| **Proposal for Consideration at the Interstate Shellfish Sanitation Conference 2011 Biennial Meeting** | ☐ ☒ ☐ | **Growing Area Harvesting/Handling/Distribution Administrative** |
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| **Name of Submitter:** | State Shellfish Control Authorities for Delaware, Georgia, Maryland, New Jersey, New York, North Carolina, and South Carolina |
| **Affiliation:** | Delaware Department of Natural Resources and Environmental Control;<br>Maryland Department of Environment;<br>Maryland Department of Health and Mental Hygiene;<br>Maryland Department of Natural Resources;<br>Georgia Department of Agriculture;<br>Georgia Department of Natural Resources;<br>New Jersey Department of Health and Senior Services;<br>New Jersey Department of Environmental Protection;<br>New York Department of Environmental Conservation;<br>North Carolina Department of Environment and Natural Resources<br>South Carolina Department of Health and Environmental Control |
| **Address:** | See SSCA list on ISSC Web Site |
| **Phone:**<br>**Fax:**<br>**Email:** | See SSCA list on ISSC Web Site |
| **Proposal Subject:** | *Vibro vulnificus* and *Vibrio parahaemoylyticus* Risk Management of Oysters |
| **Specific NSSP Guide Reference:** | Section II Model Ordinance, Chapter II Risk Assessment and Risk Management<br>@.01 Outbreaks of Shellfish Related Illnesses<br>@.04 *Vibrio vulnificus* Risk Management for Oysters |
| **Key Words:** | *Vibro vulnificus*; *Vibrio parahaemolyticus*; Risk Management |
| **Text of Proposal/ Requested Action:** | Chapter II Risk Assessment and Risk Management<br><br>@.01 Outbreaks of Shellfish Related Illnesses<br><br>**J. The Authority shall assess annually *Vibrio vulnificus* and *Vibrio parahaemolyticus* illnesses associated wit**h the consumption of molluscan shellfish. The assessment will include a record of all *V. vulnificus* and/or *V. parahaemolyticus* shellfish-associated illnesses reported within the state and from receiving states, the numbers of illnesses per event, and actions taken by the Authority in response to the illnesses.<br><br>Effective January 1, 2012:<br><br>@.04 *Vibrio vulnificus* and *Vibrio parahaemolyticus* Risk Management for Oysters<br><br>A. For states having 2 or more etiologically confirmed shellfish-borne *Vibrio vulnificus* or *Vibrio parahaemolyticus* illnesses ~~since 1995~~ within ~~g~~the prior five (5) years traced to the consumption of commercially harvested raw or undercooked oysters that originated from ~~the waters~~ a growing area of that state (Source State), the Authority shall develop and implement *a Vibrio vulnificus* and/or *Vibrio parahaemolyticus* ~~Risk Management~~ Control Plan. |

~~B. The Source State's *Vibrio vulnificus* Risk Management Plan shall define the administrative procedures and resources necessary to accomplish (i.e. establish and maintain) involvement by the state in a collective illness risk reduction program. The goal of the *Vibrio vulnificus* Risk Management Plan will be to reduce the risk per serving to a 60% illness rate reduction for etiologically confirmed shellfish-borne *Vibrio vulnificus* septicemia illnesses reported collectively by California, Florida, Louisiana, and Texas, from the consumption of commercially harvested raw or undercooked oysters to a level equivalent to a 60% illness rate reduction from 1995 – 1999 baseline average illness rate of 0.278 per million.~~

~~C.~~B. The goal of the Control Plan is to reduce the probability of occurrence of *Vibrio* illness during periods that have been historically associated with annual illnesses. The Plan is to be implemented as part of a comprehensive program which includes all the time and temperature requirements contained in the Model Ordinance. The Source State's *Vibrio ~~vulnificus~~* Risk Management ~~-~~ Control Plan shall include, at a minimum:

(1) The ISSC Consumer Education Program targeted toward individuals who consume raw oysters and whose health condition(s) increase their risk for *Vibrio vulnificus* illnesses; and

~~(2)A process to collect standardized information for each *Vibrio vulnificus* illness: including underlying medical conditions; knowledge of disease status; prior counseling on avoidance of high risk foods, including raw oysters; existence of consumer advisories at point of purchase or consumption; and, if possible, whether consumer was aware and understood the advisories;~~

~~(3)~~(2) A standardized process for tracking products implicated in ~~*Vibrio vulnificus* -~~illnesses.~~; and~~

~~(4)Identification and implementation of the controls, or equivalent controls, which produced an illness per serving equivalent to a 60% illness rate reduction in the core states.~~

~~@.05 *Vibrio parahaemolyticus* Control Plan~~

~~The goal of the Control Plan is to reduce the probability of occurrence of *Vibrio parahaemolyticus* illness during periods that have been historically associated with annual illnesses. The Plan is to be implemented as part of a comprehensive program which includes all the time and temperature requirements contained in the Model Ordinance.~~

~~A.~~C. Risk Evaluation.

Every State from which oysters are harvested shall conduct a *Vibrio vulnificus* and a *Vibrio parahaemolyticus* risk evaluation annually. The evaluation shall consider each of the following factors, including seasonal variations in the factors, in determining whether the risk of *Vibrio ~~parahaemolyticus~~* infection from the consumption of oysters harvested from an area (hydrological, geographical, or growing) is reasonably likely to occur: (For the purposes of this section, "reasonably likely to occur" shall mean that the risk constitutes an annual occurrence)

(1) The number of *Vibrio vulnificus* and *Vibrio parahaemolyticus* cases epidemiologically linked to the consumption of oysters commercially harvested from the State; and

(2) Levels of total and tdh+ *Vibrio parahaemolyticus* in the area, to the

extent that such data exists; and
(3) The water temperatures in the area; and
(4) The air temperatures in the area; and
(5) Salinity in the area; and
(6) Harvesting techniques in the area; and
(7) The quantity of harvest from the area and its uses i.e. shucking, halfshell, PHP.

~~B.~~ D. Control Plan

(1) If a State's *Vibrio vulnificus* and/or *Vibrio parahaemolyticus* risk evaluation determines that the risk of *Vibrio ~~parahaemolyticus~~* illness from the consumption of oysters harvested from a growing area is reasonably likely to occur, the State shall develop and implement a *Vibrio ~~parahaemolyticus~~* Control Plan; or
(2) For *Vibrio parahaemolyticus*, ~~I~~if a State has a shellfish growing area in which harvesting occurs at a time when average monthly daytime water temperatures exceed those listed below, the State shall develop and implement a *Vibrio parahaemolyticus* Control Plan. The average water temperatures representative of harvesting conditions (for a period not to exceed thirty (30) days) that prompt the need for a Control Plan are:
(a) Waters bordering the Pacific Ocean - 60°F.
(b) Waters bordering the Gulf of Mexico and Atlantic Ocean (NJ and south) - 81°F.
(c) However, development of a Plan is not necessary if the State conducts a risk evaluation, as described in §~~A~~**C**., that determines that it is not reasonably likely that a -*Vibrio parahaemolyticus* illness will occur from the consumption of oysters harvested from those areas.
(i) In conducting the evaluation, the State shall evaluate the factors listed in §~~A~~**C**. for the area during periods when the temperatures exceed those listed in this section;
(ii) In concluding that the risk is not reasonably likely to occur, the State shall consider how the factors listed in §~~A~~C**.** differ in the area being assessed from other areas in the state and adjoining states that have been the source of shellfish that have been epidemiologically linked to cases of *Vibrio parahaemolyticus* illness**.**~~; or~~

~~(3) If a State has a shellfish growing area that was the source of oysters that were epidemiologically linked to an outbreak of *Vibrio parahaemolyticus* within the prior five (5) years, the State shall develop and implement a *Vibrio parahaemolyticus* Control Plan for the area.~~

~~(4)~~ (3) For States required to implement *Vibrio ~~parahaemolyticus~~* Control Plans, the Plan shall include the administrative procedures and resources necessary to accomplish the following:
(a) Establish one or more triggers for when control measures are needed. These triggers shall be the temperatures in §~~B~~D. (2) where they apply, or other triggers as determined by the risk evaluation.
(b) Implement one or more control measures to reduce the risk of *Vibrio ~~parahaemolyticus~~* illness at times when it is reasonably likely to occur.
The control measures for *Vibrio vulnificus* may include:
(i) Labeling all oysters, "For shucking by a certified dealer", when the Average Monthly Maximum Water

Temperature exceeds 75°F;

(ii) Subjecting all oysters intended for the raw, half-shell market to an Authority- approved post harvest processing that reduces the *Vibrio vulnificus* levels to <30 MPN/gram when the Average Monthly Maximum Water Temperature exceeds 75°F;

(iii) Closing shellfish growing areas for the purpose of harvest of oysters intended for the raw, half-shell market when the Average Monthly Maximum Water Temperature exceeds 75°F;

(iv) Labeling all oysters, "For shucking by a certified dealer", during the months of May through September, inclusive;

(v) Subjecting all oysters intended for the raw, half-shell market to a post harvest processing that is both approved by the Authority and reduces the *Vibrio vulnificus* levels to <30 MPN/gram during the months of May through September,inclusive;

(vi) Closing shellfish growing areas for the purpose of harvesting oysters intended for the raw, half-shell market during the months of May through September, inclusive; and

(vii) Limiting time from harvest to refrigeration based on modeling or sampling, as determined by the Authority in consultation with FDA;

~~2.~~ The control measures for *Vibrio parahaemolyticus* may include:

(i) Post harvest processing using a process that has been validated to achieve a 2 log reduction in the levels of total *Vibrio parahaemolyticus* for Gulf and Atlantic Coast oysters and a 3 log reduction for the Pacific Coast oysters;

(ii) Closing the area to oyster harvest;

(iii) Restricting oyster harvest to product that is labeled for shucking by a certified dealer, or other means to allow the hazard to be addressed by further processing;

(iv) Limiting time from harvest to refrigeration to no more than five hours, or other times based on modeling or sampling, as determined by the Authority in consultation with FDA;

(v) Limiting time from harvest to refrigeration such that the levels of total *Vibrio parahaemolyticus* after the completion of initial cooling to 60 °F (internal temperature of the oysters) do not exceed the average levels from the harvest water at time of harvest by more than 0.75 logarithms, based on sampling or modeling, as approved by the Authority;

(vi) Other control measures that based on appropriate scientific studies are designed to ensure that the risk of *Vp* illness is no longer reasonably likely to occur, as approved by the Authority.

(c) Require the original dealer to cool oysters to an internal temperature of 50°F (10°C) or below within 10 hours or less as determined by

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| | the Authority after placement into refrigeration during periods when the risk of *Vibrio ~~parahaemolyticus~~* illness is reasonably likely to occur. The dealer's HACCP Plan shall include controls necessary to ensure, document and verify that the internal temperature of oysters has reached 50°F (10°C) or below within 10 hours or less as determined by the Authority of being placed into refrigeration. Oysters without proper HACCP records demonstrating compliance with this cooling requirement shall be diverted to PHP or labeled *"for shucking only"*, or other means to allow the hazard to be addressed by further processing.<br><br>(d) Evaluate the effectiveness of the Plan.<br><br>(e) Modify the Control Plan when the evaluation shows the Plan is ineffective, or when new information is available or new technology makes this prudent as determined by the Authority.<br><br>(f) Optional cost benefit analysis of the ~~*Vibrio parahaemolyticus*~~ Control Plan.<br><br>~~C~~ E. The Time When Harvest Begins<br><br>For the purpose of time to temperature control, time begins once the first shellstock harvested is no longer submerged.<br><br>F. Evaluating Effectiveness of Plans<br><br>In consultation with FDA the Authority will evaluate the implementation of their control plan based on effective management and enforcement of control measures to reduce the risk of illnesses. |
| **Public Health Significance:** | Changes will provide options and improve the ability for State Shellfish Control Authorities and the shellfish industry to achieve realistic risk management related to naturally occurring *Vibrio* bacteria. It was clearly stated at the VMC meeting held in January 2011 that because of the low incidence of *Vv* illness the 60% reduction of *Vv* illnesses from the Gulf States is not attainable without post harvest processing (PHP)( 1). The cost of having all product from the Gulf of Mexico post harvest processed is economically prohibitive to the industry (2) and PHP product is not desired by the oyster consuming public (3).<br><br>References: (1)VMC Committee Reports (Al Rainosek's updated illness rate Calculations); (2) RTI International Report Project Number 0211460.008 (3)"Analysis of How Post-harvest processing Technologies for Controlling Vibrio vulnificus Can Be Implemented"; Dr. Steve Otwell, Laura Garrido,Victor Garrido and Dr.Charlie Sims report "Sensory Assessment Study for Post -Harvest Processed (PHP) Oysters |
| **Cost Information (if available):** | Neutral |

## Al Rainosek

**From:** "Al Rainosek" <rainosek@jaguar1.usouthal.edu>
**To:** "alr" <Al.Rainosek@noaa.gov>
**Sent:** Monday, January 10, 2011 9:45 AM
**Attach:** Numbers!.eml
**Subject:** Fw: Updated Revised Illness Rate Calculations

