comparison.

3. If the raw product is still acceptable (>5 hedonic score) a cooked sample will be evaluated for appearance, odor, taste and texture according to the nine point hedonic scale. A previously frozen, cooked reference sample of highest quality will be available for comparison.

4. Two break points must be reported. The first is when the fish falls from a rating of good to fair (hedonic score of 7 to 6). This is when the first off odor is detected in the raw product. The second break point is when the fish first becomes unacceptable (hedonic score <5).

SENSORY EVALUATION FORM

RAW EVALUATION

Name _____ Product _____ Date _____

Quality	Sample ___			Sample ___			Sample ___			Sample ___			Sample ___			Sample ___		
	Appearance	Odor	Texture	Appearance	Odor	Texture	Appearance	Odor	Texture	Appearance	Odor	Texture	Appearance	Odor	Texture	Appearance	Odor	Texture
 Excellent																		
Very Good																		
 Good																		
Fair																		
 Borderline																		
Slightly Poor																		
 Poor																		
Very Poor																		
 Inedible																		

Comments:

SENSORY EVALUATION FORM

COOKED EVALUATION

Name _____ Product _____ Date _____

Quality	Sample ___				Sample ___				Sample ___				Sample ___				Sample ___				Sample ___			
	Appearance	Odor	Taste	Texture	Appearance	Odor	Taste	Texture	Appearance	Odor	Taste	Texture	Appearance	Odor	Taste	Texture	Appearance	Odor	Taste	Texture	Appearance	Odor	Taste	Texture
 Excellent																								
Very Good																								
 Good																								
Fair																								
 Borderline																								
Slightly Poor																								
 Poor																								
Very Poor																								
 Inedible																								

Comments:

APPENDIX VI

USDC/NMFS Fish Fillet Inspection Standards

Scored factors	Deductions
FROZEN	
1. General appearance defects	
2. Dehydration	
3. Uniformity of thickness	
4. Uniformity of weight	
THAWED	
5. Workmanship defects	
6. Color defects	
7. Honeycombing	
COOKED	
8. Texture	
9. Odor (Limiting rule—Table I)	
10. Flavor (Limiting rule—Table I)	
Total deductions	
Product score (100—Total deductions)	
Flavor and odor rating	
Final grade	

PART 263—UNITED STATES STANDARDS FOR GRADES OF FISH FILLETS

Subpart A—United States General Standards for Grades of Fish Fillets

Sec.

Subpart B—United States Standards for Grades of Cod Fillets

SCORE SHEET

Sec.

Subpart C—United States Standards for Grades of Flounder and Sole Fillets

Subpart D—United States Standards for Grades of Haddock Fillets

Subpart E—United States Standards for Grades of Ocean-Perch Fillets and Pacific Ocean-Perch Fillets

AUTHORITY: 7 U.S.C. 1621-1630.

SOURCE: 42 FR 52756, Sept. 30, 1977, unless otherwise noted.

Subpart A—United States General Standards for Grades of Fish Fillets

SOURCE: 44 FR 32386, June 6, 1979, unless otherwise noted.

§ 263.101 Scope and product description.

(a) This standard shall apply to fresh or frozen fillets of fish of any species that are suitable for use as human food and processed and maintained in accordance with good manufacturing procedures. It does not apply to products covered by Subparts B, C, D, and E of Part 263.

(b) Fillets are slices of practically boneless fish flesh of irregular size and shape, which are removed from the carcass by cuts made parallel to the backbone and sections of such fillets cut so as to facilitate packing.

§ 263.102 Product forms.

(a) *Types:* (1) Fresh.

(2) Frozen individually (IQF); glazed or unglazed.

(3) Frozen solid packs; glazed or unglazed.

(b) *Styles:* (1) Single.

(i) Skin-on.

(ii) Skin-on scaled.

(iii) Skin-on (white side only) (applies only to flatfish).

(iv) Skin-off (skinless).

(2) Butterfly.

§ 263.103 Grades.

