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Good Manufacturing Practices for the Harvesting and Processing of Sea Scallops (*Placopecten magellanicus*)

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GOOD MANUFACTURING PRACTICES FOR THE
HARVESTING AND PROCESSING OF
SEA SCALLOPS (Placopecten magellanicus)

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Submitted to

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National Fisheries Institute

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INTRODUCTION

The following are a draft set of good manufacturing practices (GMP) for the handling and processing of the Atlantic sea scallop, Placopecten magellanicus. The GMPs described here relate to the general objective for the production of good quality and wholesome seafood. More specifically, they relate to the uptake of water with subsequent gains in weight as a result of handling and processing on vessels and shoreside facilities. In part GMPs are derived from existing industry procedures and practices, and in recognition of the limitations to change existing practices without adversely impacting the economic and social structure of the industry.

It is important to recognize that there is a significant amount of variability in the research data due to the natural variability of the scallop. A host of biological and physical parameters effect how scallops "perform" relative to handling and processing practices. At this point we can only point to upper limits in changes in moisture that our limited data has revealed.

Of ultimate importance is the question relative to the natural moisture content of sea scallops. Needless to say that this too has a good deal of variability ranging from the extremes of about 75 to 79% but most of the data indicates that a "good average" is about 77.5% moisture. For the purpose of this draft document, the above mentioned average of 77.5% moisture is considered as the starting point at the time of harvesting.

The data presented in this document relative to the use of processing aids relate to the condensed phosphate, sodium tripolyphosphate (STP). However other phosphate types and commercial blends may result in different values for moisture content and retention.

SCALLOP DREDGE VESSELS
SCALLOP NET VESSELS

PRACTICE:

Shucking buckets with seawater, sometimes ice is added.

RATIONAL:

Scallops must be kept chilled to prevent thermal abuse (wafering, rigor, unctinal properties) when water temperatures exceed 65 degrees F. Water in shucking buckets prevents entrapment of grit and sand into meat.

PRACTICE:

Scallops from shucking buckets are washed in seawater between haul-backs.

RATIONAL:

Washing is the only way to remove grit and sand. Frequent emptying of shucking buckets prevents thermal abuse during warm weather.

FINDINGS:

Practices can cause an increase in weight due to the incorporation of water not to exceed 2%.

PRACTICE:

After washing in seawater, scallops meats are transferred to insulated totes with removable covers. Totes should contain seawater and ice to a ratio not to exceed 2:1 when seawater temperatures are greater than 65 degrees F. Less ice could be used when seawater temperatures are below 65 degrees F.

RATIONAL:

Use of insulated totes minimizes ice melt. Ice is used to prevent thermal abuse. Seawater:ice slurry is used to insure maximize efficient chilling and prevent physical damage to scallop meats.

PRACTICE:

Totes emptied every six hours to bag scallops.

RATIONAL:

Longer time intervals may allow temperatures in totes to increase to unacceptable levels and cause unnecessary weight gains.

FINDINGS:

Use of insulated totes with seawater:ice (2:1) will cause weight gains associated with the degree or extent of ice melting in tote. Weight gains are variable depending upon biological parameters such as season and reproductive cycle, location of harvest, residence time in the tote and degree of ice melt. Ice melt is variable due to initial seawater temperature, deck temperatures, quality and integrity of the insulated totes, and the amount of scallops harvested. Up to 13% gain has been experienced under extreme conditions with seawater temperatures at or above 80 degrees F and deck temperatures exceeding 90 degrees F. Under average conditions and the use of a 2:1 seawater:ice slurry, weight gains would not be expected to exceed 10%.

PRACTICE:

After bagging, bags are rinsed with seawater and placed in chill bin covered with ice for six hours. This should coincide with bag-up schedule.

RATIONAL:

Efficient of pre-chilling of bags before permanent stowage is necessary to prevent excessive melting of ice during permanent stowage which creates air spaces around bags.

FINDINGS:

Permanent stowage of unchilled or unadequately chilled bags causes air pockets to develop around bags and which provide conditions which may lead to bacterial growth and discoloration of bags. Weight gain not to exceed 1%.

PRACTICE:

After pre-chilling, bags of scallops are cleaned with clean seawater and a nylon bristle brush.

RATIONAL:

Cleaning the surface of the bags removes debris and scallop exudate.

FINDINGS:

Weight gains not to exceed 0%.

PRACTICE:

Bags permanently stowed on a sufficient bed of ice, with placement of bags allowing adequate space for ice in between and around bags.

