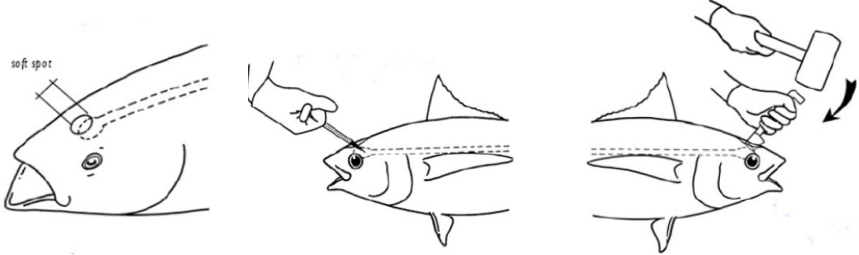





South West Handline Fishermen's Association Cornish Bluefin Tuna Standard Operating Procedure

SOP – Requirement guideline to best practice for fish welfare and food safety standard operating procedure

<p>On Vessel</p>	<ol style="list-style-type: none"> 1. Catch the fish with minimum stress 2. Boarding fish onto vessel 3. Quick slaughtering of the fish 4. Tag fish immediately after slaughter with Fish Key Tag 5. The fish needs to be located onto cleaned and safe area on deck <p style="color: orange;">Percussive stun of the fish is not recommended due to accuracy of impact and repeated impact will not stun the fish and only cause damage and stress to the fish</p> 6. Bleeding fish efficiently 7. Proper removal of blood, guts/intestines without damaging flesh 8. Removal of head if fish too large for tub (head off, gutted, bled fish. "Bullet") 9. Lowering the temperature of the fish to <4°C by using ice, storage of the fish properly after chilling in flake ice in insulated containers or fish hold. 10. Fish temperature management hourly 11. Landing fish
<p>Catch & boarding</p>	<ol style="list-style-type: none"> 1. Catch the fish with minimum stress. <ol style="list-style-type: none"> a. <i>The Bluefin has high metabolic rate and higher body temperature than ambient temperature. It is reported that when tuna struggles, it uses all its energy to fight for escape. Hence it is very important to bring the tuna to the pre-exercise level before it is removed from the hook. The glycogen is depleted considerably during struggle. The Adenosine triphosphate, the chemical store of energy in the muscle starts decomposing. The struggled fish enters rigor mortis very quickly after death. This has a damaging effect on the quality of the meat. The struggling of tuna causes to accumulate lactic in the muscle in the live condition itself within a short period of struggle. This causes visual changes in the colour of the muscle and develops an effect known as 'burnt fish.'</i> 2. Boarding fish onto vessel <ol style="list-style-type: none"> a. <i>Once the fish is located along side of vessel lying in a calm position held with Boger Grip. Head chin gaff or tail noose can be used to pull fish onto deck. Best practise is to have clean rubber sheet or padded sheet to sit fish on.</i>
<p>Slaughter/bleed/gill/gut/head fish</p>	<ol style="list-style-type: none"> 3. Quick slaughtering of the fish <ol style="list-style-type: none"> a. <i>Efficiently slaughter fish using large stainless-steel spike forced through circular soft spot above line between eyes into brain with minimum blows, fish will convulse with slight tail vibrations.</i> <div style="text-align: center;">  </div> <ol style="list-style-type: none"> 4. Tag fish immediately after slaughter <ol style="list-style-type: none"> a. Numbered tag MUST be applied to fish tail at this stage in process <div style="text-align: center;">  </div> <p style="color: orange; text-align: center;">Percussive stun of the fish is NOT recommended due to accuracy of impact and repeated impact will not stun the fish and only cause damage and stress to the fish.</p> 5. The fish needs to be located onto cleaned and safe area on deck <ol style="list-style-type: none"> a. <i>Specific storage location needs to be identified, hold area, specific container, rubber / padded blanket or matt to hold the fish</i> b. <i>This area must be freshly cleaned and sterilized prior to fishing.</i> 6. Bleeding fish efficiently