(a) *U.S. Grade A.* Fish fillets shall:

(1) Possess good flavor and odor characteristic of the species; and

(2) Comply with the limits for defects for U.S. Grade A quality as outlined in § 263.104.

(b) *U.S. Grade B.* Fish fillets shall:

(1) Possess reasonably good flavor and odor characteristic of the species; and

(2) Comply with the limits for defects for U.S. Grade B quality in accordance with § 263.104.

(c) *U.S. Grade C.* Fish fillets shall:

(1) Possess minimal acceptable flavor and odor characteristic of the species with no objectionable off-flavors or off-odors; and

(2) Comply with the limits for defects for U.S. Grade C quality in accordance with § 263.104.

(d) *"Substandard".* Fish fillets shall:

(1) Possess minimal acceptable flavor and odor characteristics of the species with no objectionable off-flavors or off-odors; and

(2) Fail to meet the limits for physical defects for U.S. Grade C quality given under § 263.104, paragraphs (d), (e), and (f).

§ 263.104 Grade determination.

(a) *Procedures for grade determination:* The grade shall be determined by evaluating the product in the frozen, and/or thawed, and cooked states. Each defect is classified as to its relative severity as minor, major, or serious in accordance with paragraphs (d), (e), and (f) of this section. Odor and flavor are evaluated in accordance with paragraph (c) of this section. Tolerances for the various defects are set for each grade classification according to group species.

(b) *Sampling.* Sampling is to be done in accordance with the Regulations Governing Processed Fishery Products, Title 50, Chapter II, Subchapter G, Part 260.61, Tables II, V, or VI, where applicable. The sample unit shall be the container and its entire contents for containers up to 10 pounds. A representative 3 pound sample unit for containers over 10 pounds shall be used.

(c) *Evaluation of flavor and odor.* (1) Evaluation of flavor and odor on each of the sample units shall be carried out only by those trained to do so. For evaluation of the odor of raw fillets, the thawed fillets should be broken and the broken flesh held close to the nose immediately to detect off-odor.

(2) If raw odor evaluation indicates any noncharacteristic and/or off-odors, the sample unit or parts thereof shall be cooked by any of the following methods for verification of results of raw odor evaluation:

(i) *Baked method.* Package the product in aluminum foil. Place the packaged product on a flat cookie sheet or shallow flat-bottom pan of sufficient size so that the packages can be evenly spread on the sheet or pan. Place the pan and frozen contents in a properly ventilated oven preheated to 400° F until the internal temperature of the product reaches 160° F.

(ii) *Boil in bag method.* Insert the thawed unseasoned sample into a boilable film-type pouch. Fold open end of the pouch over a suspension bar. Clamp in place to provide a loose seal after evacuating the air by immersing the pouch into boiling water. Cook the contents until the internal temperature of the product reaches 160°F.

(iii) *Steam method.* Wrap the sample in a single layer of aluminum foil and place on a wire rack suspended over boiling water in a covered container. Steam the packaged product until the internal temperature of the product reaches 160°F.

(d) *Examination for physical defects:* Each sample unit shall be examined for defects using the list of defect definitions that follow. Defects will be categorized as minor, major, and serious according to Table 1 of this standard.

(e) *Definition of defects in fillets:* (1) "Abnormal condition" means that the normal physical and/or chemical structure of the fish flesh has been sufficiently changed so that the usability and/or desirability of the flesh is adversely affected. It includes but is not limited to the following:

(i) Jellied—refers to the abnormal condition wherein a fish fillet is partly or wholly characterized by a gelatinous, glossy, translucent appearance.

(ii) Milky—refers to the abnormal condition wherein a fish fillet is partly or wholly characterized by a milky-white, excessively mushy, pasty, or fluidized appearance.

(iii) Chalky—refers to an abnormal condition wherein a fish fillet is partly or wholly characterized by a dry, chalky, granular appearance, and fiberless structure.