RATIONAL:

Bags must be adequately iced and sufficiently cooled to prevent spoilage and retard bacterial growth and maintain product quality. A degree of ice melt is important to insure adequate and continued cooling of scallop bags during stowage. Normal ice melt can be beneficial in the rinsing of bags and removal of bacteria.

FINDINGS:

Weight gain of scallop in bags during stowage is variable. Biological factors include season, state of reproduction and size of scallop meat. Other factors include area of harvest, time of stowage, temperature of ice hold, and the degree of weight gain associated with deck treatment. Weight gain not to exceed 6% when scallops are chilled on deck with a 2:1 seawater:ice slurry. When scallops are not chilled on deck, weight gains during stowage can range from 6-10% and should not exceed 12%.

PRACTICE:

Bags should be broken-out of ice stowage just prior to offloading.
Bags should not be rinsed and exposed to warm temperatures.

RATIONAL:

Additional handling is unnecessary. It may cause product damage and additional weight gains.

FINDINGS:

Weight gains not to exceed 0%.

COMMENTS:

Weight gains reported here for vessel handling practices are not additive and should not be considered as a target value at offloading. Weight gains at one particular practice will effect weight gains for subsequent practices. Consequently, based on experimental data % weight gain for vessels should not exceed 13%. This, in general, corresponds to a landed product on average for the total catch, not exceeding 80% moisture. However, more work is needed to expand the database fully to justify a landed % moisture level in scallops that could serve as a level for compliance and/or establishing baseline data.

OFFLOADING AND TRANSPORTATION

PRACTICE:

After offloading, bags of scallops if held or transported prior to processing, should be packed in ice in a container that provides proper drainage of ice melt.

RATIONAL:

Scallops should be kept cooled to maintain proper temperature and minimize unnecessary weight gains from melting ice.

FINDINGS:

Estimates of weight gain for this practice has not been determined. Weight gains are dependent upon length of stowage and degree of ice melt. Weight gain should not exceed 2%.

SHORESIDE PROCESSING

PRACTICE:

Practice for washing scallop meats.

A. Chilled freshwater

Scallops meats should be placed in chilled (less than or equal to 45 degrees F) potable freshwater. Scallops should be mechanically (air) or manually (paddle) agitated not to exceed 20 minutes. Scallop meats should be immediately drained, graded and packed.

RATIONAL:

It is necessary to thoroughly wash scallop meats to remove any remaining shell fragments, grit and sand. Additionally scallops have to be washed to separate meats for grading and packing. Washing appears to be the most effective method for separating meats to prevent physical damage.

FINDINGS:

Weight gains for washing are variable and depend upon weight gains from previous handling practices. Preliminary data indicated that weight gains should not exceed 4%. However, more data is needed for washing practices to fully document final weight changes.

COMMENTS:

In the contents of this exercise, this practice (washing) is considered to produce a final product¹ ready for market. No further washing or processing is anticipated.² However, experience has demonstrated that this practice does not always result in a superior or desired product according to organoleptic evaluations. In general, this corresponds to a scallop with a moisture content not to exceed 81% on average based on a landed product of 80% moisture. However, if product has been held or transported packed in ice moisture content should not exceed 81.5% on average.

1. This statement does not apply to the application of STP or other processing aids by the use of dips with a duration not to exceed two minutes.

2. When scallops are to be IQF processed, it is reasonable to expect additional increases in moisture not to exceed 1%.

PRACTICE:

Practice for washing scallop meats.

B. Chilled Brine (3%)

Scallops meats should be placed in chilled (less than or equal to 45 degrees F) brine. Brine should be made from potable freshwater and food grade salt. Scallops should be mechanically (air) or manually (paddle) agitated not to exceed 20 minutes. Scallop meats should be immediately drained, graded and packed.

RATIONAL:

It is necessary to thoroughly wash scallop meats to remove any remaining shell fragments, grit and sand. Additionally scallops have to be washed to separate meats for grading and packing. Washing appears to be the most effective method for separating meats to prevent physical damage.

FINDINGS:

Weight gains for washing are variable and depend upon weight gains from previous handling practices. Preliminary data indicated that weight gains should not exceed 0% (+1%). It is also possible that scallops could have a net weight loss after washing with 3% brine. However, more data is needed for washing practices to fully document final weight changes.

COMMENTS:

In the contents of this exercise, this practice (washing) is considered to produce a final product₂ ready for market.¹ No further washing or processing is anticipated.² However, experience has demonstrated that this practice may change the flavor profile slightly and/or organoleptic evaluations. In general, this corresponds to a scallop with a moisture content not to exceed 80% on average based on a landed product of 80% moisture. However, if product has been held or transported packed in ice moisture content should not exceed 80.5% on average.

