



Cooperation for Sustainable Development

The 2<sup>nd</sup> International Webinar series of E-Lectures

# Sea Food Technologies: Experiences of Taiwan

Yi-Feng Kao

Fisheries Research Institute,

Council of Agriculture

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# Outline

- Introduction
- The current state of the seafood in Taiwan
  - seafood sources in Taiwan
  - the trade of seafood in Taiwan
  - the GO & NGO of fishery relevance
  - the certifications of seafood product
- The main seafood processing industry in Taiwan
- Seafood processing byproduct utilization
- Summary

# Introduction

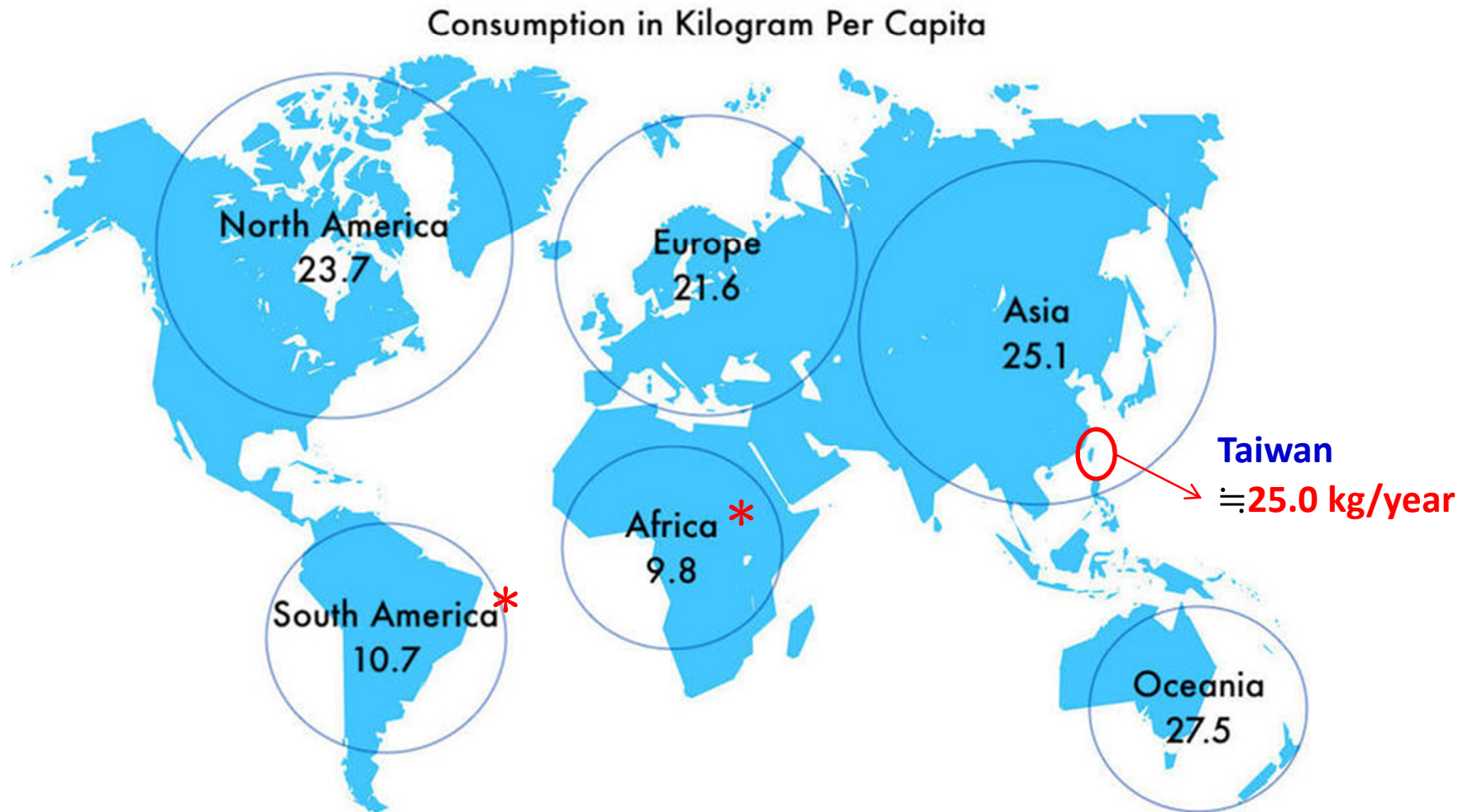


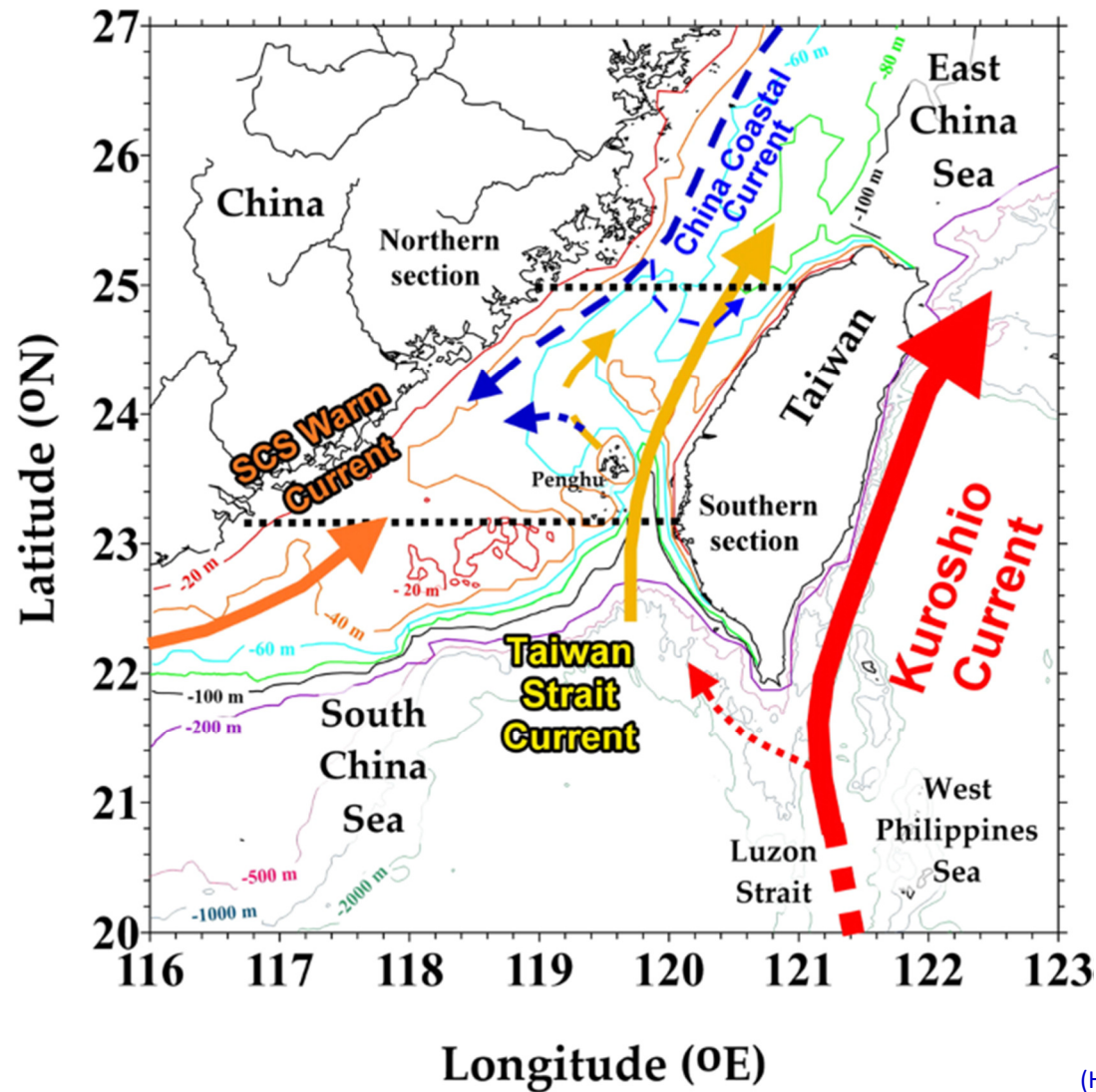
Figure . Fish consumption per capita worldwide in 2019 (Ashraf et al., 2019)