The intensity of abnormal conditions is defined as follows:

(A) Moderate—refers to a condition that is distinctly noticeable but does not seriously affect the appearance, desirability, and/or the eating quality of the product.

(B) Excessive—refers to a condition which is both distinctly noticeable and seriously objectionable.

(2) Appearance defect—refers to the color of the fish flesh and to the degree of surface dehydration of the product.

(i) Color defect—refers to any readily discernable abnormal coloration including bruises, blood spots, browning, yellowing, and melanin spotting. Each square inch (6.5 cm^2) of affected area is counted as one instance as determined by a transparent grid of 1 inch squares.

The extent of appearance defects is defined as follows:

(A) Slight—2-4 instances.

(B) Moderate—5-6 instances.

(C) Excessive—over 6 instances.

(ii) Dehydration—refers to loss of moisture from fish fillet surfaces during frozen storage.

(A) Slight dehydration—is surface color masking affecting more than 5 percent of surface area which can be readily removed by scraping with a blunt instrument.

(B) Moderate dehydration—is deep color masking penetrating the flesh affecting less than 5 percent, but more than 1 percent of surface area and requiring a knife or other sharp instrument to remove.

(C) Excessive dehydration—is deep color masking penetrating the flesh affecting more than 5 percent of surface area and requiring a knife or other sharp instrument to remove.

(3) Workmanship defects refer to:

(i) Cutting and trimming imperfections, ragged edges, holes, tears, and improper or misplaced cuts. Each square inch (6.5 cm^2) of affected area is counted as one instance whether it is full or fractional. "Ragged edges" refers to the irregular or shredded appearance of the fillet edge.

(ii) Scales, fins, or pieces of fins or extraneous material.

(A) Scales (skin-off) scaled fillets—An occurrence of attached or loose scales in any sample unit up to 1 square inch (6.5 cm^2) is counted as one instance. Each additional 1 square inch (6.5 cm^2) is an additional instance.

(B) Fins—Any fin or parts of any fin up to 1 square inch (6.5 cm^2) in area shall be considered one instance of fin.

(C) Extraneous material means any piece of foreign matter on the fillet or elsewhere in the package. Each occurrence is considered one instance.

The extent of workmanship defects is defined as follows:

Slight degree—1-2 instances.
Moderate degree—3-4 instances.
Excessive degree—over 4 instances.

(4) Bone—refers to a bone, or piece of bone, that exceeds either the dimension 15 mm in length or 0.355 mm in diameter. Each area of one inch square (6.5 cm^2) which contains a bone or a cluster of bones shall be regarded as one instance of bones. The amount of bones is defined as follows:

Slight—1 instance.
Moderate—2-4 instances.
Excessive—over 4 instances.

(5) Skin—includes exterior skin and black membrane (belly lining).

(i) For skinless fillets, each piece of skin up to 1 square inch (6.5 cm^2) and every additional complete 1 square inch (6.5 cm^2) thereafter shall be considered an instance.

(ii) In the case of skin-on or skinless fillets, each piece of black membrane (belly lining) up to 1 square inch (6.5 cm^2) thereafter shall be considered an instance.

The amount of skin is defined as follows:

Slight degree—1 instance.
Moderate degree—2-4 instances.
Excessive degree—over 4 instances.

(6) Size of fillets—refers to the freedom from undesirably small pieces of fillets. Undesirably small shall mean any piece of fillet weighing less than 1 ounce (30 grams) per container. Moderate degree—2 pieces. Excessive—over 2 pieces.

(7) "Texture defects"—refers to the texture of the cooked fish being not characteristic of the species.

(i) Slight—fairly firm, does not form a fibrous mass in the mouth, moist but not mushy.

(ii) Moderate—moderately tough or rubbery, has noticeable tendency to form a fibrous mass in the mouth, moist but not mushy.

(iii) Excessive—excessively tough or rubbery, has marked tendency to form a fibrous mass in the mouth, or is very dry or very mushy.