This will be discussed with GAO
Illness Rate Reduction

**Based on updated population estimates provided by the Bureau of Census, and reviewed/confirmed Vv cases for 2007 throught 2010 from ISSC, the revised Illness Rate Calculations for the Core States (CA, FL, LA, TX) appear below.**

**Notes: (1) Population numbers from the Bureau of Census Annual Estimates of the Resident Population for the United States, Regions, States and Puerto Rico.**
**(2) Number of countable Vv cases provided by Marc Glatzer, FDA.**

**A. BASELINE (Core States): 1995 - 1999**
**Total Countable Cases = 98**
**Av Cases per year = 98 / 5 = 19.6**
**Av Population per year = 70,637,188**
**Av Baseline Illness Rate = 19.6 / 70,637,188 = 0.278 per million**

**B. Illness Rate Reductions from Baseline:**

**1. 2007: 17 countable (reviewed) cases**
**Est Population = 82,717,833**
**Est Illness Rate = 17 / 82,717,833 = 0.206 per million**
**Estimated Illness Rate Reduction from Baseline:**
**(0.278 - 0.206) / 0.278 = 25.9%**

**2. 2008: 13 countable (reviewed) cases**
**Est Population = 83,760,052**
**Est Illness Rate = 13 / 83,760,052 = 0.155 per million**
**Estimated Illness Rate Reduction from Baseline:**
**(0.278 - 0.155) / 0.278 = 44.2%**

**3. 2007/2008 Average Illness Rate Reduction from Baseline:**
**Average Cases = 15**
**Est Average Population = 83,238,942**
**Est Av Illness Rate = 15 / 83,238,942 = 0.180 per million**
**Est Average Illness Rate Reduction from Baseline:**
**(0.278 - 0.180) / 0.278 = 35.0%**

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**4. 2009: 15 cases (reviewed)**
**Est. Pop'n = 84,774,011**
**Est. Illness Rate = 15 / 84,774,011 = 0.177 per million**
**Est Illness Rate Reduction from Baseline:**
**(0.278 - 0.177) / 0.278 = 36.3%**

**5. 2010: 14 cases (reviewed)**
**Est. Pop'n = 86,065,142**
**Est. Illness Rate = 14 / 86,065,142 = 0.163 per million**
**Est Illness Rate Reduction from Baseline:**
**(0.278 - 0.163) / 0.278 = 41.4%**

**6. 2009/2010 Est. Av IRR = 38.8%**

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**7. 2007 - 2010 Est Av IRR = 37.0%**

Cases from Illness review Sub-committee

## Core State Vv Cases - Baseline & Measurable Years

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 0 | 0 | 0 | 2 | 4 | 1 | 0 | 2 | 3 | 3 | 1 | 0 | 16 |
| 1996 | 0 | 0 | 0 | 1 | 2 | 4 | 3 | 6 | 4 | 1 | 1 | 0 | 22 |
| 1997 | 0 | 0 | 0 | 0 | 4 | 1 | 1 | 2 | 4 | 1 | 1 | 0 | 14 |
| 1998 | 0 | 0 | 0 | 1 | 3 | 3 | 2 | 4 | 1 | 5 | 1 | 0 | 20 |
| 1999 | 0 | 0 | 1 | 4 | 3 | 2 | 4 | 2 | 7 | 2 | 0 | 1 | 26 |
| 2007 | 0 | 0 | 1 | 5 | 3 | 0 | 2 | 3 | 1 | 1 | 1 | 0 | 17 |
| 2008 | 0 | 0 | 0 | 2 | 2 | 1 | 3 | 0 | 3 | 1 | 1 | 0 | 13 |
| 2009 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 3 | 2 | 2 | 5 | 0 | 15 |
| 2010 | 0 | 0 | 0 | 3 | 1 | 1 | 2 | 3 | 1 | 0 | 3 | 0 | 14 |
| Total | 0 | 0 | 2 | 19 | 22 | 15 | 17 | 25 | 26 | 16 | 14 | 1 | 157 |

**NOTE: 1995-1999 cases represent the Baseline Cases; 2007-2010 cases represent the cases used to measure the Illness Rate Reduction. The Baseline Cases and 2007-2008 Cases have been reviewed by the ISSC Vv Illness Case Review Subcommittee and accepted by the ISSC Vibrio Management Committee (VMC) as countable cases. The 2009-2010 cases have been reviewed by the ISSC Vv Illness Case Review Subcommittee and will be submitted to the VMC for acceptance at the VMC meeting in January, 2011. In addition, CDC has not closed out the 2010 Vv case submission period, and there may be additional cases reported that will require review and acceptance by the ISSC. Assignment of a case to a month is made using the date of consumption. If the date of consumption is not known, date of onset will be used.**

# Sensory Assessment Study

# for

# Post-Harvest Processed (PHP) Oysters

**Dr. Steve Otwell, Laura Garrido, Victor Garrido**

**and Dr. Charlie Sims**

**Aquatic Food Products Lab**

**Food Science and Human Nutrition Department**

**University of Florida**

November 22, 2010

SENSORY ASSESSMENT STUDY
for
POST- HARVEST PROCESSED (PHP) OYSTERS

## ACKNOWLEDGEMENTS

This project would not have been possible without collaborative assistance by numerous individuals with special talents and shared concerns for the oyster industry and consumer health. Participants included:

Charlene Burke, University of Florida, Apalachicola, FL. Served as technical advisor and assisted in coordination and logistics of product.

David Heil, FL Department of Agriculture and Consumer Service, Tallahassee, FL. Served as a regulatory advisor to the project.

Rick Hunter, Food Technology Service, Inc. Provided plant time and personnel for Gamma Irradiation (GI) oyster process.

Jim Jones, Food Technology Service, Inc. Provided plant time and personnel for Gamma Irradiation (GI) oyster process.

Grady Leavins, Leavins Seafood, Inc., Apalachicola, FL. Served as an industry advisor to the project.

William T. Mahan, Sea Grant College Program, Apalachicola, FL. Served as technical advisor and local liaison for the project.

Michael Voisin, Motivatit Seafood, Inc. Houma, LA. Provided plant time and personnel for high pressure (HP) oyster processing.

Tommy Ward, Buddy Ward and Sons Seafood, Inc. Apalachicola, FL. Provided access to the company's oyster lease and harvest vessel necessary for the product procurement.

T.J. Ward and Jordan Todd, Apalachicola, FL. Served as expert shuckers for the project.

Robert Webb, Webb's Seafood, Inc. Youngstown, FL. Provided plant time and personnel for Heat Intervention (HI) and Low Temperature Freezing (LTF) oyster processing.

SENSORY ASSESSMENT STUDY
for
POST- HARVEST PROCESSED (PHP) OYSTERS

## TABLE OF CONTENTS

# SENSORY ASSESSMENT STUDY
# for
# POST- HARVEST PROCESSED (PHP) OYSTERS

## INTRODUCTION

Persistent concerns for illnesses associated with certain consumers eating raw oysters harvested during the warmer months about the Gulf of Mexico are calling for more use of post-harvesting processing (PHP) methods that reduce or eliminate the microbial culprits, *Vibrio vulnificus and Vibrio parahaemolyticus*. The PHP methods in question include validated operations involving the application of mild temperatures, gamma irradiation, high pressure, or low temperature freezing. These methods are in various stages of commercial use and they have been validated in accordance with required analytical protocols to verify the reduction and/or elimination of the naturally occurring yet potentially pathogenic *Vibrio* bacteria. The traditional processing methods for untreated oysters do not incorporate a similar bacteria kill step.

While the PHP methods can provide reduction of the bacterial concerns they can also introduce changes in the sensory attributes of the raw oysters that could influence consumer acceptance. The successful implementation of PHP methods will depend on consumer preferences and acceptance. This situation calls for a non-biased, science-based study to determine consumer preferences and acceptance for PHP versus traditional processed oysters destine for raw consumption.

## RESEARCH OBJECTIVES

The objectives of this project were to measure consumer preference and acceptance for raw oysters from untreated, traditional (T) processing compared with each of the four PHP methods (MH- mild heat intervention, HP-high pressure, GI-gamma irradiation, and LTF-low temperature freezing) using live oysters from the same harvest based on paired comparison tests and acceptability ratings. The intent was to assess preferences and acceptance for traditional verses PHP oysters rather than comparisons amongst PHP products. Procedures incorporated shelf-life considerations during the consumer sensory testing to account for any changes in PHP product attributes versus the traditional raw oysters through two separate periods of storage common in summer commerce. In addition, the same traditional and respective PHP oyster products were formally evaluated for sensory characteristics (i.e., taste, aroma, color, and texture) based on the established oyster sensory profiling system developed for ISSC (http://fshn.ifas.ufl.edu/seafood). Sensory profiling can provide some explanation for any differences measured for consumer preference and acceptance.

METHODOLOGY

All project work depended on industry cooperation in procurement and processing of the raw oysters. The work was conducted in a manner to exemplify typical oyster processing and marketing practices through existing commercial operations. All oyster products and processing were subject to a chain of custody arrangement that included continuous participation and monitoring of all products by the project investigators from the moment of harvest through processing, distribution, storage and preparation for consumer testing and sensory profiling.

All oysters (*Crassosteria virginica*) were harvested from approved waters with existing commercial procedures (small vessel dredging) from one selected site in Apalachicola Bay, Florida. The site was a private lease maintained by owner, Tommy Ward, in Apalachicola, Florida and denoted by the official Florida state designation, FL-1632 L-525. Site selection involved pre-monitoring of weather conditions and on-site prescreening by the experienced project investigators to assure the live oysters had a consistent salt flavor not subject to freshwater exposure that tends to dilute flavors. The site selection was critical in terms of uniform product condition and quality. All oysters used in this study were from the same harvest site and could not be distinguished or culled by any quality differences at the moment of harvest.

The oysters were harvested in two installments, one on September 6, 2010 and one on September 7$^{th}$, 2010 (Table 1). Each harvest consisted of 15 bushels (900 lbs) that were collected in the morning and delivered to an approved processing plant (Tommy Ward's; 13 Miles) for an initial wash to remove external mud and debris. The washing procedure was a simple, short time rinse through a typical stainless-steel tumbling unit that applied a water spray on the surface of the oysters. Product post-harvest handling achieved an internal product temperature below 50$^{o}$F within 2 hours of delivery in accordance with harvest regulations stipulated by the Florida Department of Agriculture and Consumer Services regulations (FL DOACS, 2009).

The quantity of harvest from the selected site and time was determined by the required amount of product for testing and to assure a simultaneous period of processing through the traditional and all PHP procedures within 48 hours post-harvest. The anticipate product volume and flow of work allowed two periods for sensory assessments for shelf-life consequences after 7 and 14 days post-harvest.
The work plan is illustrated in Table 1.

Table 1. Illustration of the work schedule from harvest through respective processing methods and eventual consumer and expert assessments. Oysters for traditional (T) processing were collected simultaneously during each harvest September 6 and 7 (Harvest site – Apalachicola Bay, Florida site designation FL-1632 L-525)

<table>
<tr><th rowspan="2">Days in storage</th><th colspan="4">Post-Harvest Processing (PHP) Methods</th></tr>
<tr><th>HP</th><th>LTF</th><th>GI</th><th>MH</th></tr>
<tr><td>0</td><td colspan="2">Harvest and refrigeration</td><td>Harvest & transported to Panama City, FL - Iced and processed (stored at 0°F)</td><td>Harvest & transported to Panama City, FL - Iced</td></tr>
<tr><td>1</td><td>Transport to Houma, LA - Iced</td><td>Transported to Mulberry, FL - Iced</td><td>Transported to Gainesville, FL – Dry ice</td><td>Processed and transported to Gainesville, FL - Iced</td></tr>
<tr><td rowspan="2">2</td><td>Processed and transported to Gainesville, FL - Iced</td><td>Processed and transported to Gainesville, FL - Iced</td><td rowspan="2">Frozen storage (0°F)</td><td rowspan="2">Refrigerated storage (35°F)</td></tr>
<tr><td colspan="2">Refrigerated Storage (35°F)</td></tr>
<tr><td>7</td><td colspan="2">Day 7 Sensory Evaluations & Expert Evaluations</td><td colspan="2">Day 7 Sensory Evaluations & Expert Evaluations</td></tr>
<tr><td>14</td><td colspan="2">Day 14 Sensory Evaluations & Expert Evaluations</td><td colspan="2">Day 14 Sensory Evaluations & Expert Evaluations</td></tr>
</table>

Oyster Processing Methods

The traditional (T) processing involved simple refrigerated storage in customary burlap oyster bags stored in refrigeration (35°F). Each PHP method was conducted in accordance with prior validated and published procedures currently available for commercial use. The protocol for PHP validation is specified and maintained by the National Shellfish Sanitation Conference (NSSP 2007a and 2007b). Each State Shellfish Certification Authority is responsible for the evaluation and approval of the PHP methods with concurrence from Food and Drug Administration (FDA).

