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Training Manual on Preparation of Boneless Rohu and Soft Bone Rohu

Odisha, India

Funded by

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About WorldFish
WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision- making on the critical issues of our times.

WorldFish is part of One CGIAR, the world's largest agricultural innovation network.

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Context and purpose of the manual

Fish is consumed in many forms all over the world and the value-added fish products are consumed in substantial quantities. India is a major aquaculture producer with maximum production coming from the inland culture sector. Rohu (*Labeo rohita*) is a Indian Major Carp (IMC) and is one of the commercially important freshwater fish contributing a larger portion to the total inland fish production. Despite its high production and good taste, the market value of carps and consumer acceptance is low in many states of India because of the presence of intramuscular spines and bones. Therefore, value addition and diversification of processed fish products is an important need in the fish processing sector. Nowadays, the preference for ready to cook or ready to serve type of products is also increasing, especially in urban and semi-urban areas.

In this backdrop, the purpose of the manual is to disseminate a standardised methodology of deboning and bone softening of Rohu, which will enable to deliver ready to cook or ready to serve food products from Rohu fish. The training manual covers the basic skeletal structures of Rohu for a better understanding of the bone positions, methods of deboning and softening the fish and preparation of different products from boneless Rohu. This training manual will be helpful for Women Self Help Groups (WSHG), fish farmers, entrepreneurs, hotel industries and consumers as well.

1. Schedule of Training on Deboning and Bone Softening of Rohu

Duration: 1 day

Participants: Women Self Help Group (WSHG) members, private entrepreneurs and any individual who is interested to learn deboning of rohu for livelihood and extra income.

Day	Topic	Time	Schedule
Day 1			
Session 1	Inauguration and Introduction	30 minutes	10:00 – 10:30
Session 2	External structure of Rohu	15 minutes	10:31 – 10:45
Tea Break		15 minutes	10:46 – 11:00
Session 3	Skeletal structure of Rohu	15 minutes	11:01 – 11:15
Session 4	Procedure of deboning and bone softening of Rohu	30 minutes	11:16 – 11:45
Session 5	Economics, Marketing of boneless Rohu	15 minutes	11:46 – 12:00
Session 6	Practical of boneless and bone softening of rohu by resource person or facilitator	90 minutes	12:01 – 13:30
Lunch Break		60 minutes	13:30 – 14:30
	Practical by participants	135 minutes	14:31 – 16:45
Review and closing of the day		60 minutes	16:46 – 17:00

2. Session 01: Training Inauguration and Introduction

Objective: To inaugurate training session on deboning and softening of rohu and to get a basic idea of the training course.

Registration: An attendance sheet should be maintained to register the trainees and trainers. The following format can be used:

Training on Deboning and Bone Softening of Rohu				
Date:	**Duration**: 1 day		**Venue**:	
Sl	**Name of Participants**	**Address**	**Contact No.**	**Signature**
1				
2				

Introduction with each other: The training course coordinator will facilitate introducing the participants to each other. Any kind of suitable technique can be followed for introducing the participants by which a friendly atmosphere will create. A name card should be used during the training period, which will assist to facilitate the session by the trainers and also help to remember the participants each other.

Inauguration of the training course: The inauguration program should start with worshiping the Lord and lighting the candles.

2.1 Aim and Objectives of the Training Program

This training course aims to enhance the knowledge and skills on deboning and softening of an Indian Major Carp (IMC), Rohu (*Labeo rohita*).

Overall objectives of this training course are –

- To popularize the ready to cook boneless Rohu in the market
- To create entrepreneurs in this sector
- To provide employment opportunity to WSHG members

At the of the training course, the participants will –

- Acquire detailed knowledge of the skeletal structure of Rohu
- Gain adequate knowledge on the location of intramuscular bones/pin bones in Rohu
- Learn the methods of deboning and soften the fish
- Obtain detailed knowledge on the different products developed from boneless Rohu and its economics and marketing

2.2 Trainees Expectation

Before going to the main sessions of the training program, the trainee's expectations from this training need to be analyzed. VIPP (Visualisation in Participatory Planning) card can be used for this purpose and the expectation should display during the training period. The expectations will be analyzed at the end of the training course and need to be answered all the expectations.

3. Session 02: External Structure of Rohu

Objectives: To inaugurate training session on deboning and softening of Rohu and to get a basic idea on the external structure of rohu.

3.1 External Structures of Rohu

- *Labeo rohita* has a moderately elongated body. The dorsal side of the body is blackish and the ventrolateral sides are silvery.
- The body is distinguishable into the head, trunk and tail.
- The head extends from the snout up to the posterior margin of the operculum.
- The mouth is bounded by thick, fleshy upper and lower lips. Teeth are absent in the jaws.
- The operculum is thin, large, and plate-like gill cover on either lateral, posterior side of the head.
- The trunk is covered by thin overlapping cycloid scales. The lateral line (sense organ) runs along the lateral sides of the body.
- The part of the body behind the urinary aperture is the tail.
- The trunk bears well developed paired and unpaired fins.