¹ This statement does not apply to the application of STP or other processing aids by the use of dips with a duration not to exceed two minutes.

² When scallops are to be IQF processed, it is reasonable to expect additional increases in moisture not to exceed 1%.

PRACTICE:

Practice for washing scallop meats.

C. Sodium tripolyphosphates (STP)

Scallops meats should be placed in chilled (less than or equal to 45 degrees F) STP solution. Solution should be made from portable freshwater and food grade STP at a concentration of 4-6% by weight. Scallops should be mechanically (air) or manually (paddle) agitated not to exceed 20 minutes. Scallop meats should be immediately drained, graded and packed.

RATIONAL:

It is necessary to thoroughly wash scallop meats to remove any remaining shell fragments, grit and sand. Additionally scallops have to be washed to separate meats for grading and packing. Washing appears to be the most effective method for separating meats to prevent physical damage. Phosphates, as a processing aid, have been demonstrated to improve product quality when properly applied. Quality attributes can be extended fresh shelveflife, moisture retention (fresh and frozen), lower bacterial counts, color, odor and improved texture of raw and cooked product.

FINDINGS:

Weight gains for washing are variable and depend upon weight gains from previous handling practices and concentrations of STP. Preliminary data indicated that weight gains achieved in phosphate solutions are typically smaller than those achieved in freshwater washes. Research data has indicated that weight gains should not exceed 3% when using 6% by weight solution of STP. Quality attributes of phosphate use can be the extension of fresh shelveflife, moisture retention (fresh and frozen), lower bacterial counts, color, odor and improved texture of raw and cooked product.

COMMENTS:

In the contents of this exercise, this practice (processing) is considered to produce a final product¹ ready for market. No further washing or processing is anticipated.² The optimum STP concentration is not precisely known but the data indicates that it may be between 4-6% and weight gains may vary accordingly. Lower concentrations may result in greater weight gains but concomitant decreases in moisture retention. Concerns of higher concentrations relates to unacceptable residual phosphate levels. Other forms of phosphates as processing aids may give different results. More data is needed to determine optimum concentrations of phosphates as processing aids in a washing operation. In general, this corresponds to a scallop with a moisture content not to exceed 81% on average based on a landed product of 80% moisture. However, if product has been held or transported packed in ice moisture content should not exceed 81.5% on average.

1. This statement does not apply to the application of STP or other processing aids by the use of dips with a duration not to exceed two minutes.

2. When scallops are to be IQF processed, it is reasonable to expect additional increases in moisture not to exceed 1%.

PRACTICE:

Application of STP as a dip.

The application of STP as a dip should follow the prescribed practice for washing in either freshwater or brine solution. Dipping solutions containing STP at a concentration of 8-10% by weight is recommended in combination with a dwell time not to exceed two minutes. After dipping scallops are drained, graded and packed.

RATIONALE:

It is necessary to proceed above practice with the described washing practice to remove shell fragments, grit and sand. Washing appears to be the most effective method for separating meats to prevent physical damage and to allow proper contact with phosphate medium. Phosphates as a processing aid have been demonstrated to improve product quality when properly applied. Quality attributes can be extended fresh shelve life moisture retention (fresh and frozen), lower bacterial counts, color, odor and improved texture raw and cooked product.

FINDINGS:

Weight gain for the practice of dipping are variable and depend upon weight gains from previous handling and washing practices. Preliminary data indicated that weight gains achieved in phosphate solutions are in the range of 2-3%. Weight gains are affected by concentrations of STP used in the dipping solution and dwell time. STP concentrations above 10% may result in residual added levels of phosphate to exceed 0.5%.

COMMENTS:

The contents of this practice (the use of STP as a dip) is considered to produce a final product ready for market no further washing or processing is anticipated. In general, this corresponds to a scallop with a moisture content not to exceed 81.5% on average (freshwater wash) or 80.5% on average (brine wash) based on a landed product of 80% moisture. However, if product has been held or transported in ice, moisture content should not exceed 82% and 81% on average respectively.

PRACTICE:

Practice for processing scallop meats with sodium tripolyphosphate (STP)

A. Processing

Bags of scallops are emptied into a chilled (less than 45 degrees F) solution of 2-4% by weight food grade STP or other phosphate compounds and commercial blends. Salt (NaCl 1% by weight) may be added to processing solution. Scallops and processing solution should be agitated periodically and held at or below 45 degrees F and for periods of three to six hours. After processing scallops should be drained, graded and packed.