High Pressure (HP): Refrigerated oysters were initially banded with plastic strips to maintain closure before placing in a cylindrical metal container that was filled with potable water and pressurized to approximately 36,000 PSI for 3 minutes. The treated oysters were then unloaded on a table for visual sorting and final packaging in an igloo cooler with ice, then transported to the University of Florida in Gainesville for storage

refrigerated (35°F) and sensory evaluations. These procedures were conducted at the validated and approved HP processing facilities of Motivatit Seafood in Houma, Louisiana.

Gamma Irradiation (GI): Oysters were banded with rubber bands to maintain closure while being held in 30 lbs waxed carton boxes that were placed on metal racks that carried the product into the irradiation chamber. The oysters were exposed to gamma radiation for a period of time necessary to achieve a minimum absorbed dose of 0.82 kGy as indicated by dosimeters placed on the waxed cartons. Treated product was then placed into an igloo cooler with ice, then transported to the University of Florida in Gainesville for refrigerated storage (35°F) and sensory evaluations. The irradiation procedures were conducted at processing facilitates maintained by Food Technology Services, Inc based in Mulberry, Florida. This is the same operation where the gamma irradiation procedures were validated for raw oyster PHP in December 2008.

Low Temperature Freezing (LTF): Oysters were manually shucked by removing the top shell, leaving the meat attached to the bottom shell. The half-shell product was placed on a conveyor belt that traveled through a nitrogen freezing tunnel set at an ambient temperature of – 170$^{o}$F with a belt speed of 3 ft/minute. Product exiting the nitrogen tunnel was solidly frozen. A potable, cold-water glaze was applied on the top of each frozen oyster to provide protection against freezer burn and dehydration. All frozen oysters were placed in an igloo cooler with dry ice, then transported to the University of Florida in Gainesville for frozen storage (0°F) and sensory evaluations. The validated low temperature freezing operations were conducted at Webb's Seafood, Inc in Youngstown, Florida.

Mild Heat Treatment (MH): Oysters were banded with rubber bands to assure closure during submersion in a tank of water maintained at 150$^{o}$F +/- 2$^{o}$F. Product was kept in the warm water for approximately 5 minutes to achieve an internal temperature of 122$^{o}$F for 1 - 2 minutes, then immediately placed in an ice slush for 2 minutes. The treated product was drained and placed in igloo coolers with ice, then transported to the University of Florida in Gainesville for refrigerated storage (35°F) and sensory evaluations. The mild heat interventions were conducted at Webb's Seafood, Inc in Youngstown, Florida. The mild heat interventions were based on prior work by Hesselman et al 1999.

Sample Preparation

The preparation of all oysters for sensory assessments was conducted in the Aquatic Food Products Lab at the University of Florida under supervision of the project investigators. All samples were presented in half-shell product form. Shucking was performed by professional oyster shuckers hired to assure the task was done correctly so as not to damage the oyster tissues and to present a whole edible oyster product with some accompanying 'liquor' or product fluids that are commonly associated with the consumption of half-shell oysters. Shucking involved carefully severing of the adductor muscles to remove the top shell followed by careful severing of the adductor muscles from the bottom shell that provided a container for the product. In order to maintain a uniform, cold product temperature and to prevent dehydration, the oysters were shucked 20 minutes prior to each sensory session and the half-shell products were placed on ice until served. The frozen, LTF half-shell oysters were thawed in containers held at room temperature for less than one hour then placed on ice until served. After thawing, the adductor muscle was severed from the bottom shell which served as a product container. All oysters used for the consumer and the expert panels were served at an average temperature of 45$^{o}$F or less which is the temperature customarily used for serving raw oysters in restaurants.

Note, during the shucking and thawing process any defective products were discarded. Defects included dead oysters for traditional products, excessive mud or debris, or damaged for PHP products. At 7 days post-harvest, the traditional oysters were the sample with the highest amount of rejects (49) followed by LTF (11), MH (11) and GI (4). After 14 days post-harvest, again the traditional oysters resulted in the highest rate of rejects (68), followed by HP (16), MH (10), GI (3) and LTF (3). The higher rate of rejects for the traditional product was due to mortality which is not an issue with PHP and banded oysters.

Consumer Sensory Assessments

Consumer preferences and acceptance were determined based on paired comparison tests and acceptability ratings. The tests were conducted with a group of consumers prescreened to assure familiarity with oyster consumption and a balance for various demographics (Table 3). Although the participants were recruited from one location, Gainesville, Florida, this college location included individuals from across the United States. Total participants ranged from 84 to 90 consumers per session. In each session the consumers were presented with a set of two different, unidentified oyster products served in the same manner at the same time with instructions to direct their responses. There were four possible

sets for each consumer; T vs. HP; T vs. MH; T vs. GI; or T vs. LTF. All sets compared traditional (T) oysters to one of the PHP methods. Two sets were presented per session and there were two sessions per each period of storage, 7 and 14 days post-harvest. This approach allowed comparison tests for all possible sets at both 7 and 14 days post-harvest.

The sets were presented in a random order per consumer so as not to introduce any unintended bias by order of presentation. During each session the consumers were asked to examine and consume at least two oysters from each oyster product presented. Thus the consumers ate at least 4 oysters for each set presented. To avoid sensory exhaustion only two sets are presented during one session and consumers were only allowed to participate in one session per day (two sets and 8 oysters per session). The same consumers were used in two sessions through two consecutive days to assure the same consumers responded to all possible sets of oyster products. The sample procurement and processing schedule (Table 1) were arranged to provide sessions for all the oyster products after 7 and 14 days post-harvest. There were no intermittent questions, discussions or interviews with the consumers between sessions or the separate periods of shelf-life that would have influenced their ratings or identity of the products.

All oyster products were presented utilizing blind codes so that the consumers were not aware of traditional or PHP products. The panelists were first asked to examine then taste both products per set and select the product they preferred. Then, they were asked to rate the acceptability of each product in the set. Acceptability ratings included measures for overall likeability, appearance, flavor and texture. A 9-point hedonic scale (1=dislike extremely, 5=neither like nor dislike, 9=like extremely) was used for all acceptability ratings (Attachment #1).

All consumer paired comparison tests were conducted in the Food Science and Human Nutrition Department's sensory laboratory equipped with sensory booths and computer data entry for real-time results. Coaching was limited to only assure consumer understood of procedures. Water and un-salted crackers were provided to panelists to cleanse the palate between samples. Their responses were recorded via computer entry using the program *Compusense*. The number of responses required to distinguish a significant preference was based on reference to the established paired comparison table number 17-12 in Meilgarrd et al. 2007. The acceptability ratings were subjected to analysis of variance and mean separations (Tukey's HSD, 0.05).

It is important to note that the preferences and acceptable ratings are strictly based on sets of comparisons between traditional and each individual PHP oyster product. There were no measures or ratings based on comparisons amongst any PHP products.

Table 3. Demographics for consumers prescreened for participation in the preference and acceptance tests.

| Age Range | | Sex | | Raw Oyster Consumption | |
|---|---|---|---|---|---|
| 20-40 yrs. | 66% | Female | 49% | > Once /month | 43% |
| 40-60 yrs. | 34% | Male | 51% | < Once/month but >twice /year | 41% |
| | | | | Twice /year or less | 16% |

Expert Sensory Assessments

The trained expert panel evaluated the oyster products using standard sensory profiling concurrently (same day) with the consumer sensory assessments for both periods of shelf-life, days 7 and 14 post-harvest. Expert profiling involved an established Oyster Sensory Panel that was trained and developed for ISSC. The expert panel has been maintained with continuous raw oyster assessments since 2008 (http://fshn.ifas.ufl.edu/seafood). The expert panel involved 10 screened and trained adults using standard protocol for sensory profiling stipulated in Meilgarrd et al. 2007. This panel has developed a full slate of lexicons and respective standards for a multitude of oyster product characteristics involving appearance, flavor, aroma, texture, mouthfeel and other sensory attributes. They rated or scored the various raw oyster products relative to the established standards and score sheets (http://fshn.ifas.ufl.edu/seafood; (Attachment #2 and Attachment #3). The expert panel scores were subjected to analysis of variance and mean separations (Tukey's HSD, 0.05).

RESULTS

Consumer Sensory Assessments

**Consumer preference** was influenced by oyster processing methods and duration of storage after processing (Table 2). The majority of consumers preferred traditional (T) oysters at the initial 7 days post-harvest. This initial preference for traditional oysters was significant at the 95% confidence level in comparisons with MH, HP and GI oysters. The difference in preference for traditional oysters was less distinct in comparisons with LTF oysters. These initial

preferences shifted as the product was held in refrigeration. After 14 days post-harvest there were no significant differences in consumer preferences at 95% confidence levels. Although the totaled preferences per comparisons on day 14 appeared to favor traditional and GI oysters, the differences in preference ratings were not significant. The loss in distinct preference can be partially explained by changes in the sensory attributes as the products aged in refrigeration (see Expert Panel results). Likewise, the preference comparisons involving LTF oysters were less subject to sensory changes during the short period of frozen storage.

Table 2. Results of the paired comparison preference tests through 7 and 14 days post-harvest storage. The number of consumers per session and the respective preferences per oyster process are tallied under each column.

| PHP Oysters | 7 days post-harvest | | | 14 days post-harvest | | |
|---|---|---|---|---|---|---|
| | **No. Consumers** | **PHP** | **Traditional** | **No. Consumers** | **PHP** | **Traditional** |
| Mild Heat (MH) | **89** | **34** | **55**** | 84 | 34 | 50 |
| Gamma Irradiation (GI) | **89** | **26** | **63**** | 84 | 49 | 35 |
| High Pressure (HP) | **90** | **28** | **62**** | 86 | 38 | 48 |
| Low Temp Freezing (LTF) | 90 | 36 | 54 | 86 | 43 | 43 |

**** indicates these values are significantly different at the p= 0.05 or 95% confidence level**

**Consumer acceptability** ratings indicated general acceptance for all oyster products regardless of processing method (Figures 1-4). Average consumer ratings remained above scores of 5.0 which represents the median transition from unacceptable to acceptable products relative to overall likeability, appearance, texture and flavor. Ratings for overall likeability followed the pattern of consumer preference that was influenced by post-harvest refrigeration of the products (Figure 1). Likeability was scored significantly higher at the 95% confidence level for traditional oysters in comparisons with all PHP products after 7 days post-harvest, but there was no difference in likeability for any of the various processed oysters after 14 days post-harvest. Appearance after 7 days post-harvest was not a significant factor in acceptability except in comparisons with the LTF oysters (Figure 2), but the significantly higher ratings for acceptable texture and flavor explain the acceptability differences and preferences scored for

traditional products after 7 days post-harvest (Figures 3 and 4). Most acceptability ratings were not significantly different in comparison for all oyster products after 14 days post-harvest which explains the lack of difference in preference. In general, the acceptability ratings slightly decreased as the products aged in refrigeration and the appearance and texture of the LFT oysters still rated significantly lower than the traditional oysters after 14 days post-harvest.

Figure 1. Acceptance ratings for Overall Likeability of each PHP oyster in comparison with the traditional oysters. Significant differences (p=0.05 or 95% confidence levels) in ratings per comparisons are denoted by different letters 'a and b'.

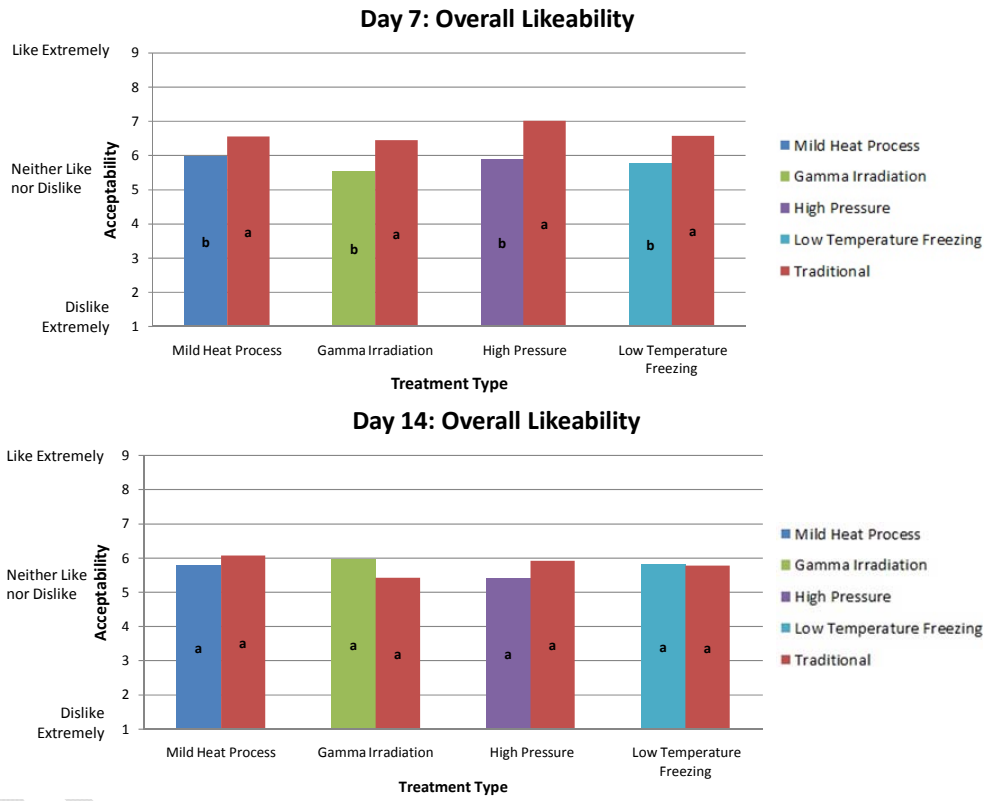


Figure 2. Acceptance ratings for Appearance of each PHP oyster in comparison with the traditional oysters. Significant differences (p=0.05 or 95% confidence levels) in ratings per comparisons are denoted by different letters 'a and b'.