Box 1. Know the different fins of Rohu

- **Pectoral fins:** The pectoral fins are located at the anterolateral side of the trunk behind the operculum. Each pectoral fin is supported by 19 fin-rays. These fins are borne by pectoral girdles.
- **Pelvic fins**: The pelvic fins are situated on the ventral side behind the pectorals. Each pelvic fin contains 9 fin-rays and borne by pelvic girdle.
- **Dorsal fin**: There is only one dorsal fin in Rohu which arises from the mid-dorsal line of the trunk half-way between the snout and the base of the tail. The dorsal fin consists of 13 fin-rays.
- **Anal fin:** The anal fin lies posterior to the anus. It has 4-6 fin-rays.
- **Caudal fin:** The caudal fin is homocercal with two symmetrical lobes. Several fin-rays support the caudal fin.

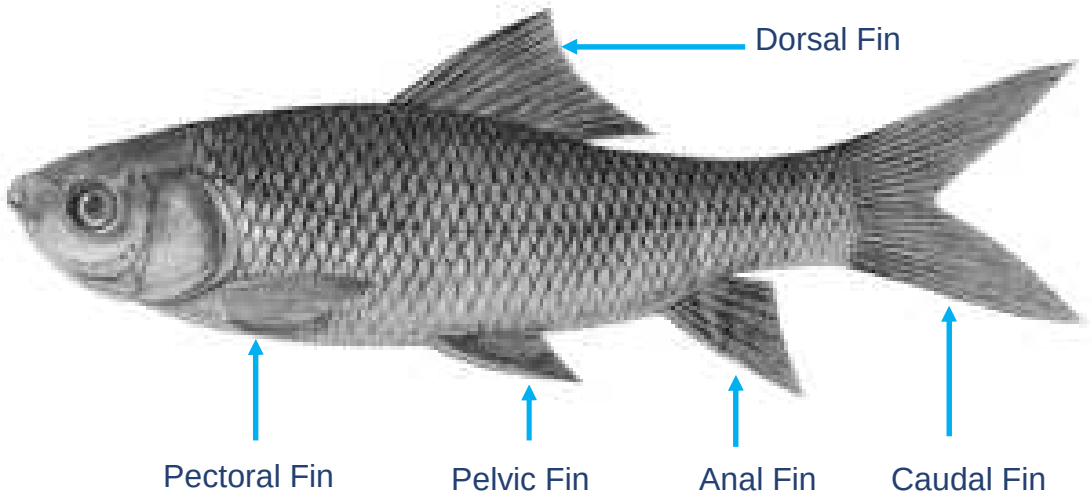


Figure 1. Arrangement of fins of Rohu.

4. Session 03: Skeletal structure of Rohu

Objectives: To get a basic idea of the skeletal structure of Rohu.

4.1 Skeletal Structure:

- The scales and fin-rays constitute the exoskeleton of the Rohu.
- The endoskeleton is composed of (i) skull, vertebral column with the ribs and the skeletal elements supporting the unpaired fins (axial skeleton) and (ii) the supporting structures of the paired fins and the corresponding girdles (appendicular skeleton).
- The vertebral column is composed of 37-38 vertebrae.
- The ribs are paired slender bony rods. The ribs are attached to the vertebral column. There are seventeen pairs of pleural ribs.
- Besides the ribs, there are series of inter-muscular bones that vary in shape and size.
- Inter-muscular bones are of two types, i.e. Y shaped pin bone and straight pin bones.
- Y pin bones are normally embedded in the dorsal broad muscle and the straight pin bones are normally located in the caudal muscle of Rohu.
- The total number of intermuscular bones present in Rohu is 104. There are 60 Y shaped pin bones (30 on each side) and 44 straight pin bones (22 on each side).
- These are floating bones and can be taken out during deboning. These bones create trouble during the filleting of Rohu. Due to their stiffness and branched shape, the intermuscular bones of Rohu may pose a health hazard to consumers and can even be fatal, especially in children.