(f) *Categorization of physical defects.* Instances shall be assessed on a per pound basis for physical defects, except for defects relating to abnormal conditions, texture, dehydration and sizes of fillets.

TABLE 1—DEFECT TABLE

Defect description	Classification		
	Minor	Major	Serious
1. Abnormal Condition:			
Moderate		2	
Excessive			4
2. Appearance:			
(a) Color defects:			
Slight (2–4 instances)	1		
Moderate (5–6 instances)		2	
Excessive (over 6 instances)			4
(b) Dehydration:			
Slight (surface <5% of area)	1		
Moderate (deep 1 to 5% of area)		2	
Excessive (deep >5% of area)			4
3. Workmanship defects:			
(a) Cutting and trimming:			
Slight (1–2 instances)	1		
Moderate (3–4 instances)		2	
Excessive (over 4 instances)			2
(b) Scales, fins, extraneous material:			
Slight (1–2 instances)	1		
Moderate (3–4 instances)		2	
Excessive (over 4 instances)			2
4. Bones:			
Slight (1 instance)	1		
Moderate (2–4 instances)		2	
Excessive (over 4 instances)			4
5. Skin and Membrane:			
Slight (1 instance)	1		
Moderate (2–4 instances)		2	

TABLE 1—DEFECT TABLE—Continued

Defect description	Classification		
	Minor	Major	Serious
Excessive (over 4 instances)			2
6. Size of Fillets:			
Moderate (2 instances)		2	
Excessive (over 2 instances)			2
7. Texture:			
Slight	1		
Moderate		2	
Excessive			4

TOLERANCES FOR VARIOUS DEFECTS

Combined minor and major defects	Serious defects	Group species[1]
U.S. Grade A:		
Up to 4 points	None	Groundfish.
Up to 5 points	do	Flatfish.
Up to 6 points	do	All others.
U.S. Grade B:		
Up to 8 points	do	Groundfish.
Up to 10 points	do	Flatfish.
Up to 12 points	do	All others.
U.S. Grade C:		
Up to 10 points	Up to 8 points	Groundfish.
Up to 12 points	do	Flatfish.
Up to 14 points	do	All others.

[1] Groundfish (white fish) includes cusk, ocean catfish, pollock, hake, whiting, and ling. Flatfish includes Greenland turbot and halibut.

(g) *Grade assignment:* Each sample unit will be assigned the grade into which it falls in accordance with the tolerance contained in Table 1 for Group Species. The grade to be assigned a lot is the grade indicated by the average of the total scores, provided the number of sample units in the next lower grade for both physical defects and flavor and odor does not exceed the acceptance number as indicated in the sampling plans contained in § 260.61.

[44 FR 32386, June 6, 1979, as amended at 51 FR 34990, Oct. 1, 1986]

Subpart B—United States Standards for Grades of Cod Fillets

§ 263.151 Product description.

The product described in this part consists of clean, whole, wholesome fillets or primarily large pieces of clean, whole, wholesome fillets, cut away from either side of cod, *Gadus morhua* or *Gadus macrocephalus*; the fillets may be either skinless or with skin on. They are packaged in accordance with good commercial practice and are maintained at temperatures necessary for the preservation of the product. (This part does not provide for the grading of pieces of fish flesh cut away from previously frozen fish blocks, slabs, or similar products.

§ 263.152 Grades of cod fillets.

(a) "U.S. Grade A" is the quality of cod fillets that possess good flavor and odor; and for those factors of quality which are rated in accordance with the scoring system outlined in this part the total score is not less than 85 points.

(b) "U.S. Grade B" is the quality of cod fillets that possess at least reasonably good flavor and odor; and for those factors of quality which are rated in accordance with the scoring system outlined in this part the total score is not less than 70 points.

(c) "Substandard" is the quality of cod fillets that fail to meet the requirements of U.S. Grade B.

§ 263.154 Product forms.