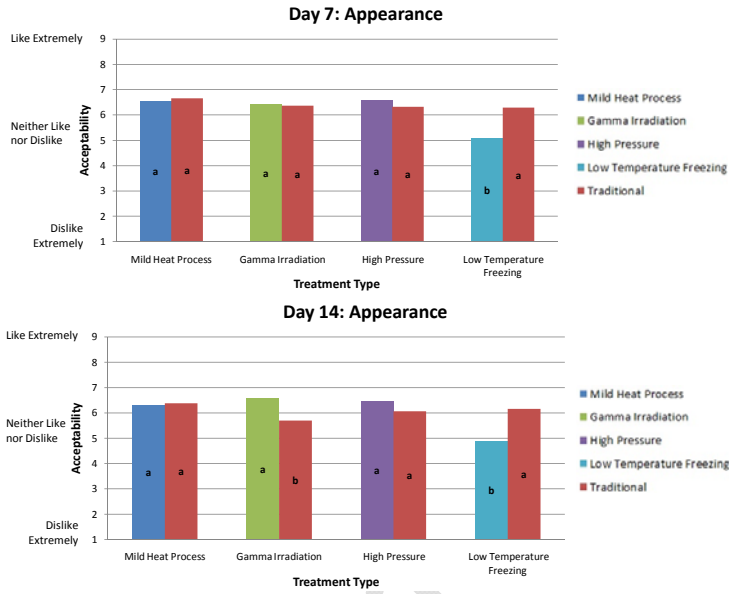



Figure 3. Acceptance ratings for Texture of each PHP oyster in comparison with the traditional oysters. Significant differences (p=0.05 or 95% confidence levels) in ratings per comparisons are denoted by different letters 'a and b'.

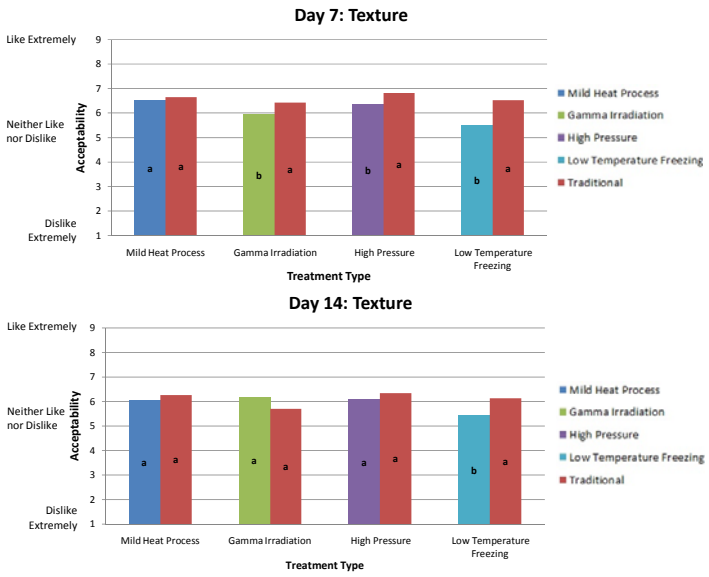
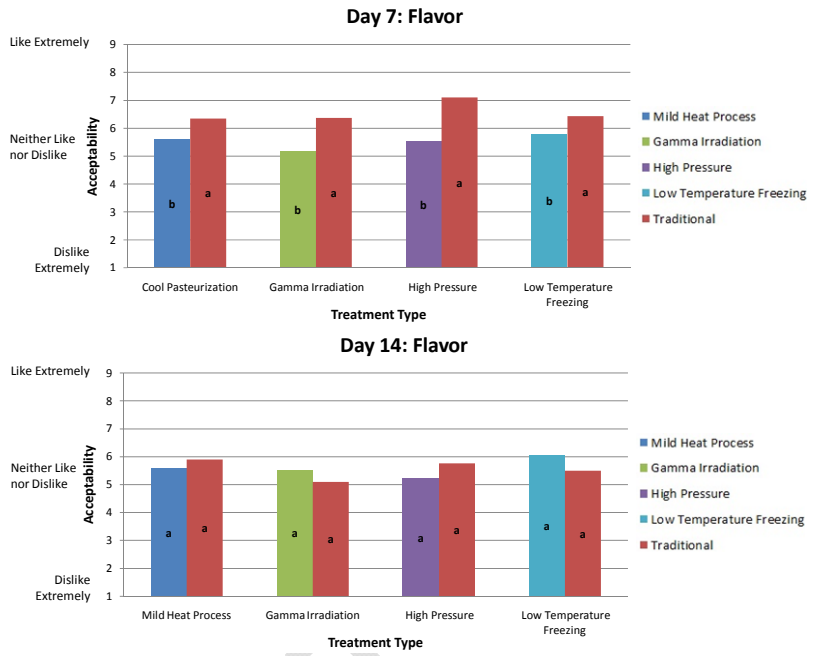


Figure 4. Acceptance ratings for Texture of each PHP oyster in comparison with the traditional oysters. Significant differences (p=0.05 or 95% confidence levels) in ratings per comparisons are denoted by different letters 'a and b'.




Expert Sensory Assessments

The sensory profiles developed by the expert panel provide some explanation for the consumer preferences and acceptability ratings (Figures 5-10). For example, the higher ratings for the traditional oysters after 7 days post-harvest can be partially explained by the higher perceived salty taste (Figure 8) and less earthy tones in flavor (Figure 9). Despite the low ratings, earthy tones are objectionable. The earthy tones noted in the flavor of the MH oysters reduced the preference for MH oysters in comparison with traditional oysters which had a similar salty taste rating. All PHP oysters had slightly higher earthy tones in aroma and flavor which persisted through 14 days shelf-life (Figure 9). Likewise, the PHP product aromas were initially scored as more briny and seaweed-like than the traditional oysters after 7 days post-harvest (Figure 7). These sensory attributes were not rated during the consumer comparison tests but they may play a role in influencing preference and acceptance. Additionally, the appearance and texture of all oyster products were similar across both periods of shelf-life,

with the exception of a drier and less plumb LTF product and the firmer more prominent textured HP product. The firmer texture attributes were persistent and more obvious for HP oysters through 14 days storage. Plump appearance and firm mouth feel or bites can influence consumer preferences.

Interestingly, the LTF oysters had the lowest score for salty taste (Figure 8) due to the use of the fresh water glaze to protect the product during frozen storage. This sensory attribute could be influenced by use of salt water glazes.

The shift in preferences and acceptance after 14 day post-harvest is distinctly obvious due to the perceived decreases in oyster liquor color (Figure 5), product aromas (Figure 7), and salty taste which was accompanied by a slight decrease in sweet and umami tastes (Figure 8). Overall, the sensory attributes became more similar as the oyster products aged in refrigerated storage. Likewise, an adverse aftertaste began to increase (Figure 10) and actual bitter flavors were noted as side observations with the standard sensory profiling. These negative attributes decrease preference and acceptance.

The various expert color ratings for shell and meats were more variable within individual oyster products than in comparisons between the various oyster products. This is not unexpected since the oysters were harvested from the same location and were similar in size and season of harvest. Likewise, the variation in color ratings did not change during storage such that color was not a useful attribute to distinguish differences between traditional and PHP products.

Figure 5. Expert sensory profiles for the volume, viscosity and color of the liquor that accompanies the oyster products are represented by bars for the average ratings based on 10 expert scores. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.

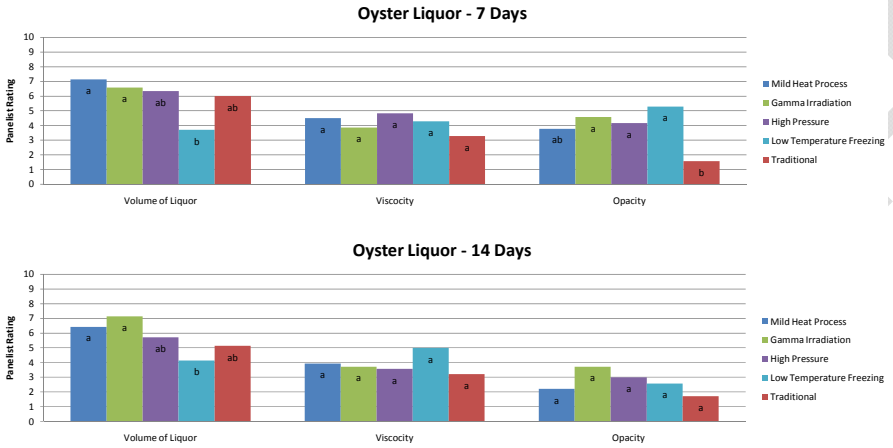



Figure 6. Expert sensory profiles for the volume, plumpness and various texture measures for the edible oyster meats are represented by bars for the average ratings based on 10 expert scores. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.

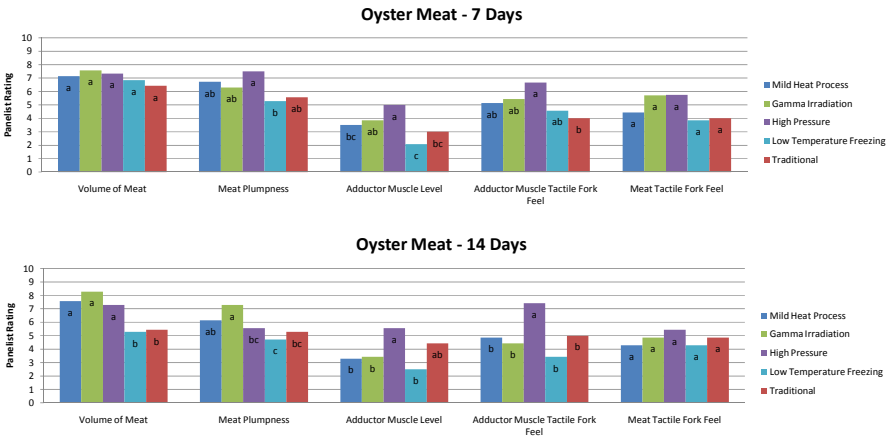


Figure 7. Expert sensory profiles for the briny, seaweed, earthy and metallic aromas associated with the oyster products are represented by bars for the average ratings based on 10 expert scores. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.

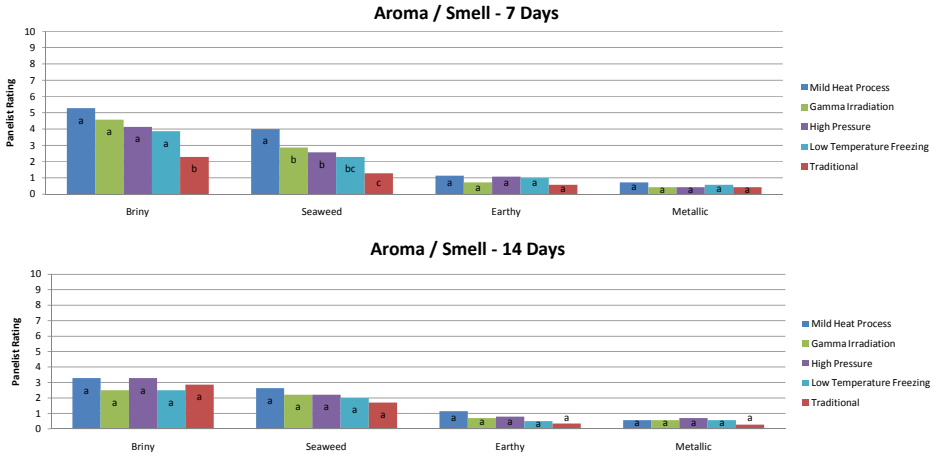



Figure 8. Expert sensory profiles for the salty, sweet and umami tastes associated with the oyster products are represented by bars for the average ratings based on 10 expert scores. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.