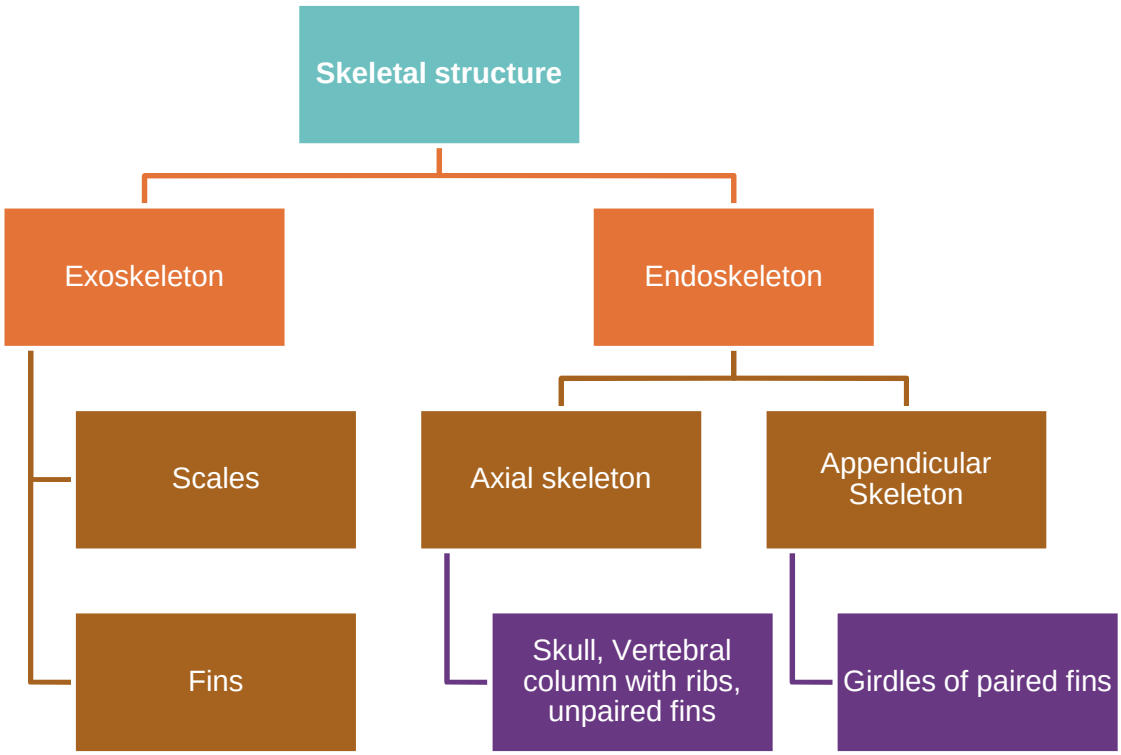


Figure 2. Skeletal structure of Rohu.

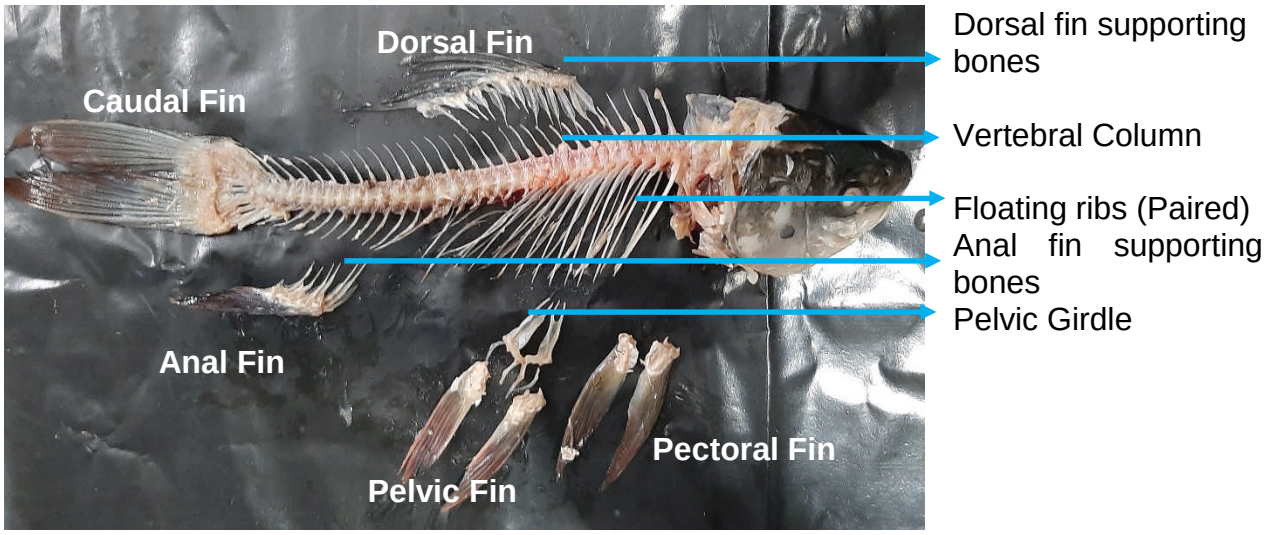


Figure 3. Appendicular skeleton of Rohu.