RATIONALE:

Processing scallops in solutions of STP or other phosphate compounds has been demonstrated to improve product quality when properly applied. Longer exposure times (greater than 20 minutes) and at recommended concentrations have improved sensory and functional attributes during fresh and frozen storage. Salt and conjunction with STP has shown to have beneficial synergistic effects. Cold processing temperatures minimize bacterial growth. Longer processing times with low concentrations of STP may permit more uniform distribution of STP and therefore provide for a more consistent processing result.

FINDINGS:

Data has shown that properly controlled processing with STP* (when compared against unprocessed or processed with water) scallop quality attributes are improved. For fresh products these include:

- improved sensory attributes (raw appearance and odor; cooked odor, flavor and texture);
- decreased drip and cooked water loss;
- extension of fresh shelf life; and
- lower aerobic plate counts.

For frozen products improved quality attributes include:

- improved sensory attributes (thaw appearance and odor; cooked odor, flavor and texture);
- decreased thaw drip and cooked water loss; and
- extension of frozen storage (STP as a cryoprotectant).

Use of 1% NaCl in processing (2-4% STP) solution has been shown to decrease the amount of thaw and cooked drip loss obviating the need for higher concentrations of STP*.

The use of 2-4% STP solution for the prescribed processing times (2-4 hrs.) have been shown to result in residual levels of added phosphates less than 0.5%. Lower concentrations of STP result in excessive water weight gains and reduces the functional attributes as described above.

Higher concentrations of STP (greater than 4%) have been shown to impart unfavorable characteristics to appearance, flavor and texture. Residual levels of added phosphate may exceed 0.5%.

Data has shown that processing times of two to six hours are sufficient to allow adequate incorporation of STP without excessive hydration and results in improved functional and sensory attributes as described above.

Weight gains for processing and STP are variable and depend upon the weight gains from previously handling practices. Data has shown that as processed above weight gain in scallops range from 4-12%.

COMMENTS:

Weight gains as a result of processing are highly variable and depend upon weight gains from previous handling practices, biological and environmental parameters. In the context of this exercise this practice (processing) is considered to produce a final product ready for market.¹ No further washing or processing is anticipated.

The optimum STP concentration is not precisely known for this application but the data indicates that it may be between 2-4%. Other forms of phosphates as processing aids may give different results. Also, the mode of application (e.g. soak, vacuum/tumbling, dips), needs further comparative evaluations. More work is needed on the organoleptic evaluation and consumer acceptability relative to the use of phosphates or other processing aids inclusive of method of application.

In general, this practice should result in scallops with a moisture content not to exceed 83% on average based on a landed product of 80% moisture.

1. This statement does not apply to the application of STP or other processing aids by the use of dips with a duration not to exceed two minutes.

2. When scallops are to be IQF processed, it is reasonable to expect additional increases in moisture not to exceed 1%.

SCALLOP SHELLSTOCK

PRACTICE:

Scallops after culling are placed in vessel ice hold. Ice is mixed or layered with scallops for stowage to insure proper chilling.

RATIONALE:

Ice is used to prevent product deterioration during the length of the fishing trip.

FINDINGS:

No data is available on weight (moisture) changes associated with shellstock stowage.

PRACTICE:

Offloading and shucking of scallop shellstock

Scallops shellstock is offloaded into refrigerated holding areas prior to shucking. Scallops are shucked, weighed, washed, graded and packed. The practice for washing shucked scallops in chilled freshwater, chilled brine and chilled sodium tripolyphosphate solution is the same in previous sections on washing.

RATIONALE:

It is necessarily to thoroughly wash scallop meats to remove any shell fragments, grit and sand prior to grading and packing. Additionally, the use of STP as a processing aid has been demonstrated to improve product quality when properly applied. Quality attributes can be extended shelve life, moisture retention (fresh and frozen), lower bacterial counts, color, odor and improved texture of raw and cooked product.

FINDINGS:

A. Chilled freshwater

Weight gains for washing are variable and depend upon biological and environmental parameters, size of scallop meat, quality of the landed shellstock and the natural moisture content of the scallop. Preliminary data indicates that weight gain should not exceed 6%.

COMMENTS:

In the context of this practice, ¹(washing) is considered to produce a final product ₂ ready for market. No further washing or processing is anticipated. In general, this corresponds to a scallop with a moisture content not to exceed 80% on average. However, the degree of moisture increase during vessel stowage of shellstock is unknown. More research is needed in this area to set levels of compliance.

B. Chilled brine

Weight gains for washing are variable and depend upon biological and environmental parameters, size of scallop meat, quality of the landed shellstock and the natural moisture content of the scallop. Preliminary data indicates that weight gain should not exceed 1%.