(a) Types:

APPENDIX VII

Quality Control Data Base

CLAM PLANT QUALITY CONTROL MANAGER

A. MICROBIOLOGICAL QUALITY ASSURANCE FILE

B. CHEMICAL QUALITY ASSURANCE FILE

C. WASTE MANAGEMENT FILE

D. SUPPLIERS QUALITY ASSURANCE FILE

A. MICROBIOLOGICAL QUALITY ASSURANCE FILE

SAMPLE DESCRIPTION

1. MEAT SAMPLE
2. SURFACE SAMPLE
3. JUICE SAMPLE
4. WELL WATER SAMPLE

1. MEAT SAMPLE

LOT NUMBER_____

TIME_____

DATE_____

LOCATION (Check One)

TRUCK	____	PIPE	____	P.R. SHAKER #1	____
COOLER	____	DEWATERER	____	P.R. SHAKER #2	____
CONVEYOR	____	DICER	____	P.R. WHITE BELT	____
SHELL WASH #1	____	IMPACTOR	____	GRINDER	____
CONVEYOR	____	EVISCERATION REEL	____	SCREW CONVEYOR	____
RETORT	____	SWECO SEPARATOR	____	RIFFLE WASH	____
CONVEYOR	____	PIPE	____	PIPE PRODUCT	____
SHELL WASH #2	____	MEAT WASHER	____	IQF SHAKER	____
SHAKER	____	INSPECTION TABLE	____	FREEZER	____
BRINE TANK	____	PIPE	____	FINAL PRODUCT	____
				STORED PRODUCT	____

ODOR

ACCEPTABLE_____

UNACCEPTABLE_____

STANDARD PLATE COUNT (ORGANISMS/G)_____

MOLD/YEAST COUNT (ORGANISMS/G)_____

COLIFORM COUNT (ORGANISMS/G)_____

FECAL COLIFORM COUNT (ORGANISMS/G)_____

E. COLI COUNT (ORGANISMS/G)_____

SALMONELLA

POSITIVE_____ NEGATIVE_____

COAGULASE POSITIVE STAPHLYOCOCCUS

POSITIVE_____ NEGATIVE_____

VIBRIO

POSITIVE_____ NEGATIVE_____

LISTERIA

POSITIVE_____ NEGATIVE_____

2. SURFACE SAMPLE

DATE_____

TIME_____

LOCATION (Check One)

TRUCK	____	PIPE	____
COOLER	____	MEAT WASHER	____
CONVEYOR	____	INSPECTION TABLE	____
SHELL WASH #1	____	PIPE	____
CONVEYOR	____	P.R. SHAKER #1	____
RETORT	____	P.R. SHAKER #2	____
CONVEYOR	____	GRINDER	____
SHELL WASH #2	____	SCREW CONVEYOR	____
SHAKER	____	RIFFLE WASH	____
BRINE TANK	____	PIPE	____
PIPE	____	IQF SHAKER	____
DEWATERER	____	FREEZER	____
DICER	____	FINAL PRODUCT	____
IMPACTOR	____	STORED PRODUCT	____
EVISCERATION REEL	____		

APPEARANCE

ACCEPTABLE_____

UNACCEPTABLE_____

STANDARD PLATE COUNT (ORGANISMS/SQ. IN.)_____

COLIFORM COUNT (ORGANISMS/SQ. IN.)_____

FECAL COLIFORM COUNT (ORGANISMS/SQ. IN.)_____

SALMONELLA

POSITIVE_____ NEGATIVE_____

COAGULASE POSITIVE STAPHYLOCOCCUS

POSITIVE_____ NEGATIVE_____

VIBRIO

POSITIVE_____ NEGATIVE_____

LISTERIA

POSITIVE_____ NEGATIVE_____

3. JUICE SAMPLE

LOT NUMBER_____

TIME_____

DATE_____

LOCATION (Check One)
- RETORTS_____
- HOLDING TANK #1_____
- HOLDING TANK #2_____
- HOLDING TANK #3_____
- JEFFERY HOPPER_____
- EVAPORATION DISCHARGE_____
- P.R. HOLDING TANK _____