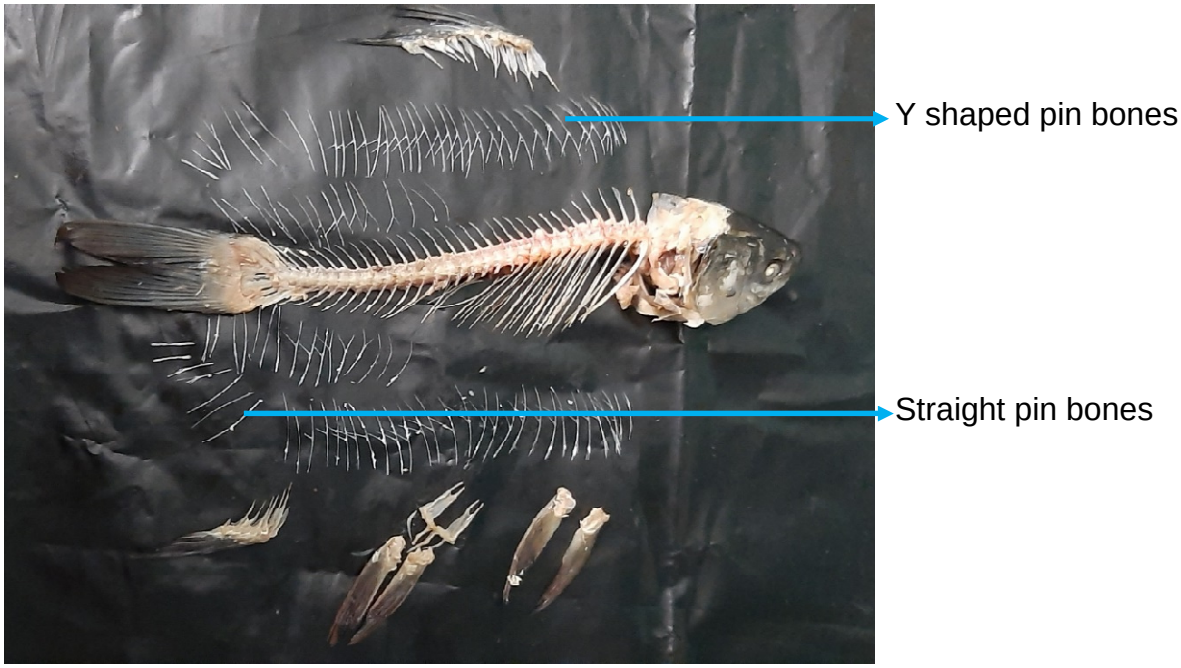


Figure 4. Distribution of pin bones in Rohu.

5. Session 04: Procedure of Deboning Rohu and Processing

5.1 Deboning of Rohu

5.1.1 Fish Selection

Fresh fish should be selected. It is better to avoid buying fish that are less fresh because it will affect the quality of the final product. The characteristics to determine the freshness of fish are as follows:

- The smell of fresh fish is pleasant and neutral. Spoiled or rotten fish has an unpleasant, sharp smell.
- Fresh fish has bulged and shiny eyes. Eyes of old fish are cloudy and sunken into the head.
- The gills and fins of fresh fish are moist. Healthy gills are bright red. In case of non-fresh fish, gills are dry, covered with sticky slime, greyish-brown in colour with an unpleasant smell.
- The skin of live and fresh fish is moist. Scales must be tightly attached to the body. The surface of healthy and fresh fish must be tight and shiny so that fish slides out of your hands. Discoloration and cracked skin are signs of rotting fish.
- Slime is equally distributed over the fish, It is clear and odourless. In old fish, slime gets increased.
- The body of a fresh fish is firm and has a specific consistency and appearance. When pressed it should bounce back. Soft, grey and inelastic fish is old or bad.
- The belly of a live and fresh fish is shiny and undamaged, and the anal opening is tight. Anal opening of old and bad fish sticks out and is yellow-brown.
- Rigor mortis in Rohu starts after 1 hour of death. So, rohu should be deboned after the period of rigor mortis.

5.1.2 Requisite Equipment

The equipment required for boneless Rohu processing are as follows;

1. Processing table	2. Hand gloves
3. Headcover	4. Face mask
5. Kitchen apron	6. Fish scale remover
7. Stainless steel knife	8. Scissor
9. Tweezer	10. Clean water
11. Fresh fish	12. Crushed ice
13. Freezer	14. Plastic crate or tray

5.1.3 Fish Cleaning

- Slime accumulating on the skin surface of dying fish is a protection mechanism against harmful conditions.
- After the death of fish, slime secretion from the epithelial mucus glands of fish skin increases. It creates a perfect environment for micro-organism growth and should be removed by thorough washing.
- Then, keep the fish on a board or plain concrete place and grasp the head firmly. Using a manual scaler or a large tablespoon, scrape the scales off, working from the tail to the head.
- Electrical hand-held scalers can also be used to simplify and speed up the scaling procedure. The use of electrical hand-held scalers reduces labour intensity and assures complete elimination of scales.
- Using a sharp knife or cutter, remove the pectoral fins, pelvic fins, dorsal fin and anal fin.
- Clean and rinse the fish thoroughly from the body of the fish. The fish is now dressed and should be stored with ice until processing.