# Geographical location of Taiwan





# The natural environments form excellent habitats for marine fish species



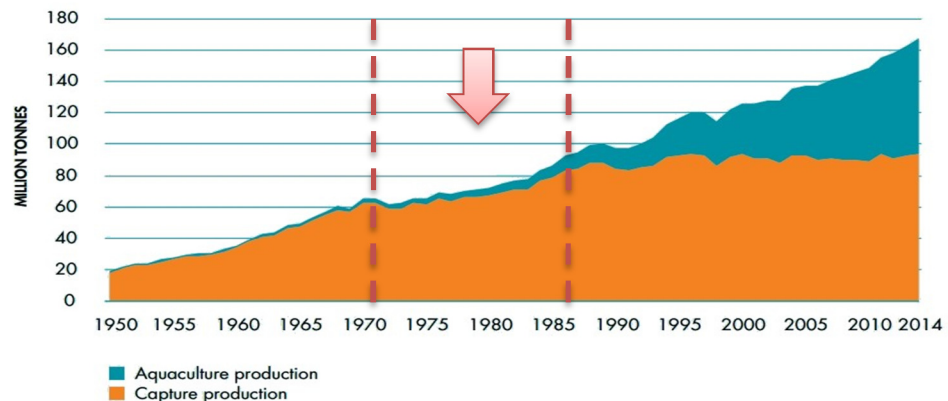
# The seafood processing evolution in Taiwan

- **Before Japanese Colonial Rule (~1895)**
  - there are only simply salting and drying skills, the main product including mullet roe and salted mullet.
- **Under Japanese Colonial Rule (1895~1945)**
  - the Japanese set up factories to produce shark skin, bonito stick, fish soluble and canned seafood in small scale.
  - in 1923, the bonito processing research factory was set up in Keelung at the northernmost tip of Taiwan.
  - in 1929, the Keelung research headquarters (which is the precursor of Fisheries Research Institute) had been established and included the five sections.



- **After the takeover of Taiwan by nationalist government (1945~1967)**
  - the fishery harvest is lessening and the processing industry grows slowly, still mainly produced dried and salted products by domestic factories.
  - the cultivation of seafood processing teachers, human resources, and scientific research talent.
- **Seafood processing growth stage (1968~1987)**
  - the aquaculture production of tiger prawns and eels has increased sharply, and the export of canned seafood has expanded smoothly.
  - rely on the increasing of fishery harvest, the seafood processing industries have shown growth rapidly.
  - the ratio of the trade value on the fishery export accounted for 72% achievement to the highest ever.

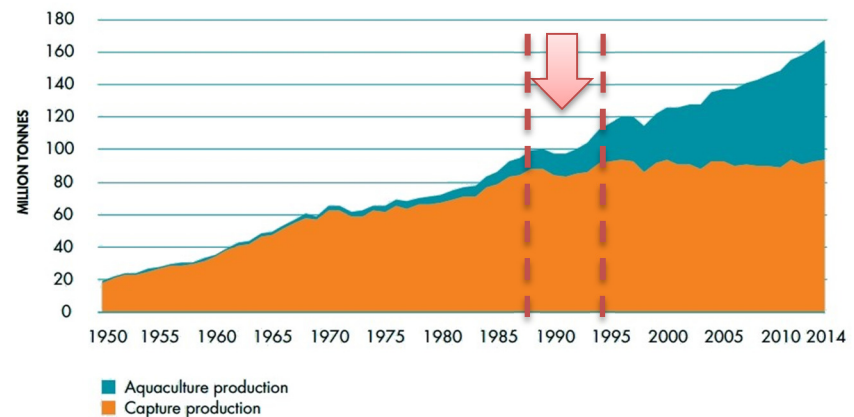
Recovered Taiwan  
By nationalist government



- the specialized manpower inputted into the processing industries, and the seafood relevance research has begun to develop vigorously.
- the quality and hygiene problems on traditional products and export goods have been improved.