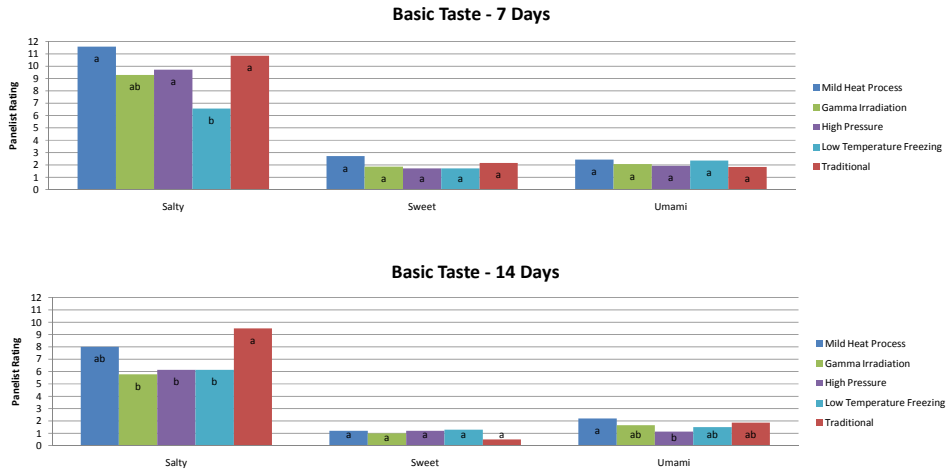


Figure 9. Expert sensory profiles for the seaweed, chick-liver-like, earthy and green-leafy flavors associated with the oyster products are represented by bars for the average ratings based on 10 expert scores. The term CLL represents chick-like-liver flavor. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.

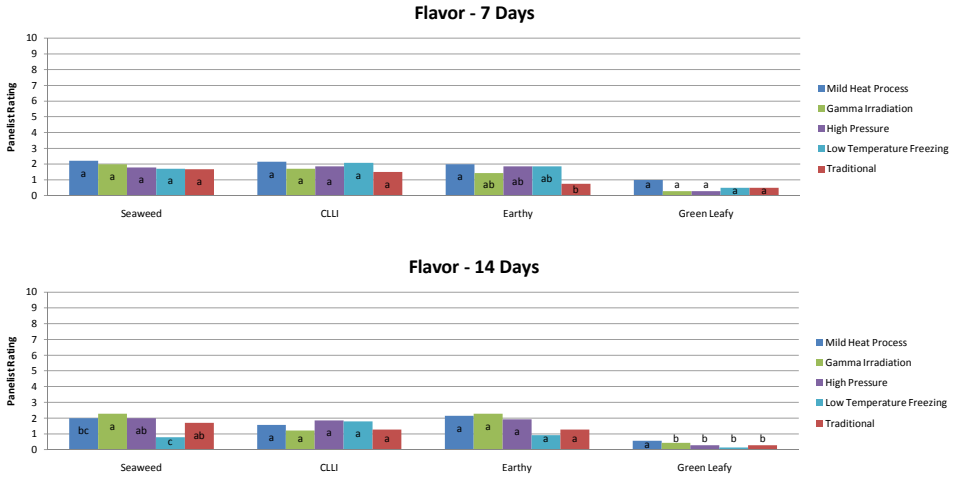



Figure 10. Expert sensory profiles for metallic and astringent aftertastes associated with the oyster products are represented by bars for the average ratings based on 10 expert scores. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.

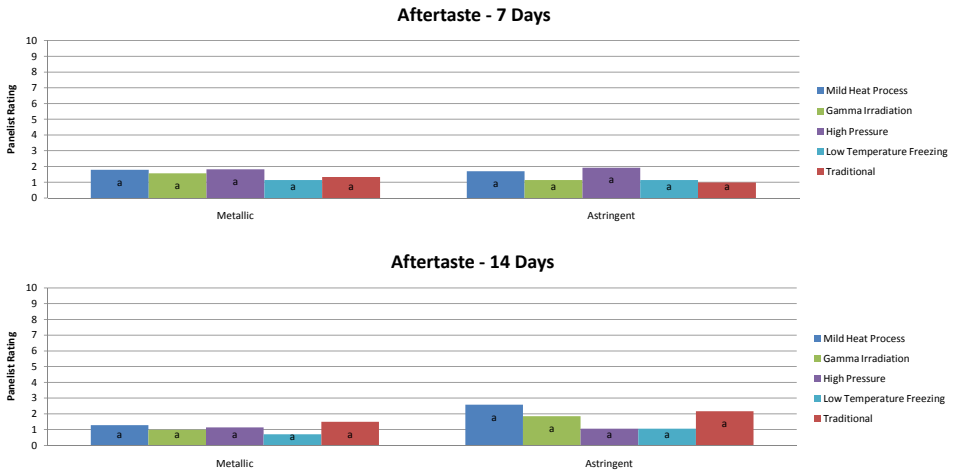
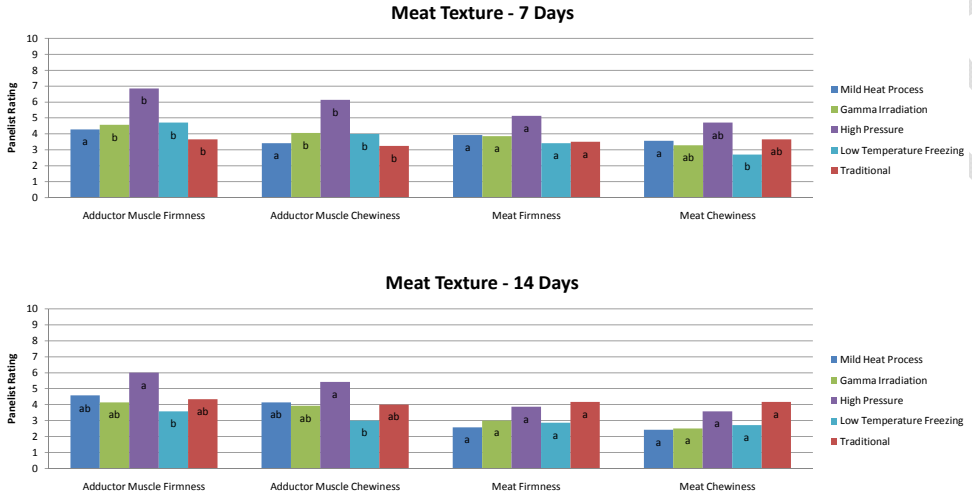


Figure 11. Expert sensory profiles for meat texture in the adductor muscle and general body or oyster meat for the oyster products are represented by bars for the average ratings based on 10 expert scores. Any bars marked by the same letter are not significantly different at the p = 0.05 or 95% confidence level.



CONCLUSIONS

Typical raw oyster consumers preferred the traditional raw oysters in comparisons with PHP oysters prepared from the same harvest during September from a typical Gulf of Mexico source (Apalachicola Bay, FL), yet this preference is diminished during prolonged refrigerated storage. The primary sensory attributes affecting preference were flavor and texture. These attributes are less distinguishable in comparisons between traditional and PHP oysters as the products aged in refrigeration. As a perishable product, the refrigerated oysters progressively change during storage. Apparently the changes caused a shift in product preference. In contrast, the preference for traditional oysters in comparisons with frozen PHP oysters (LFT) remained similar during storage as the frozen state preserves the oysters.

Despite the consumer preference expressed for traditional raw oysters during initial storage, the consumers rated all oyster products, both traditional and PHP, as acceptable. The acceptability ratings initially favored traditional raw oysters, as noted by the preference, but acceptability ratings became similar for all oyster products during more prolonged storage. Based on expert sensory profiling of the respective oyster products, the dominant sensory attributes affecting favorable acceptance were salty taste and less earthy tones in flavor and aroma.

These conclusions are based on a warm month harvest from the Gulf of Mexico. Harvest during other months with differing water temperatures that are known to influence the composition and sensory character of oysters could alter the results.

RECOMMENDATIONS

Interest for implementation of PHP methods for raw oysters harvested during warm months about the Gulf of Mexico should recognize a distinct and demonstrated consumer preference for traditional, fresh (non-frozen) products, yet a clear acceptance for both traditional and PHP oysters. This situation provides opportunities to market oysters in both traditional and PHP forms to suit particular markets relative to consumer demand, cost, convenience, and regulatory guidance.

REFERENCES

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NSSP. 2007b. National Shellfish Sanitation Program. Guide for the Control of Molluscan Shellfish 2007b. Section IV Chapter IV. Naturally Occurring Pathogens. www.issc.org

# ATTACHMENT #1

**Excerpt of the questionnaire presented to the consumers for each raw oyster product evaluated during the consumer acceptability ratings**

Please indicate how much you like or dislike the following attributes in **sample A**

## Sample A

### Overall Likeability

| dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

### Appearance

| dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

### Texture

| dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

### Flavor

| dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Please indicate how much you like or dislike the following attributes in **sample B.**

# ATTACHMENT #2

## Sensory Standards for the Evaluation of Raw Oyster Products

**Contains standards for the various sensory attributes use in the profiling of raw oysters by expert panel. This document aligns with the score sheets (Attachment 3).**

**Source:**

http://fshn.ifas.ufl.edu/seafood/oysters/sensory%20school/services.shtml#tools

**Contact:** Laura Garrido
University of Florida
shrimp@ufl.edu

# Sensory Standards for the Evaluation of Raw Oyster Products

The following attributes are rated using a scale 0-10; 0 typically represents absence , 1 represents very low, 5 represents either moderate or intermediate while10 represents either very high or extreme. For each of the attributes one or more standards were developed to help guide the panelists. The rating of the standards for each attribute can be identified by the number (i.e. Std 4,Std 5, etc) and the triangle(s) placed on each respective rating scale (attachment 3). For example a standard 4 represents the 4 in the scale 1-10.

| Lexicon | Description | Scale |
|---|---|---|
| **APPEARANCE** | | |
| **Color** | **Color (s) of the oyster parts captured by human eye** | **Figures 1 & 2** |
| **APPEARANCE OF OYSTER LIQUOR** | | |
| **Milkiness** | **Presence of a milky-like substance more noticeable in the oyster liquor. This is related to reproduction not to processing.** | **Figure 3- Presence or absence** |
| **Air Bubbles** | **Presence of small air bubbles trapped in the oyster's liquor, most likely around the meat.** | **Figure 4 - Presence or absence** |
| **Volume of Liquor** | **Quantity of oyster liquor in the shell.** | **Figure 5** |
| **Viscosity** | **How freely the liquor flows on the shell (watery vs. gluey).** | **Actual samples** |
| **Opacity** | **How clear/translucent or how cloudy/opaque the oyster liquor is.** | **Figure 6** |
| **APPEARANCE OF OYSTER MEAT** | | |
| **Shattered Meat** | **If the meat appears and/or is broken into pieces.** | **Actual samples - Presence or absence** |
| **Volume of the Meat** | **Refers to how much of the oyster shell is covered by the meat.** | **Figure 7** |
| **Plumpness** | **How well-rounded and full in form the oyster meat.** | **Figure 8** |
| **Adductor muscle** | **How raised the adductor muscle is when compared to the meat.** | **Figure 9** |
| **Adductor muscle tactile-fork feel** | **How the adductor muscle feels when touch by a plastic fork.** | **Std 2 - Soft Gelatine (Knox)*** Std 5 - Canned Peaches-Diced-4oz pull top cup (Del Monte) Std 8 – Hard Gelatine Knox**** |
| **Meat tactile-fork feel** | **How the meat feels when touch by a plastic fork.** | |

| AROMA | | |
|---|---|---|
| Briny | Related to or resembling saltiness or the sea | Std 5* &10**- Ito-Wakame dried seaweed imported by Rhee Bros, Inc - Columbia, MD |
| Seaweed | Related to the aroma of seaweed. | |
| Earthy | Refers to the characteristics of damp soil, and wet plants. | Std 10 - Whole White Mushrooms with soil - cut in half and smell. |
| Metallic | Relating to, or having the characteristic of a metal. | Std 10 - 2 capsules of Sundown Iron 28 mg capsules in 440 ml of water. Rub on skin and smell; or shake bottle, open and smell. |
| UNDESIRABLE/OBJECTIONABLE AROMAS | | |
| Agar | Related to the odor of agar. | Std 10 - Difco Bacto Agar (Fisher Scientific Catalog) |
| Ammonia | Related to ammonia. | Std 10 - Ammonia for household cleaning. |
| Boiled potato | Refers to earthy/dirty aroma in the internal portion of a boiled potato. | Std 10 - Canned Potato (Del Monte fresh cut whole new potatoes) |
| Fecal | Aroma associated with feces. | Std 10 - Past experiences |
| Fishy | Refers to the aroma associated with strong fish odors. | Std 10 - Can of Sardines in water(King Oscar) Std 10 - Clam Juice (Doxsee/Snows Clam juice) |
| Garlic | Refers to the aroma of garlic. | Std 5 - Garlic Butter Papa John's Std 10 - Kalsec Garlic Oil |
| Sour | The aroma stimulated by acids, such as citric, malic, phosphoric, etc. (Meilgaard, Civille et al.) | Std 10 - shucked oyster placed in the refrigerator for about 21-28 days will produce a maximum sour odor. |
| Wet dog | Refers to smell of a wet dog. | Std 8 - Canned of shrimp (Chicken of the sea or bumble bee) |
| Wet burlap sack | Refers to the smell of a wet burlap sack used in the oysters business to transport oysters | Std 10 - wet burlap sacks (cream, brown, or beige) from Wal-Mart. |