Figure 5. Scale removal and scale washing.

5.1.4 Gutting and Gill Removal

Gutting consists of cutting down the belly through cleavage at the caudal region, removal of internal organs and cleaning the body cavity of the peritoneum, kidney tissue and blood. The purpose of gutting is to remove those fish body parts most likely to reduce product quality. The process is discussed below:

- Keep the washed fish with the ventral side of the fish towards the left and dorsal side towards the right.
- Hold the fish head keeping the tail part forward as shown in the picture given below.
- Make a slant cleavage or slit within the one inch of flesh from the caudal side.
- Make the cleavage deep until the knife touches the vertebral column. Then, cut the fish longitudinally from caudal side to head along the dorsal side by slanting the knife which will run above the vertebral column.
- During this cut, 16 floating ribs of the same side need to be cut from the vertebral column using a scissor.
- Head part can be cut by using a sharp cutter.
- This will result in a butterfly shape of fish (divided into two halves by cutting from the dorsal side).

- In butterfly shape, fish will be completely opened from the dorsal side but remained intact from the ventral side.
- Using the knife, remove the gills and clean the gut contents and viscera by hand.

Figure 6. Gutting and butterfly shape of Rohu.

5.1.5 Removal of Vertebral Column

- After the removal of gut content, break the vertebral column below the head using the knife.
- Using a scissor, cut/ detach the rest of 16 floating ribs attached to the vertebral column. Then remove it by moving the knife from head to caudal side with a focus on less wastage of flesh.
- Again, remove the vertebral column by breaking it at the caudal region.
- The supporting bones of the dorsal fin run after the 5th rib. So, care should be taken that, the supporting bones of the dorsal fin will also be removed along with the vertebral column.
- After the removal of gills and stomach contents, do the backing with a knife.
- Tidying the back is done from the head to the tail. This trimming is done to spruce up the shape of the fish.
- Cut the ribs using scissors to facilitate removal of the middle bone.
- Use a sharp knife and scissors.

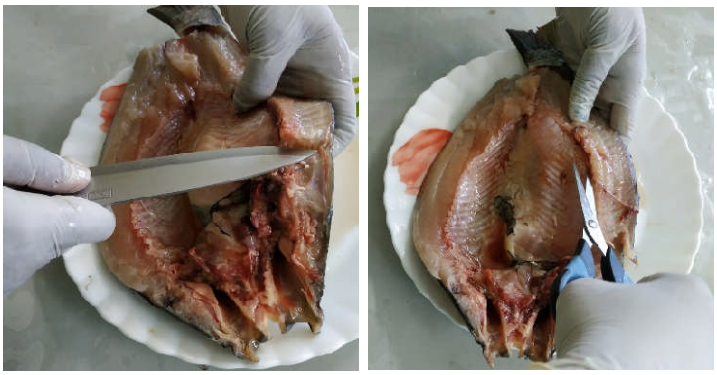


Figure 7. Removal of the vertebral column.

5.1.6 Washing-I

- Wash the fish thoroughly to clean the dirt still attached to the fish during gutting.
- After washing the fish, drain the water for 1-2 minutes, so that excess water will be removed from the fish.
- The rest amount of water from the fish body can be soaked using tissue paper or a dry cloth.

Figure 8. Washing of fish after gutting.

5.1.7 Removal of Floating Ribs

- As we know, the 16 pairs of floating ribs are present between the muscles and the peritoneum and encircle the abdominal cavity. They run downward from the mid-portion of each side of the fish towards the ventral side.
- Using a clean tweezer remove the ribs one by one from one side followed by the other side. Each rib is attached to the flesh nearly 30% and the rest part (movable) is freely present below the peritoneum. So, with little initial pressure, the ribs can be removed.
- Pull out each rib using the tweezer in the right hand at the angle of their location by putting the thumb and index finger of the left hand at the starting point of the rib (shown in picture).