COMMENTS:

In the contents of this exercise, this practice (washing) is considered to produce a final product¹ ready for market. No further washing or processing is anticipated.² However, experience has demonstrated that this practice may change the flavor profile and/or organoleptic evaluations due to increased salt content. In general, this corresponds to a scallop moisture content not to exceed 79%.

C. Sodium tripolyphosphate

Weight gains for washing are variable and depend upon biological and environmental parameters, size of scallop meat, quality of the landed shellstock and the natural moisture content of the scallop. Preliminary data indicates that weight gains achieved in phosphate solution are typically smaller than those achieved in freshwater washes. Research data has indicated that weight gains should not exceed 4%.

COMMENTS:

In the contents of this exercise (washing) is considered to produce a final product¹ ready for market. No further washing or processing is anticipated.² The optimum STP concentration is precisely known but data indicates that it may be between 4-6% and weight gains may vary accordingly. Lower concentrations may result in greater weight gains but concomitant decreases in moisture retention. Concerns of higher concentrations relates to unacceptable residual phosphate levels. Other forms of phosphates as processing aids may give different results. More data is needed to determine optimum concentrations of phosphates as processing aids in a washing operation. In general, this corresponds to a scallop with a moisture content not to exceed 80% on average. However, the degree of moisture increase during vessel stowage of shellstock is unknown. More research is needed in this area to set level of compliance.

1. This statement does not apply to the application of STP or other processing aids by the use of dips with a duration not to exceed two minutes.

2. When scallops are to be IQF processed, it is reasonable to expect additional increases in moisture not to exceed 1%.

PRACTICE:

Practice for processing scallop meats from shellstock operations with sodium tripolyphosphates (STP)

A. Processing

Shuck scallop meats are emptied into a chilled (less than 40 degrees) solution of 2-4% by weight food grade STP or other phosphate compounds and commercial blends. Salt (NaCl% by weight) may be added to processing solution. Scallops and processing solution should be agitated periodically and held at or below 40 degrees F and for periods of two to six hours. After processing scallops should be drained, graded and packed.

RATIONALE:

Processing scallops in solutions of STP or other phosphate compounds has been demonstrated to improve product quality when properly applied. Longer exposure times (greater than 20 minutes) and at recommended concentrations have improved sensory and functional attributes during fresh and frozen storage. Salt and conjunction with STP has shown to have beneficial synergistic effects. Cold processing temperatures minimize bacterial growth. Longer processing times with low concentrations of STP may permit more uniform distribution of STP and therefore provide for a more consistent processing result.

FINDINGS:

Data has shown that properly controlled processing with STP* (when compared against unprocessed or processed with water) scallop quality attributes are improved. For fresh products these include:

- improved sensory attributes (raw appearance and odor; cooked odor, flavor and texture);
- decreased drip and cooked water loss;
- extension of fresh shelf life; and
- lower aerobic plate counts.

For frozen products improved quality attributes include:

- improved sensory attributes (thaw appearance and odor; cooked odor, flavor and texture);
- decreased thaw drip and cooked water loss; and
- extension of frozen storage (STP as a cryoprotectant).

Use of 1% NaCl in processing (2-4% STP) solution has been shown to decrease the amount of thaw and cooked drip loss obviating the need for higher concentrations of STP*.

The use of 2-4% STP solution for the prescribed processing times (two to four hours) have been shown to result in residual levels of added phosphates less than 0.5%. Lower concentrations of STP result in excessive water weight gains and reduces the functional attributes as described above.

Higher concentrations of STP (greater than 4%) have been shown to impart unfavorable characteristics to appearance, flavor and texture. Residual levels of added phosphate may exceed 0.5%.

Data has shown that processing times of two to six hours are sufficient to allow adequate incorporation of STP without excessive hydration and results in improved functional and sensory attributes as described above.

Weight gains for processing and STP are variable and depend upon the weight gains from previously handling practices. Data has shown that as processed above weight gain in scallops range from 7-12%.

COMMENTS:

Weight gains as a result of processing are highly variable and depend upon weight gains from shellstock holding practices, biological and environmental parameters and the natural moisture content of the scallop. In the context of this exercise this practice (processing) is considered to produce a final product ready for market. No further washing or processing is anticipated.

The optimum STP concentration is not precisely known for this application but the data indicates that it may be between 2-4%. Other forms of phosphates as processing aids may give different results. Also, the mode of application (e.g. soak, vacuum/tumbling, dips), needs further comparative evaluations. More work is needed on the organoleptic evaluation and consumer acceptability relative to the use of phosphates or other processing aids inclusive of method of application.

In general, this practice should result in scallops with a moisture content not to exceed 81% on average.