| BASIC TASTES | | |
|---|---|---|
| Salty | Taste stimulated by sodium salts, such as sodium chloride and sodium glutamate and in part by other salts such as potassium chloride. (Meilgaard, Civille et al.) | Std 5 - 0.3% salt Std 10 - 0.55% salt Std 15 - 0.7 % salt (Meilgaard, Civille et al.) |
| Sweet | Taste stimulated by sucrose and other sugars, such as fructose, glucose, etc. and by other sweet substances.(Meilgaard, Civille et al.) | Std 4 - Ritz crackers (Meilgaar Civille et al.) |
| Umami | Taste produced by substances such as Monosodium Glutamate (MSG). A meaty, savory, or mouth filling sensation (Codex). | Std 5 - 1/4 tsp Accent in 500 ml of water Std 10 - ½ tsp Accent in 500 ml of water |
| UNDESIRABLE/OBJECTIONABLE BASIC TASTES | | |
| Sour | The taste stimulated by acids, such as citric, malic, phosphoric, etc. (Meilgaard, Civille et al.) | Std 5 - 0.1% citric acid; Presence or absence (Meilgaard, Civille et al.) |
| Bitter | The taste stimulated by substances such as caffeine, and hop bitters (Meilgaard, Civille et al.). | Std 5 - 0.08% caffeine solution Presence or absence (Meilgaard, Civille et al.) |
| FLAVOR | | |
| Seaweed | Relating to or having the characteristic to a flavor like seaweed. | Std 10- Ito-Wakame dried seaweed imported by Rhee Bros, Inc Columbia,MD |
| Chicken liver like / iron- | Relating to the iron flavor of cooked liver (organ) meat. | Std 4 - Chicken liver (Tyson's) Add to boiling water and keep boiling for 10 minutes |
| Earthy | Refers to the characteristics of damp soil, and wet plants. | Std 10 – mushrooms, white and whole with soil - cut and taste. |
| Green Leafy (spinach)- | Relating to or having the characteristic flavor of spinach. | Std 5- Fresh spinach (ready pac) |
| UNDESIRABLE/OBJECTIONABLE FLAVORS | | |
| Boiled Potato | Refers to earthy/dirty flavor in the internal portion of a boiled potato. | Std 6 - Potato (Del Monte fresh cut whole new potatoes) |
| Fishy | Refers to a fishy flavor. | Std 10 - Can of sardines in water (any brand) |
| Garlic | Relating to or having the characteristic flavor of garlic. | Std 4- Garlic butter Papa John's Std 10 - Kalsec garlic oil |
| Raw Cabbage | Relating to or having the characteristic to the flavor of raw cabbage. | Std 7 - Red cabbage Std 8 - Green cabbage |

| | | |
|---|---|---|
| **Wet Burlap Sac** | **Relating to or having the characteristic of the flavor imparted by a wet.** | **Std 10- wet burlap sacks (cream, brown, and beige) from Wal-Mart.** |
| **Aftertastes** | | |
| **Metallic** | **Relating to or having the characteristic of a metal.** | **Std 5 - 1 capsules of Sundown Iron 28 mg capsules in 440 ml of water. Std 6 - Canned oysters - Chicken of the Sea whole oysters juice only (strain juice though fine wire strainer).** |
| **Astringency** | **The chemical feeling factor combining three different aspects: drying of the mouth, roughing of oral tissues and drawing (shrinking) sensation felt in the cheeks and the muscles of the face.** | **Std 5- 1/8 teaspoon (0.5g) of alum (McCormick) in 500 ml of water. Std 5- Fresh Spinach (Ready Pac).** |
| **Chalkiness** | **In reference to texture, a product which is composed of small particles which imparts a drying sensation in the mouth (Codex).** | **Std10- 14 ml of milk of magnesia in 400 ml of water or Std 10 - 3/4 teaspoon of Tricalcium phosphate food grade –Budenheim, Germany in 400 ml of water.** |



| | | |
|---|---|---|
| **Texture & Mouth feels** | | |
| **Firmness Chewiness** | **Refers to consistency of how soft versus how firm in resistance the oysters flesh holds. Amount of maceration required to comfortably swallow the oyster.** | **Std 1- Soft gelatin (Knox) *** Std 3 -Tofu – Nasoya soft Std 5 -Canned peaches-diced- 4oz pull top cups (Del Monte) Std 6 – Hard gelatine (Knox)**** Std 8 – Cooked chicken breast-salad topping (Plain-Purdue) Std 10 - Dried apricots (Sunmaid – Mediterranean)** |
| **Grittiness** | **Presence of sand** | **Actual samples** |

***Briny Std 5**

Use approximately 1 to 1 1/2 cups of water for 2 to 3 strands of seaweed. Bring water to boil or close to boil. Break dried seaweed into 2 to 3 inch pieces and put in hot water. Allow to soak overnight and cool. Use seaweed for areas needed and liquid for briny standard. For a strong briny solution use more seaweed (about 6 - 8 strands) per cur of hot water.

****Briny Std 10**

For a strong briny (standard 10), leave the seaweed for48 hours or more at refrigerated temperature after warm liquid on the soaked seaweed cools down.

*****Soft Gelatin**

4 cups of water
2 envelopes KNOX Gelatine unflavored

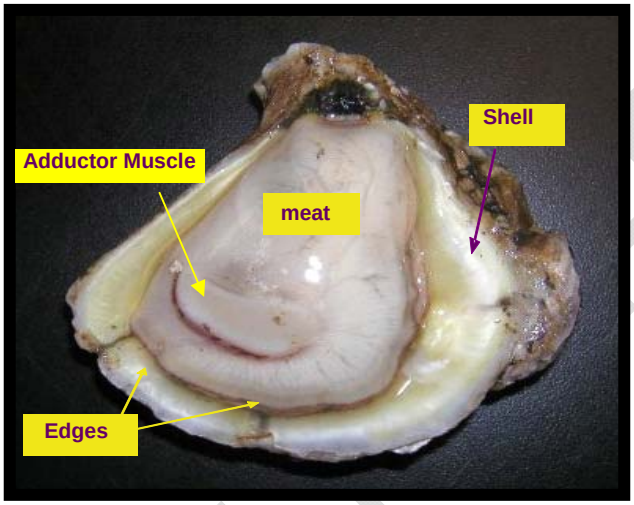
Measure 4 cups of water.
Put 1 to 2 cups of the measured water in a container, (big enough for about 5 cups)
Doesn't have to be exact. Sprinkle 2 KNOX envelopes on top of the water, let it stand for 2 minutes or until the gelatin is hydrated. (DO NOT mix it or stir it it will be a mess!)
Meanwhile heat the rest of the water for 2 minutes in the microwave.
When hot pour the water into the hydrated gelatin and stir until it is completely dissolved. Pour the liquid gelatin in the little containers and let it stand in the refrigerator for about 5 hours.

******Hard Gelatin**

3 cups of water
6 envelopes KNOX Gelatine unflavored

Measure 3 cups of water.
Put 1 to 1 1/2 cups of the measured water in a container, (big enough for about 5 cups)
Doesn't have to be exact. Sprinkle 6 KNOX envelopes on top of the water, let it stand for 2 minutes or until the gelatin is hydrated. (DO NOT mix it or stir it it will be a mess!)
Meanwhile heat the rest of the water for 2 minutes in the microwave.
When hot pour the water into the hydrated gelatin and stir until it is completely dissolved. Pour the liquid gelatin in the little containers and let it stand in the refrigerator for about 5 hours.

## Figure 1. Diagram of an oyster for color assessment




## Figure 2. Color Scales

***White***

| | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** |
|---|---|---|---|---|---|
| **Colors** | | | | | |
| **Munsell** | | | | | |
| **RGB** | | | | | |
| **Glidden Name** | **Nature's Whisper** | **Natural White** | **Fencepost** | **White High** | **White Swan** |
| **Glidden Code** | **43YY 78/053** | **50YY 83/029** | **81YY 87/031** | **98YY 82/022** | **60YY 83/062** |

*Pink*

| | 1 Lightest | 2 | 3 | 4 | 6 Darkest |
|---|---|---|---|---|---|
| Colors | | | | | |
| Munsell | | | | | |
| RGB | 241/232/233 | 211/200/172 | 229/202/215 | 229/167/190 | 206/109/137 |
| Glidden Name | Whimsical | Carnation Pink | Saltmarsh Pink | Checkerberry | Fiesta Pink |
| Glidden Code | 30RR 83/040 | 41RR 79/079 | 29RR 66/154 | 32RR 50/260 | 53RR 27/417 |

*Gray to Black*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | | | | | | |
| RGB | 217/219/217 | 204/205/204 | 188/188/187 | 160/160/159 | 94/94/94 | 62/62/61 |
| Glidden Name | Snowfield | Universal Grey | Veil | Granite Grey | Obsidian Glass | Dark Secret |
| Glidden Code | 00NN 72/000 | 00NN 62/000 | 00NN 53/000 | 00NN 37/000 | 00NN 13/000 | 00NN 05/000 |

*Gray / Brown*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | | | | | | |
| RGB | 231/228/219 | 221/215/205 | 203/196/185 | 182/171/157 | 125/115/104 | 91/80/69 |
| Glidden Name | Kitten White | Carolina Strand | Fossil Grey | Scroll Beige | Fauna | Pebble Mosaic |
| Glidden Code | 30YY 78/035 | 30YY 69/048 | 30YY 56/060 | 20YY 43/083 | 10YY 18/074 | 10YY 08/093 |

*Gray/Green*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | 5Y/8.5/2 | 5Y/8/2 | 7.5Y/7/2 | 2.5Y/6/4 | 5Y/4/4 | 5Y/3/4 |
| RGB | 222/214/183 | 208/201/171 | 179/174/146 | 166/145/100 | 110/96/52 | 85/72/35 |
| Glidden Name | Wishes | Autumn Haze | Chatham Green | Surrey Beige | Calm Water | Oak Alley |
| Glidden Code | 45YY 75/110 | 45YY 67/120 | 40YY53/119 | 30YY 36/185 | 30YY 20/193 | 30YY/09/175 |

*Green scale*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | 10Y/9/2 | 10Y/8.5/2 | 10Y/8/4 | 2.5GY/7/4 | 10Y/5/4 | 10Y/4/2 |
| RGB | 231/230/194 | 217/216/182 | 206/203/144 | 139/184/151 | 126/124/73 | 99/98/75 |
| Glidden Name | Brocade Cream | Hint of Gold | Mount Olive | Pennyroyal | Retro Green | Laurentian |
| Glidden Code | 60YY 70/189 | 60YY 64/211 | 60YY 54/255 | 60YY 40/243 | 60YY23/227 | 70YY15/160 |

*Emerald Green*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | | | | | | |
| RGB | 228/236/223 | 212/228/205 | 199/222/190 | 154/185/141 | 108/140/96 | 86/117/74 |
| Glidden Name | Boudoir | Nature Mist | Sea Scent | Summer Picnic | Frog Pad | Splendor |
| Glidden Code | 50GY 83/060 | 50GY 75/122 | 50GY 69/165 | 50GY 44/248 | 50GY 23/280 | 50GY 15/289 |

*Blue/Green (Teal)*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | | | | | | |
| RGB | 221/237/230 | 206/228/221 | 189/220/211 | 160/199/189 | 91/149/136 | 13/113/99 |
| Glidden Name | Bubbling Brook | Aquabell | Warm Meadow | Country Cottage | Kelly's Island | Forest Hush |
| Glidden Code | 50GG 83/057 | 50GG 74/077 | 50GY 69/165 | 50GG 53/144 | 50GG 26/228 | 50GG 13/314 |

*Maroon*

| | 1 Lightest | 2 | 3 | 4 | 5 | 6 Darkest |
|---|---|---|---|---|---|---|
| Colors | | | | | | |
| Munsell | | | | | | |
| RGB | 217/207/210 | 196/180/185 | 165/142/151 | 135/107/117 | 108/83/93 | 88/71/77 |
| Glidden Name | Whisper | Soft Wine | Sonata | Mystic | Alakazam | Black Currant |
| Glidden Code | 30RR 64/043 | 30RR 49/067 | 30RR 30/103 | 30RR 17/140 | 30RR 10/131 | 30RR 07/094 |