	<ol style="list-style-type: none"> a. <i>Fish needs to be bled efficiently.</i> <ol style="list-style-type: none"> i. <i>Cut under chin of fish through primary artery under gill area</i> ii. <i>Cut gill rake on either of side half-way down gill.</i> iii. <i>Cut lateral line primary artery by inserting tip of knife under pectoral fin through lateral line, 4-6cm deep.</i> iv. <i>Allow fish to bleed freely until there is a noticeable stop to free running blood.</i> b. <i>Constantly washing fish with fresh sea water through whole bleeding process</i> <p>7. Proper removal of blood, guts / intestines without damaging flesh</p> <ol style="list-style-type: none"> a. <i>Cut fish from anus along lower belly line to gills.</i> b. <i>Cut around back of gills on either side of fish from top to bottom.</i> c. <i>Pull gills out.</i> d. <i>Remove gut.</i> e. <i>Constantly washing fish with fresh sea water through whole bleeding process.</i> <p>8. Removal of head (head off, gutted, bled fish, only fish too large to fit inside tub whole)</p> <ol style="list-style-type: none"> a. <i>Use a large cleaver shape knife with hammer or saw to remove head.</i> b. <i>Cut through flesh and spine directly behind head to remove head with straight line.</i> c. <i>Constantly washing fish with fresh sea water through whole bleeding process.</i> 																																								
Storage	<ol style="list-style-type: none"> 1. Lowering the temperature of the fish to <math>4^{\circ}\text{C}</math> by using ice, storage of the fish properly after chilling in flake ice in insulated containers or fish hold. <ol style="list-style-type: none"> a. <i>Fish needs to be stored in hold area or placed into specific Bluefin Tuna case.</i> b. <i>Belly needs to be filled with crushed ice.</i> c. <i>Fish needs to be fully covered with ice at all times until landing, crushed ice or slurry ice can be used.</i> 2. Fish temperature management hourly <ol style="list-style-type: none"> a. <i>Vessel must have working temperature probe on vessel at all times.</i> b. <i>Temperature of fish taken and recorded at landing.</i> c. <i>Temperature of fish taken and recorded hourly.</i> d. <i>Target <math>4^{\circ}\text{C}</math> as control chilled</i> <table border="1" data-bbox="280 1070 1506 1364"> <tr> <td colspan="5">Vessel Name:</td> </tr> <tr> <td>Date</td> <td>Fish Tag number</td> <td>Time</td> <td>Temp</td> <td>Fish Tub Tag Number</td> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table> 	Vessel Name:					Date	Fish Tag number	Time	Temp	Fish Tub Tag Number																														
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Date	Fish Tag number	Time	Temp	Fish Tub Tag Number																																					
Landing	<ol style="list-style-type: none"> 1. Landing Fish <ol style="list-style-type: none"> a. <i>Once at port fish must be landed and placed into specific Blue Fin Tuna carry case</i> b. <i>Fish must be iced inside gut cavity</i> c. <i>Fish must be fully covered with ice</i> d. <i>Tag must remain on fish at all times</i> 																																								

Hygiene & Food safety	<ol style="list-style-type: none"> 1. All areas of the vessel and equipment that will be in contact with fish must be cleaned prior to trip. Soap & sanitizer chemicals must be used to sanitize the fish contact points <ol style="list-style-type: none"> a. Wash areas & equipment b. Sanitize c. Wash off with fresh seawater
	<ol style="list-style-type: none"> 2. Its good practice to store equipment for slaughter/gutting/gilling/bleeding equipment in a container filled with sanitizer to ensure food safety hygiene and control of bacteria.
Traceability	<ol style="list-style-type: none"> 1. All fish landed on vessel must have traceability tag applied post bleeding, heading and gutting on vessel <ol style="list-style-type: none"> a. Tag must be applied tightly to tail section of fish in front of the Cordal fin  <ol style="list-style-type: none"> 2. Fish tubs – once fish is loaded into tub for despatch lid must be secured to tub with Label Cable ties <ol style="list-style-type: none"> a. Fish on top of ice b. Ice inside belly cavity c. Fish covered with ice Tub tag must be completed and applied to secure lid <ol style="list-style-type: none"> a. Vessel name b. Date c. Tag Number d. Fish temperature at time 

Appendix

The world demand for tuna is large and growing. Tuna processing industry has grown very rapidly in the last decade. In addition to the conventional processed products such as smoked, canned and frozen products, there is an increasing demand for the prime quality fresh tuna meat for sashimi and sushi production, which commands higher prices, especially in the Japanese market.