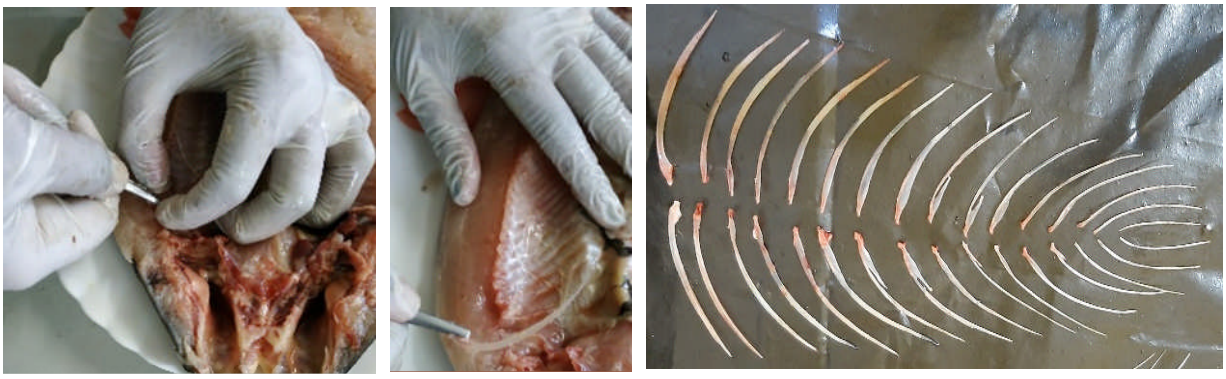


Figure 9. Removal of floating ribs of Rohu.

5.1.8 Removal of Intramuscular Bones

- After the removal of ribs, pick out the intramuscular bones.
- On each side, there are 30 Y pin bones and 24 straight pin bones.
- Out of the total 30 Y pin bones, 24 bones are located in the dorsal side starting below the head to the caudal region. This line of bones starts with 2-3 straight bones followed by Y pin bones.
- Another line of pin bones starts below the abdominal cavity and merges with the first line at the caudal region.
- The straight pin bones are mostly cluttered in the caudal region.
- Y pin bones are located in a slanting position with the shorter hand coming up towards the vertebral column whereas, the long hand of Y pin bone runs parallel and closer to the skin.
- The lower side of the pin bones moves downward.

- After the removal of the vertebral column, the shot hands of Y bones are visible in a dotted line form and one can feel the bones by touching them. This indicates the location of Y pin bones.
- Using a tweezer, make a long cut in the flesh with a half-centimeter gap to the dotted line of Y pin bones.
- In this long cut, one can feel the position of the pin bone by using the tweezer. This is the middle point of the bone.
- Putting slight pressure on the left thumb and index finger of the left hand on the lower side of the bone, the lower part of the bone can be removed.
- Similarly, the upper part of the pin bone can be removed.
- In this method, there will be no flesh coming out with the pin bone.
- In the caudal region, as the number of pin bones is more, the location of the straight pin bones can be identified by using a tweezer.
- After the removal of pin bones on one side, pin bones from another side can be removed in the same method.
- Intramuscular bones of rohu are mostly of two types. Still, the different pin bones present in rohu areas are depicted in the following pictures.

Figure 10. Removal of pin bones.

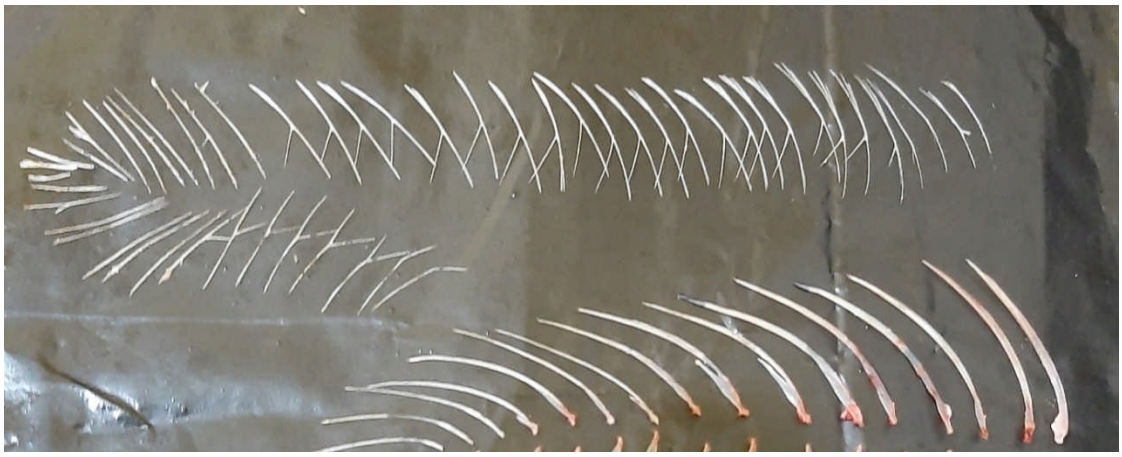


Figure 11. Location of pin bones in one side of Rohu.

Figure 12. Different shapes and sizes of pin bones present in Rohu.