➤ **Seafood industrial Recession period (1988~1994)**

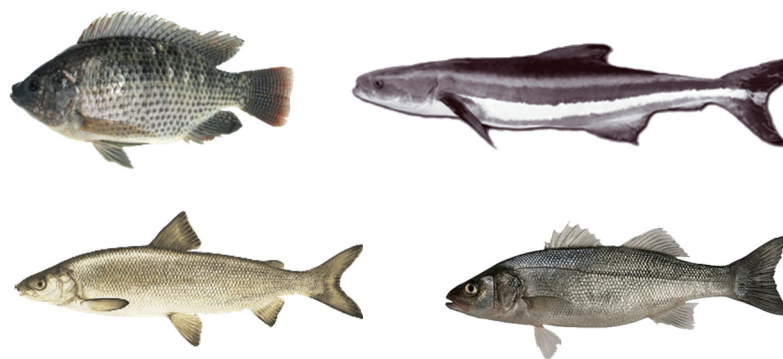
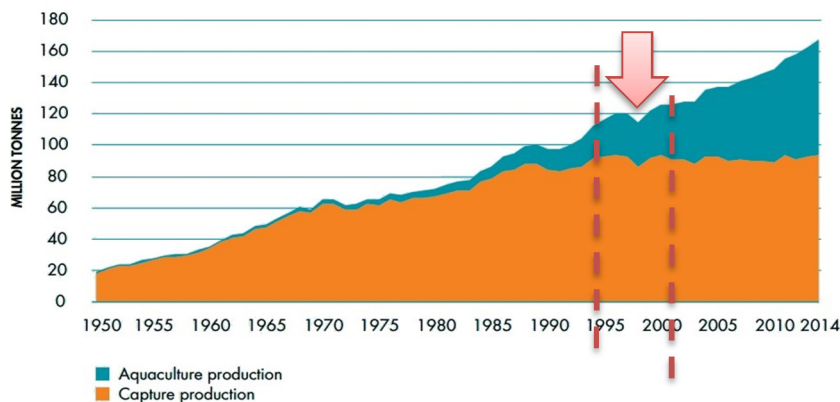
- face the fierce competition from developing countries and domestic wage rising.
- sever shrimp diseases outbreak and the harvest of eel larva decrease.
- investment in education has increased, however the demand for the specialized human resources has become stagnant.





## ➤ Transition period (1995~2001)

- Oversea investment in seafood processing industry had become a trend.
- new aquaculture species began to culture such as tilapia, milkfish, cobia, sea bass, and so on.
- the R&D requires for the new raw materials and products, and the quality control manpower requires have increased.



## ➤ Stable developmental period (2002~present)

- the marine resources of sustainable development goals have been a call for action by all countries.
- research is focused on reducing food loss and waste during the seafood processing stream.
- the seafood processing byproducts were utilized and made into healthcare, medical, and cosmetic products.

# The current state of the main sources of seafood in Taiwan

## ➤ Deep sea fishery-

- using any fishing vessel to conduct fishing in the high seas or in internal waters, territorial seas and the exclusive economic zones of other countries.

## ➤ Coastal and offshore fisheries-

- fishing activity operated within 3~10 nautical miles in the close sea.

## ➤ Aquaculture

- farming of both animals (including crustaceans, finfish and molluscs) and plants (including seaweeds and freshwater macrophytes) occurs in both inland (freshwater) and coastal (brackishwater, seawater) areas.

# The main fishery categories and distributions in Taiwan



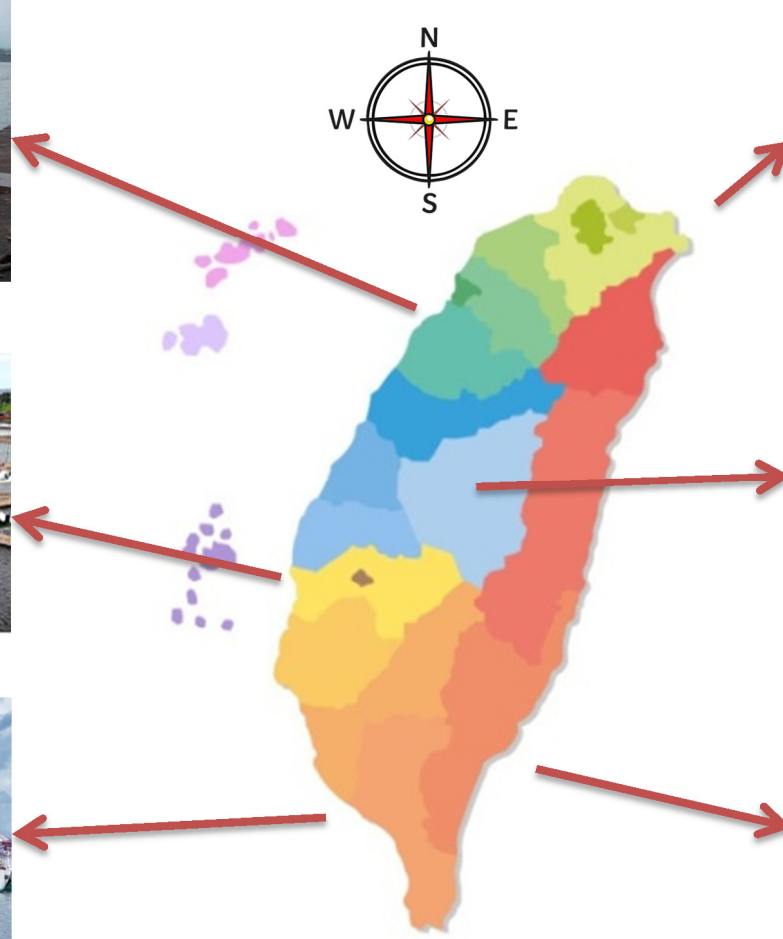
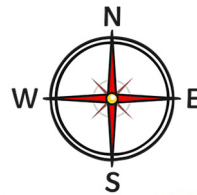
Coastal fishery