ODOR
- ACCEPTABLE_____
- UNACCEPTABLE_____

STANDARD PLATE COUNT (ORGANISMS/ml)_____

MOLD/YEAST COUNT (ORGANISMS/ml)_____

COLIFORM COUNT (ORGANISMS/ml)_____

FECAL COLIFORM COUNT (ORGANISMS/ml)_____

E. COLI COUNT (ORGANISMS/ml)_____

SALMONELLA
- POSITIVE_____
- NEGATIVE_____

COAGULASE POSITIVE STAPHYLOCOCCUS
- POSITIVE_____
- NEGATIVE_____

VIBRIO
- POSITIVE_____
- NEGATIVE_____

LISTERIA
- POSITIVE_____
- NEGATIVE_____

4. WELL WATER SAMPLE

DATE _____

TIME _____

LOCATION _____

PH _____

CHLORIDE (MG/L) _____

B. CHEMICAL QUALITY ASSURANCE FILE
SAMPLE DESCRIPTION
1. MEAT SAMPLE
2. JUICE SAMPLE

1. MEAT SAMPLE

LOT NUMBER_____

TIME_____

DATE_____

LOCATION (Check One)

TRUCK	____	PIPE	____	P.R. SHAKER #1	____
COOLER	____	DEWATERER	____	P.R. SHAKER #2	____
CONVEYOR	____	DICER	____	P.R. WHITE BELT	____
SHELL WASH #1	____	IMPACTOR	____	GRINDER	____
CONVEYOR	____	EVISCERATION REEL	____	SCREW CONVEYOR	____
RETORT	____	SWECO SEPARATOR	____	RIFFLE WASH	____
CONVEYOR	____	PIPE	____	PIPE PRODUCT	____
SHELL WASH #2	____	MEAT WASHER	____	IQF SHAKER	____
SHAKER	____	INSPECTION TABLE	____	FREEZER	____
BRINE TANK	____	PIPE	____	FINAL PRODUCT	____
				STORED PRODUCT	____

ODOR

ACCEPTABLE_____

UNACCEPTABLE_____

AMMONIA_____

PESTICIDE_____

HERBICIDE_____

INDUSTRIAL ORGANIC_____

ELEMENTAL_____

pH_____

1. JUICE SAMPLE

LOT NUMBER_____

TIME_____

DATE_____

LOCATION (Check One)

RETORTS_____
HOLDING TANK #1_____
HOLDING TANK #2_____
HOLDING TANK #3_____
JEFFERY HOPPER_____
EVAPORATION DISCHARGE_____
P.R. HOLDING TANK _____

ODOR

ACCEPTABLE_____
UNACCEPTABLE_____

AMMONIA_____
PESTICIDE_____

HERBICIDE_____

INDUSTRIAL ORGANIC_____

ELEMENTAL_____

pH_____

B. WASTE MANAGEMENT FILE

TIME_____

DATE_____

LOCATION to be completed by Jack Miles (all equipment that has a discharge)

PH_____

BOD (MG/L)_____

COD (MG/L)_____

TOTAL SUSPENDED SOLIDS (TSS) (MG/L)_____

VOLATILE SUSPENDED SOLIDS (MG/L)_____

TEMPERATURE (^{O}F)_____

VOLATILE ACIDS ( )_____

ALKALINITY (MG/L)_____

TOTAL KJELDAHL NITROGEN ( )_____

AMMONIA ( )_____

TOTAL PHOSPHORUS ( )_____

FOG ( )_____

METHANE_____

CARBON DIOXIDE_____

HYDROGEN SULPHITE_____

OIL AND GREASE (MG/L)_____

TOTAL PLATE COUNT (ORGANISMS/ML)_____

COLIFORM COUNT (ORGANISMS/ML)_____

FECAL COLIFORM COUNT (ORGANISMS/ML)_____

E. COLI COUNT (ORGANISMS/ML)_____