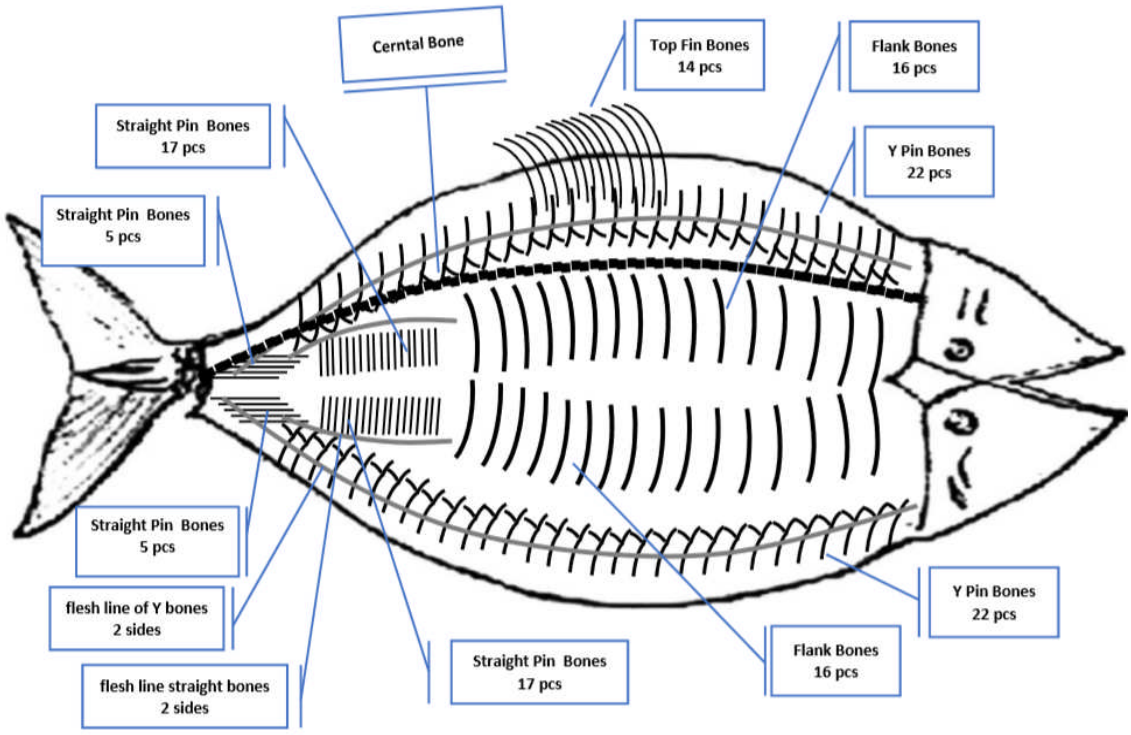


Figure 13. Intermuscular bone positions of Rohu.

5.1.9 Washing II

- After removing all the intramuscular bones, wash the fish again to clean the dirt that is still attached.
- Fishes are washed one by one using running water, not by soaking them in a container that can cause dirt to stick back to the fish.
- Use clean and cold water using ice, so that the quality of the fish does not decrease due to rising temperatures.
- Washed fish must be kept clean and placed in containers filled with ice.

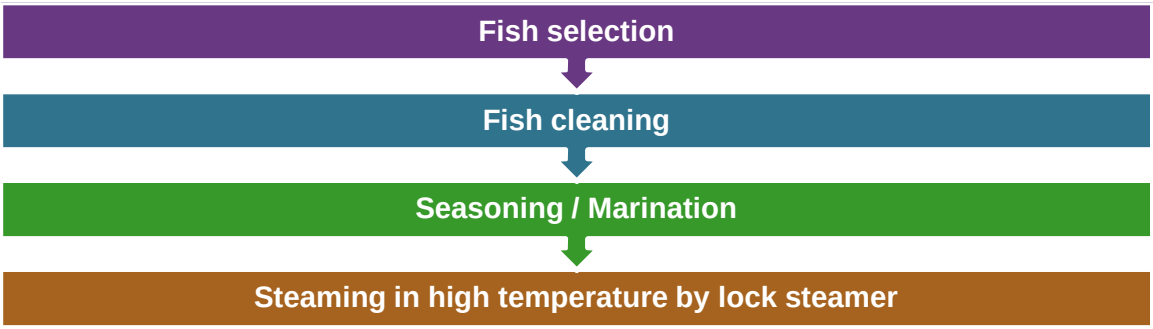
Figure 13. Washing of debones Rohu.

5.1.10 Packaging and Storage in Frozen Condition

- Washed fishes are drained first for 5 minutes in a basket and then packed one by one in a plastic package.
- Seal the fish that has been packaged in plastic using a hand sealer machine.
- Put the packaged fish in the freezer one by one. The freezer is set at -18ºC or lower temperature.
- Now the frozen fish is ready to be marketed.

Figure 14. Packing of fishes.