***Purple***

| | ***1 Lightest*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6 Darkest*** |
|---|---|---|---|---|---|---|
| **Colors** | | | | | | |
| **Munsell** | | | | | | |
| **RGB** | **224/222/228** | **215/211/226** | **165/142/151** | **159/154/184** | **126/119/153** | **92/86/121** |
| **Glidden Name** | **Mystic Purple** | **Touch of Violet** | **Giggles** | **Elevator** | **Coat of Arms** | **Purple Polka** |
| **Glidden Code** | **10RB 74/038** | **10RB 68/081** | **30RR 30/103** | **10RB 35/167** | **30RR 10/131** | **10RB 10/219** |

***Tan***

| | ***1 Lightest*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6 Darkest*** |
|---|---|---|---|---|---|---|
| **Colors** | | | | | | |
| **Munsell** | **2.5Y/9/2** | **2.5Y/8/4** | **10YR/8/6** | **10YR/7/8** | **10YR/6/10** | **10YR/6/8** |
| **RGB** | **240/227/198** | **220/198/148** | **236/194/129** | **216/165/81** | **194/137/24** | **188/139/57** |
| **Glidden Name** | **Lis Crème** | **Stucco** | **Light Topaz** | **Honeysweet** | **Golden Gate** | **Ovation** |
| **Glidden Code** | **30YY 77/169** | **20YY69/238** | **10YY58/295** | **10YY49/378** | **10YY 38/501** | **10YY 30/478** |

***Brown/Yellow***

| | ***1 Lightest*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6 Darkest*** |
|---|---|---|---|---|---|---|
| **Colors** | | | | | | |
| **Munsell** | **2.5Y/8.5/2** | **2.5Y/8/2** | **2.5Y/7/4** | **10YR/6/6** | **2.5Y/5/4** | **2.5Y/4/6** |
| **RGB** | **225/213/185** | **211/200/172** | **194/171/123** | **181/141/81** | **140/119/76** | **120/93/32** |
| **Glidden Name** | **Oyster White** | **Ivory Sampler** | **Cookie Crumb** | **First Anniversary** | **New Suede** | **American Bronze** |
| **Glidden Code** | **30YY 64/149** | **30YY 58/178** | **20YY 46/236** | **10YY34268** | **10YY 26/239** | **10YY 15/280** |

***Brown***

| | ***1 Lightest*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6 Darkest*** |
|---|---|---|---|---|---|---|
| **Colors** | | | | | | |
| **Munsell** | **10YR/9/2** | **10YR/8/2** | **10YR/7/4** | **10YR/6/4** | **10YR/4/4** | **10YR/3/6** |
| **RGB** | **242/22600** | **214/198/175** | **198/169/127** | **171/143/104** | **119/92/57** | **99/67/16** |
| **Glidden Name** | **Desert Floor** | **Dapper Tan** | **Family Legacy** | **Golden Pond** | **Side saddle** | **Timbre Trail** |
| **Glidden Code** | **20YY 69/120** | **10YY 55/163** | **00YY43/196** | **00YY 33/246** | **90YR 17/245** | **90YR 10/244** |

**Figure # 3**

**Standard for presence of milkiness (Std 10)**

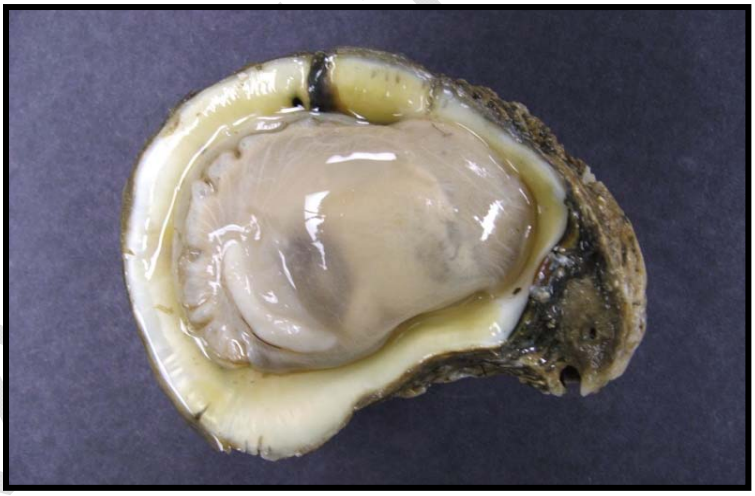
**Figure 4. Standards for presence of bubbles**

**Presence**

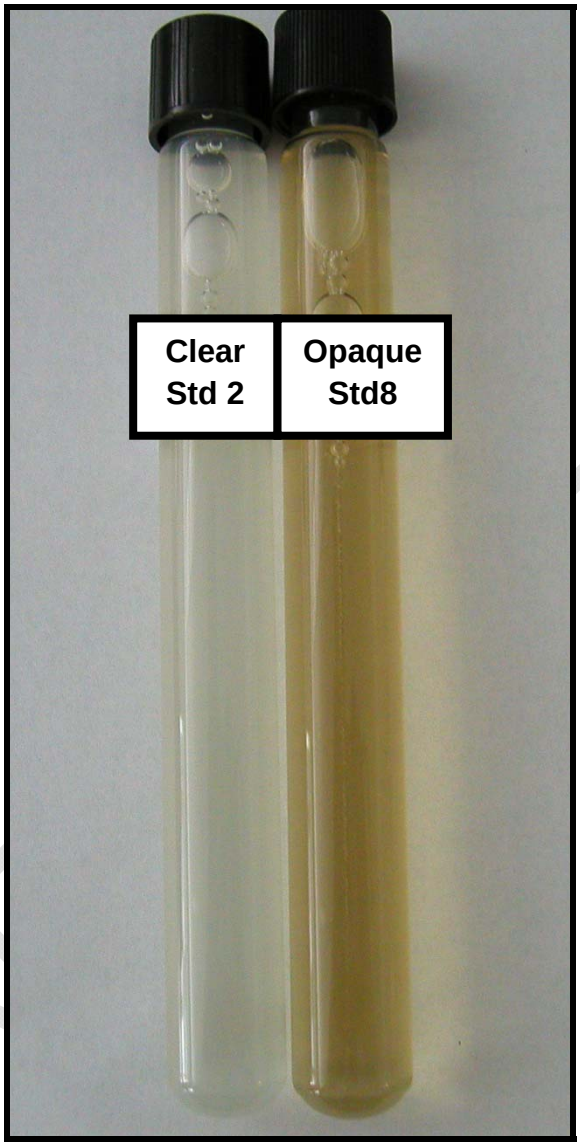
## Figure 5. Standards for volume of liquor

Low (2)

High (10)



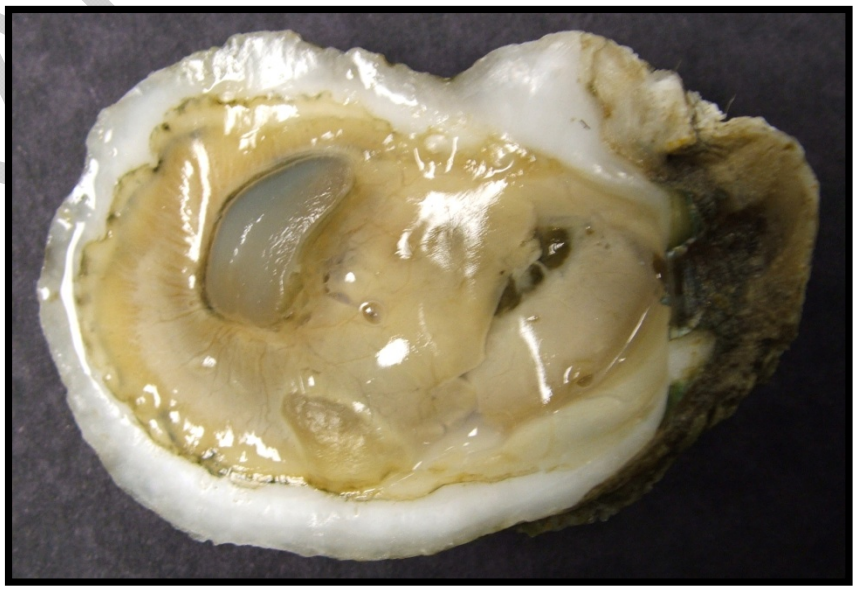
## Figure 6. Standards for liquor opacity



## Figure 7. Standards for volume of meat

**Hardly Covered (Std 2)**

**Fully Covered (Std 10)**



## Figure 8. Standards for plumpness

Flaccid (Std 2)

Plump (Std 8)

## Figure 9. Standards for adductor muscle

Level (Std 1)

Raised (Std 5)

Very Raised (Std 8)

39

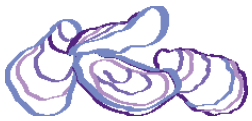
**ATTACHMENT #3**

**Score Sheet for Raw Oyster Products**

**Contains the score sheet use to profile the sensory attributes raw oysters by expert panel. This document aligns with the list of standards (Attachment 2).**

**Source:**
**http://fshn.ifas.ufl.edu/seafood/oysters/sensory%20school/services.shtml#tools**

**Contact:** **Laura Garrido**
**University of Florida**
**shrimp@ufl.edu**



# Oyster Product Characterization Form

**Sample Code:** _____
**Date:** _____
**Panelist:** _____

## *Appearance*

***Color Break-down - Circle all that apply***

**Oyster Meat:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. White | | 1 | 2 | 3 | 4 | 5 | |
| 2. Pink | | 1 | 2 | 3 | 4 | 5 | |
| | | *Light* | | | | | *Dark* |
| 3. Gray to Black | | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. Gray/Brown | | 1 | 2 | 3 | 4 | 5 | 6 |
| 5. Grey/Green | 1 | 2 | 3 | 4 | 5 | 6 | |
| 6. Green | | 1 | 2 | 3 | 4 | 5 | 6 |
| 7. Emerald Green | | 1 | 2 | 3 | 4 | 5 | 6 |
| 8. Blue/Green (Teal) | | 1 | 2 | 3 | 4 | 5 | 6 |
| 9. Maroon | | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. Purple | | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. Tan | | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. Brow/Yellow | | 1 | 2 | 3 | 4 | 5 | 6 |
| 14. Brown | | 1 | 2 | 3 | 4 | 5 | 6 |

**Edges:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. White | | 1 | 2 | 3 | 4 | 5 | |
| 2. Pink | | 1 | 2 | 3 | 4 | 5 | |
| | | *Light* | | | | | *Dark* |
| 3. Gray to Black | | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. Gray/Brown | | 1 | 2 | 3 | 4 | 5 | 6 |
| 5. Grey/Green | 1 | 2 | 3 | 4 | 5 | 6 | |
| 6. Green | | 1 | 2 | 3 | 4 | 5 | 6 |
| 7. Emerald Green | | 1 | 2 | 3 | 4 | 5 | 6 |
| 8. Blue/Green (Teal) | | 1 | 2 | 3 | 4 | 5 | 6 |
| 9. Maroon | | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. Purple | | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. Tan | | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. Brow/Yellow | | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14. Brown | | 1 | 2 | 3 | 4 | 5 | 6 |

**Inner Rim of Shell:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. White | | 1 | 2 | 3 | 4 | 5 | |
| 2. Pink | | 1 | 2 | 3 | 4 | 5 | |
| | | *Light* | | | | | *Dark* |
| 3. Gray to Black | | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. Gray/Brown | | 1 | 2 | 3 | 4 | 5 | 6 |
| 5. Grey/Green | 1 | 2 | 3 | 4 | 5 | 6 | |
| 6. Green | | 1 | 2 | 3 | 4 | 5 | 6 |
| 7. Emerald Green | | 1 | 2 | 3 | 4 | 5 | 6 |
| 8. Blue/Green (Teal) | | 1 | 2 | 3 | 4 | 5 | 6 |
| 9. Maroon | | 1 | 2 | 3 | 4 | 5 | 6 |
| 10. Purple | | 1 | 2 | 3 | 4 | 5 | 6 |
| 11. Tan | | 1 | 2 | 3 | 4 | 5 | 6 |
| 12. Brow/Yellow | | 1 | 2 | 3 | 4 | 5 | 6 |
| 14. Brown | | 1 | 2 | 3 | 4 | 5 | 6 |