The high-priced sashimi grade tuna catering to the soaring Japanese demand.

To get the highest prices for our catch we need to produce is a sashimi grade tuna. This will require you to learn and implement the special technics and good handling procedures.

For Sashimi grade products, killing, damaging the brain, bleeding, gutting, precooling, freezing to -60°C etc are to be followed. Proper handling starting from catching and implementation of good handling procedures based on concepts in place around the world, at every stage the highest standards are required.

The Bluefin has high metabolic rate and higher body temperature than ambient temperature. It is reported that when tuna struggles, it uses all its energy to fight for escape. Hence it is very important to bring the tuna to the pre-exercise level before it is removed from the hook. The glycogen is depleted considerably during struggle. The Adenosine triphosphate, the chemical store of energy in the muscle starts decomposing. The struggled fish enters rigor mortis very quickly after death. This has a damaging effect on the quality of the meat. It is better to have a longer pre-rigor and rigor period for maintaining the quality. The struggling of tuna causes to accumulate lactic in the muscle in the live condition itself within a short period of struggle. This causes visual changes in the colour of the muscle and develops an effect known as ‘burnt fish.’

Allowing minimum struggle during catch and onboard allows the quality of the muscle to retain for a longer period and also the shelf life. Bleeding of the fish reduces the post-mortem production of lactic acid. Other factors which contribute to the quality of meat are feeding habits, nature of food available, presence of parasites, sexual maturation, disease, fat content, killing methods, handling procedures, chilling and storage methods and holding temperature. The intervention to improve the quality can be done in the latter three parameters.

If tuna is not properly chilled immediately after capture, the high body temperature of tuna meat coupled with the presence of oxygen and iron in blood causes lipid oxidation and decomposition. This will lead to off taste of the meat due to rancidity. Proper bleeding can reduce a good source of oxygen and the pro-oxidant, iron. Rapid chilling and maintaining at 0°C throughout handling are recommended to get high quality meat. If the quality of tuna is to be maintained for a long period, it must be frozen to -60°C in a period of 8 h or less and should be stored at -50°C.

The storage life of chilled tuna is 10-12 days. Frozen tuna has the same initial quality as chilled tuna, but the thawed tuna has a short life of 3 days due to noticeable changes in colour and texture.

Handling of catch onboard

The various handling steps onboard fishing vessels are

1. Catch the fish with minimum stress,
2. The storage area of the vessel should be clean and safe,
3. Quick stunning and killing of the fish,
4. Destroying the spinal cord,
5. Proper removal of blood, guts and intestines without breaking,
6. Washing in clean and safe water/ seawater,
7. Lowering the temperature of the fish to 0°C by using chilled seawater and ice mixture,
8. Storage the fish properly after chilling in flake ice or finely powdered ice in insulated containers or fish hold.

Handling and storage of tuna for sashimi

Tuna is killed either by a sharp blow to the head or inserting a spike into the brain at the soft spot. The soft spot is found between the two eyes. The purpose of giving a sharp blow is to prevent struggling, which will result in the development of anaerobic glycolysis and formation of lactic acid. The glycolysis will result in early ATP degradation and the resultant rigor mortis within a short period after death. This will affect the quality of the material.

The brain should be destroyed by piercing a sharp object into the brain. The nerves should also be destroyed. The spinal cord can be destroyed by inserting a rod through the brain and into the spinal canal. This is carried out by cutting a wedge over the soft spot to expose the brain and then passing the rod through the brain into the spinal canal. The brain and spinal cord are destroyed to prevent enzyme actions and reduce the body temperature, which is controlled by the blood flow. Tuna must be bled as soon as possible after the catch. Removal of the hot blood will allow the tuna to cool faster and reduce acidity. Blood is a source of iron, which is a pro-oxidant. This will activate the peroxidation of fat and its decomposition, which will result in the development of off odours. There are three steps in bleeding.