5.2 Soft Bone Rohu Processing


Fish selection
Fish cleaning
Seasoning / Marination
Steaming in high temperature by lock steamer

5.2.1 Equipment and materials

- The equipment required for soft bone rohu processing are as follows;

1. Processing Table	2. Ice Container
3. Hight Temperature Steamer	4. Stainless steel Knife
5. Scissors	6. Cutting Board
7. Fish scale remover	8. Plastic Basket
9. Gloves	10. Masker
11. Head Cover	12. Waterproof Apron
13. Fresh Fish and Clean Ices	14. Clean Water
Supporting Equipment and Materials	
15. Freezer	16. Hand Sealer
17. Spices for seasoning/margination	18. Packaging Plastic

5.2.2 Fish Selection

- This step will be similar to the fish selection in boneless rohu processing.

5.2.3 Fish Cleaning

- First, remove the scales of the fish using a scale remover starting from the caudal region to the head. Make sure the fish scales are cleaned properly from the base of all the fins, below the upper column and near the caudal region.
- Then, pull out the gills below the upper column.
- Remove the gut contents of the stomach first by slicing the fish's chest 1-2 cm long with a knife. Then gently pull in the fish's bowels.
- Wash the gill and gut by flushing with clean water to make sure the gill and stomach of fish is clean
- After cleaning, fish should be kept in ice immediately to maintain the quality.

Figure 15. Scale removal, slicing and washing.

5.2.4 Seasoning/Marination

- The cleaned fish can be kept approximately for 5 minutes to drain out the excess water.
- Then, prepare the spices mix for margination as per the taste.
- Coat the spice evenly inside and over the fish body.
- Marinate the fish for 15-30 minutes or as per the requirement to be completely absorbed by the flesh.
- Once, the fish is marinated, wrap it with aluminium foil, so the fish will not be easily damaged and stick together in the steaming process at high temperatures

Figure 16. Marination and wrapping in aluminum foil.

5.2.5 Steaming in High Temperature by Lock Steamer

- A lock steamer has a base pan, one perforated rack to keep the cooking items to steam, a lid and a whistle.
- Fill water in the base pan of the steamer and do not exceed the limits of the perforated rack.
- Boil water inside the steamer.
- Then, open the steamer, stack the fishes in the steamer without breaking the fish and tearing the aluminum wrap, then lock the steamer.
- Start cooking the fish using the steamer.
- Let the fire burn for at least 45 minutes or more (according to the number of steamed fish) even though steam starts coming out of the steam vent.
- Make sure it does not smell charred, the charred smell is because the water in the steam has dried.
- Turn off the fire after the specified time, let the temperature inside the steam to come down to the environmental temperature.
- As a caution, do not immediately open the steamer in a hot condition because the remaining hot steam can be dangerous. Then, remove the fish one by one from the steamer.
- Soft-bone Rohu fishes are now ready to be served.

Figure 17. Racked fishes inside the steamer

Figure 18. Steaming of fishes in the steamer

Figure 19. Soft-boned Rohu

6. Session 05: Economics, Marketing of Boneless Rohu

- Rohu is the most preferred fish in Odisha and the price varies from Rs.160 to Rs.200 per kg raw fish.
- Consumption of Rohu can be greatly increased by making boneless Rohu in the market.
- Fresh boneless Rohu will capture more market as well as a higher price.
- Different dishes of boneless Rohu and value-added products can attract more customers and can provide a way for entrepreneurship development.
- Whole boneless Rohu masala fry, barbeque fry and value-added products like fish fingers, fish crispy, fish cutlets, fish rolls, fish nuggets, fish samosa, fish sandwich, fish pakora and fish pickle etc. can be prepared from boneless Rohu.
- One demonstration program on boneless Rohu products was conducted by the Odisha-WorldFish project during the 'Balijatra festival' in 2019.
- Whole barbeque Rohu and fish crispy were prepared and sold among the people on a pilot basis.
- One training was conducted on the processing of boneless Rohu for the diploma students of College of Fisheries, OUAT. Another training was also conducted for the staff of the hotel "Bijaya Dhaba", Bhubaneswar.
- In Odisha, many WSHGs are involved in pisciculture. After harvesting Rohu from their pond, they sell the fishes to the local traders at a lower price i.e.Rs.130 to Rs.140/kg. In addition to that to get an extra income, members of WSHG can be involved in processing (removal of pin bones) of boneless Rohu harvested from their pond or purchased from the market. Once, there will be a continuous supply of boneless Rohu to a good hotel, it will fetch a better price for them.
- An individual can take up this boneless Rohu processing to start its enterprise. Directly, hotel staff can also be involved in boneless Rohu processing. The marketing intermediaries linked to the boneless Rohu also can get benefitted.

Boneless rohu barbeque

Boneless rohu masala fry

Sale of Boneless rohu barbeque and crispy in Balijatra, 2019

Training to Diploma students, College of Fisheries, OUAT on Rohu deboning

Training to Bijaya Dhaba staffs on deboning of Rohu

About WorldFish

WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision- making on the critical issues of our times.

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