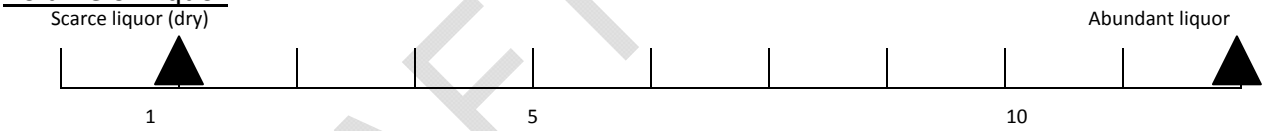
**Oyster Liquor**

**Please circle appropriate descriptor(s):**

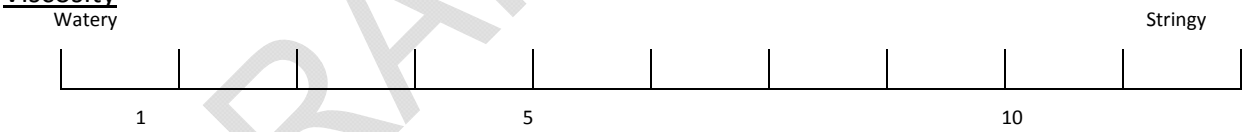
Milkiness: Not Milky Milky

Air Bubbles: Absent Present

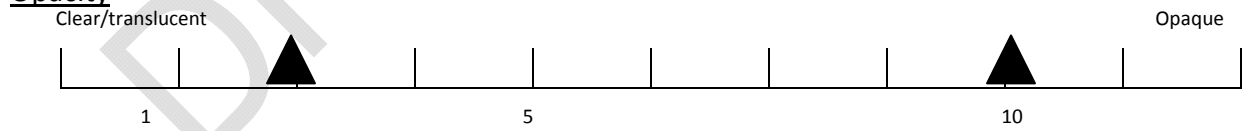
Volume of Liquor




Viscosity




Opacity

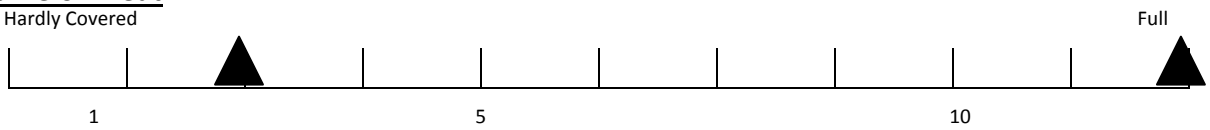



**Oyster Meat**

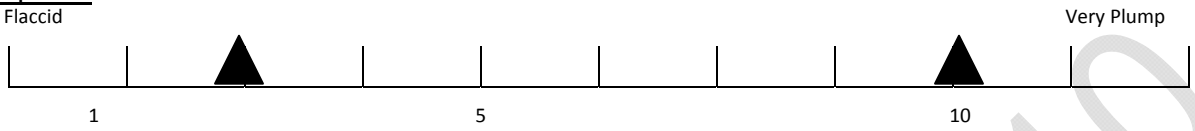
**Please circle appropriate descriptor(s):**

Shattered Meat: Yes No

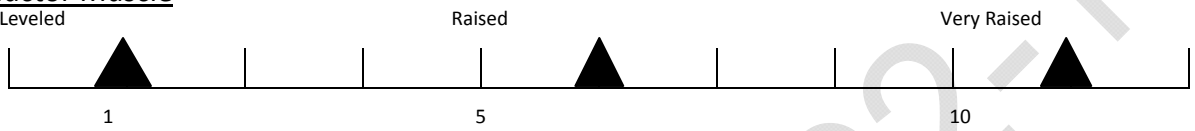
Volume of Meat




Plumpness




Adductor Muscle

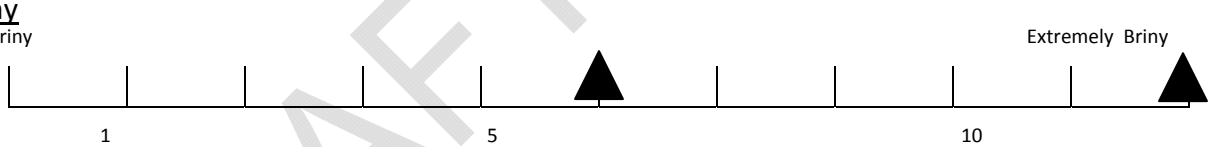



Adductor Muscle Tactile-Fork Feel

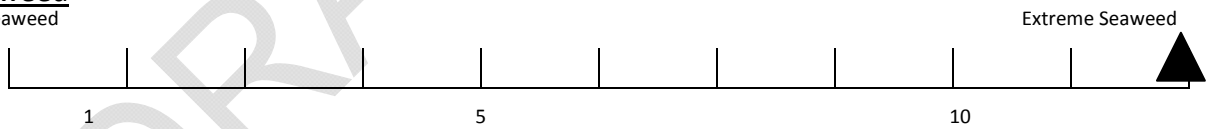

Meat Tactile-Fork Feel


## ***Aroma/Smell***

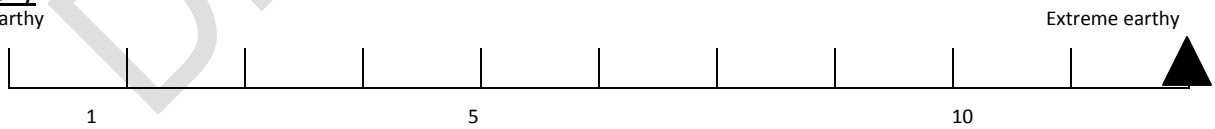
Briny



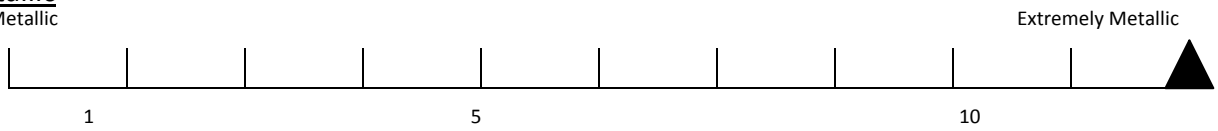

Seaweed




Earthy




Metallic

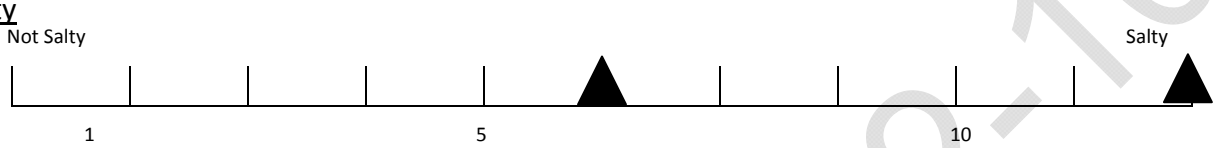


**If any objectionable odors are detected, please circle the appropriate descriptor(s):**

| | | | | |
|---|---|---|---|---|
| Agar | Ammonia | Boiled Potato | Fecal | Fishy |
| Garlic | Sour | Wet Burlap Sac | Wet Dog | Other:_____ |

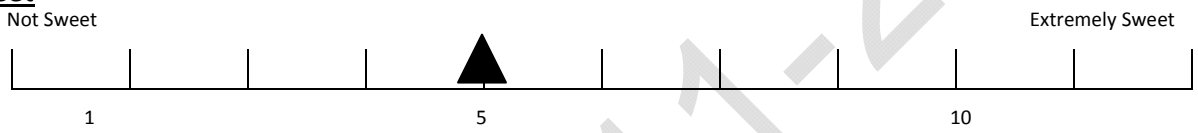
## ***Basic Tastes***

Salty




*If saltiness is higher than 10, please specify:_____*

Sweet



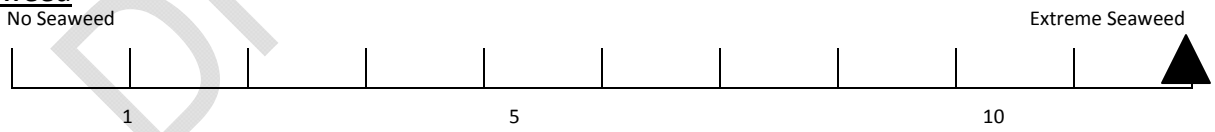

Umami


**If any objectionable basic tastes are detected, please circle the appropriate descriptor(s):**

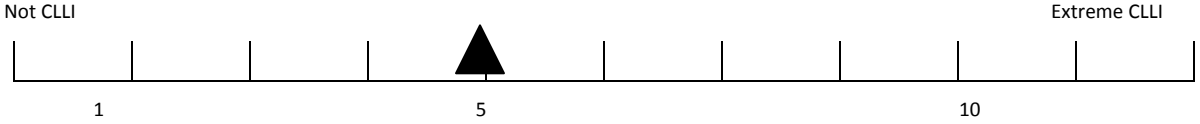
Sour Bitter

## ***Flavor***

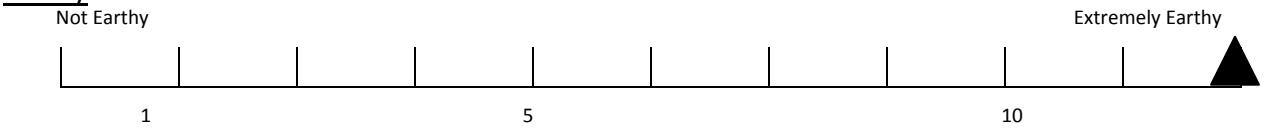
Seaweed



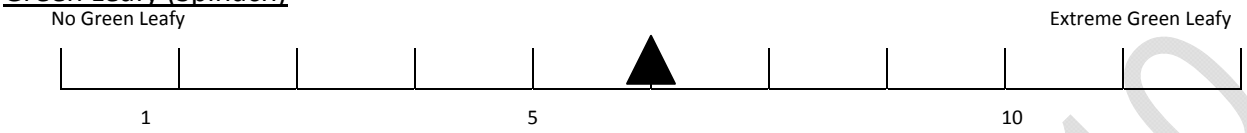

Chicken-Liver-Like/Iron(CLLI)



Earthy




Green Leafy (Spinach)



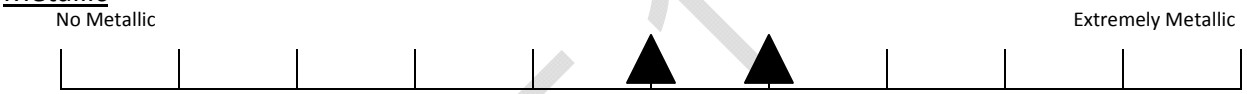

**If any objectionable flavors are detected, please circle the appropriate descriptor(s):**

Boiled Potato-Like Fishy Garlic (Oil) Raw Cabbage

Wet Burlap Sac Other:_____

## *Aftertastes*

Metallic




Astringent

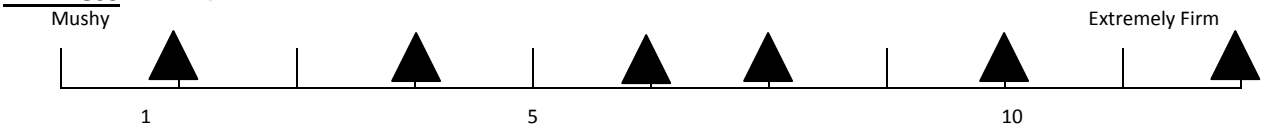

**If any objectionable aftertastes are detected, please circle the appropriate descriptor(s):**

Chalky Other:_____

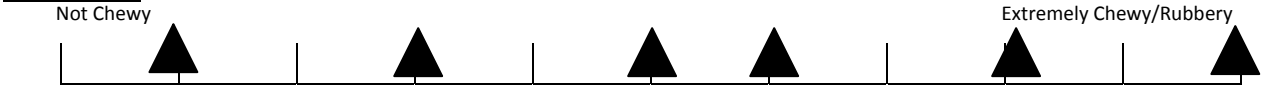
## *Texture & Mouth feels*

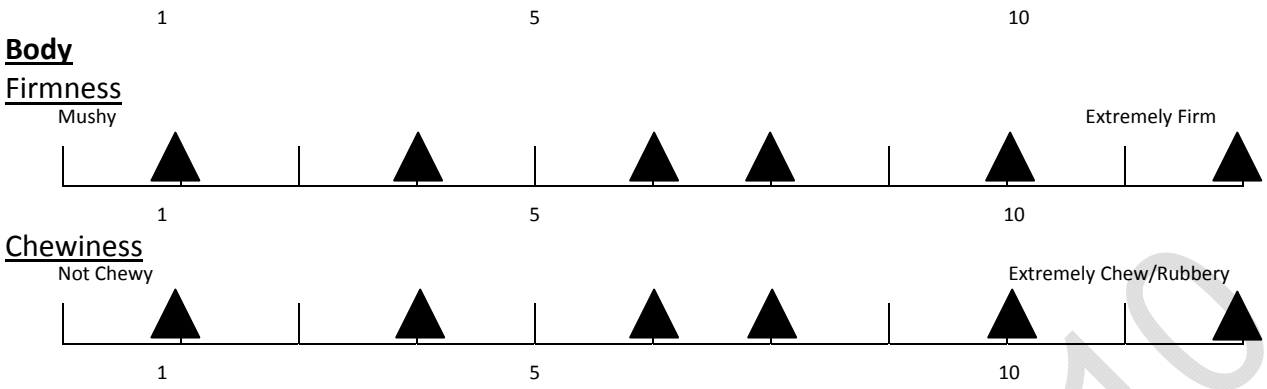
**Adductor Muscle**

Firmness




Chewiness






**If any objectionable mouth feels are detected, please circle the appropriate descriptor(s):**

Grittiness from sand Grittiness from shell

Other:_____