1. Make a cut of 2 inches long behind the pectoral fin with a clean knife of 2 inches long and ½ inches wide to cut the blood vessel. The fish must be cut on both sides.
2. The next step is to cut the blood vessels in the gills. By opening the gill cover, make cut through the membrane behind the gill to cut the blood vessel without damaging the heart. This is repeated with the other gill also.
3. The final step is to cut vertically on both sides of the tail between the third and fourth dorsal fin without removing the tail. During these cutting operations clean salt water must be running over the cut so as to prevent the blood from clotting.

Gutting and gilling

It is important that all the internal organs are removed as quickly as possible after bleeding. To remove the internal organs, make a straight cut 4 inches long in the belly cutting towards the anus. The anus should not be cut through; but cut as close to the anus as possible may be made. The attachment of intestine to the body wall is removed by pulling it through the cut.

Next step is to remove the gills from the head without damaging the heart. Cut the main muscle attaching the gill cover to the head and also the membrane behind the gills. Remove the gills and guts and any remaining attachments. On completion of this process, the belly area and gill portion must be properly cleaned using clean and safe seawater. The cut remnants and blood should be completely removed. The gill area is usually scrubbed with a soft nylon brush to remove complete blood in that area. After the process is completed, the outer surface must be washed properly to remove any slime or foreign material present. The seawater used for cleaning must be cooled. This will also help the initial cooling of tuna. Gut contains a large amount of enzymes and hydrolytic bacteria. These enzymes will act on the belly walls, which will make the belly wall soft and penetration of bacteria easy. Since the gut contains digested food materials, it is a good source for the bacteria to grow. These bacteria will penetrate the muscle through the soft belly wall caused by the enzyme action and make the flesh to deteriorate early.

Chilling

After the gutting, gilling, bleeding and cleaning operations are over, it must be kept in saltwater ice slush for a period of up to 12 hours or until the core temperature of tuna reaches 0°C. Kochi should be adopted on vessels wherever possible. Better quality product is obtained if the temperature is lowered as quickly as possible. In small vessels where these operations are not possible, the tuna must be stored in ice immediately after catch. Sufficient ice should be added or repacked periodically to ensure proper cooling. Early chilling is advantageous to bring down the temperature to zero degree centigrade and the following problems will be reduced considerably.

1. Reduce the burnt tuna syndrome (BTS)/reduce the enzyme activity/reduce bacterial growth.

Icing tuna onboard

When the core temperature attains 0°C, the tuna must be removed from the ice slurry and kept in the fish hold having one layer of ice in the bottom. The belly part of the tuna must be packed properly with ice. The outer area of the tuna must be covered with a green tuna paper soaked in salt water to protect the skin from damage during contact with ice. Fresh water causes bleaching of skin, whereas saltwater helps to maintain the natural colour of the skin. Green tuna paper is a special parchment paper available in Japan.

If block ice is used for icing, it must be properly crushed. There should not be any large pieces of ice or pieces with sharp edge. The tuna should be properly covered with ice throughout the storage. The tuna is placed head to tail to ensure sufficient ice between each fish. Tuna must be laid flat to ensure that tuna does not bend. Bending will cause tearing of meat.

The ice should be spread evenly over the fish. The melt water must be able to run clear of the fish and melt water must be removed. Large and small tuna must not be iced together. Refrigerated seawater system also can be used. In this system tuna must be kept in plastic bags. When tuna is stored in the fresh state, the temperature of the meat should not fall below – 2.5°C since rapid browning of the meat in the outer layer can occur at this temperature.

Process control requirements

1. Proper washing during and after processing and ensure removal of blood, gut remnants, and foreign material
2. Use of clean and safe sea water, NOT fresh water
3. Handle and process tuna quickly and carefully after being taken onboard
4. Cool tuna in ice or slurry with 2:1 ice water ratio
5. Keep only properly cooled tuna in fish hold
6. Keep tuna properly to avoid bending
7. Check the temperature of fish hold and tuna at regular intervals and ensure that the core temperature is 0°C.

Fresh Storage Requirements

1. Fish hold must be free from any contamination
2. Fish hold must be properly insulated
3. The ice should be clean and safe
4. In Raw Sea Water system, only clean and safe seawater with adequate temperature should be used
5. The core temperature of the tuna must be maintained at 0°C.

Handling of tuna onshore

The material should be delivered at the receiving end in insulated containers in ice or in ice water slurry. Care should be taken to control the temperature rise and prevent the material from any damage during handling onshore.