Aquaculture fishery



Deep sea fishery



Offshore fishery



Inland fishery



Coastal fishery

# The trend of the fisheries production over the last decade in Taiwan

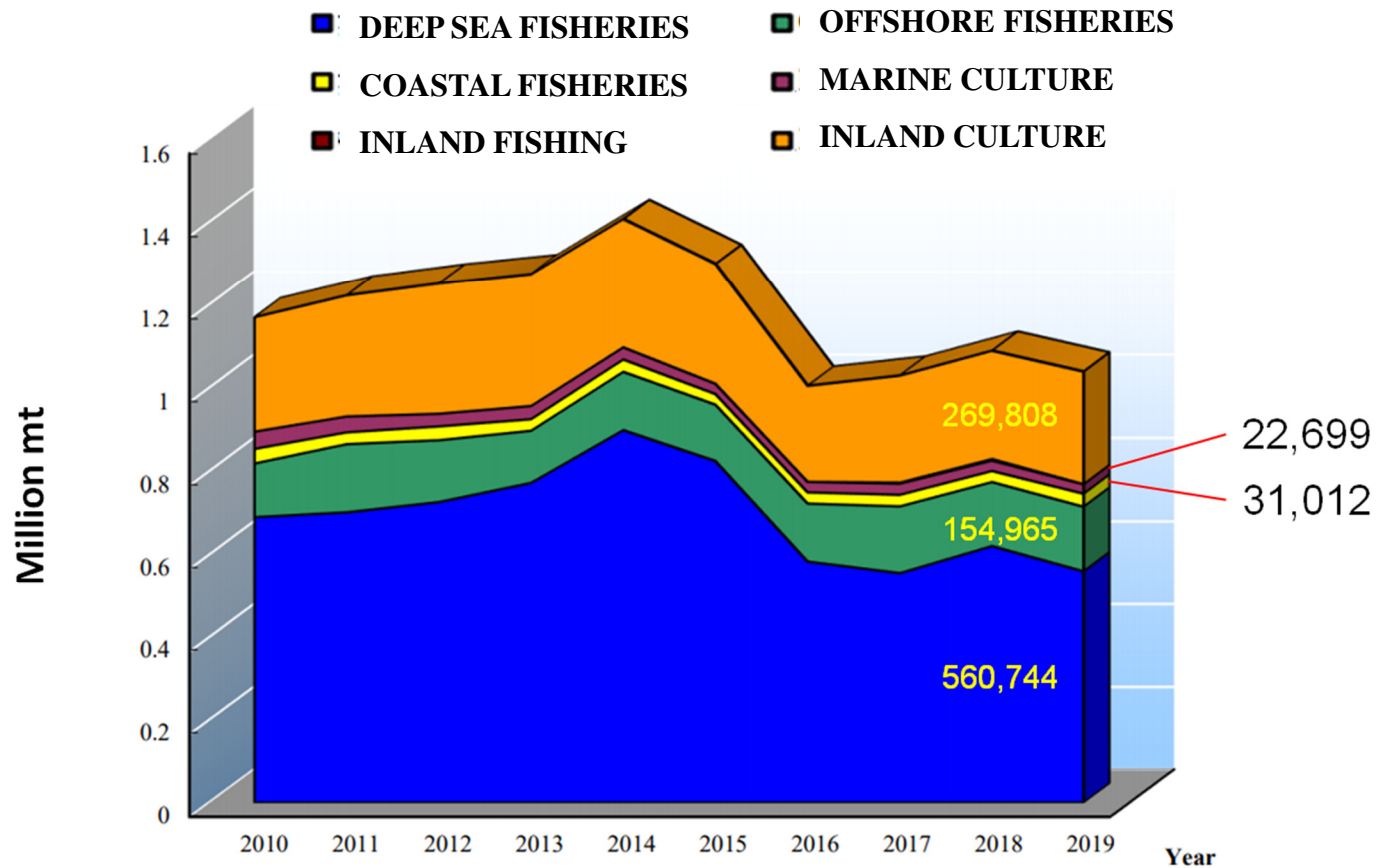
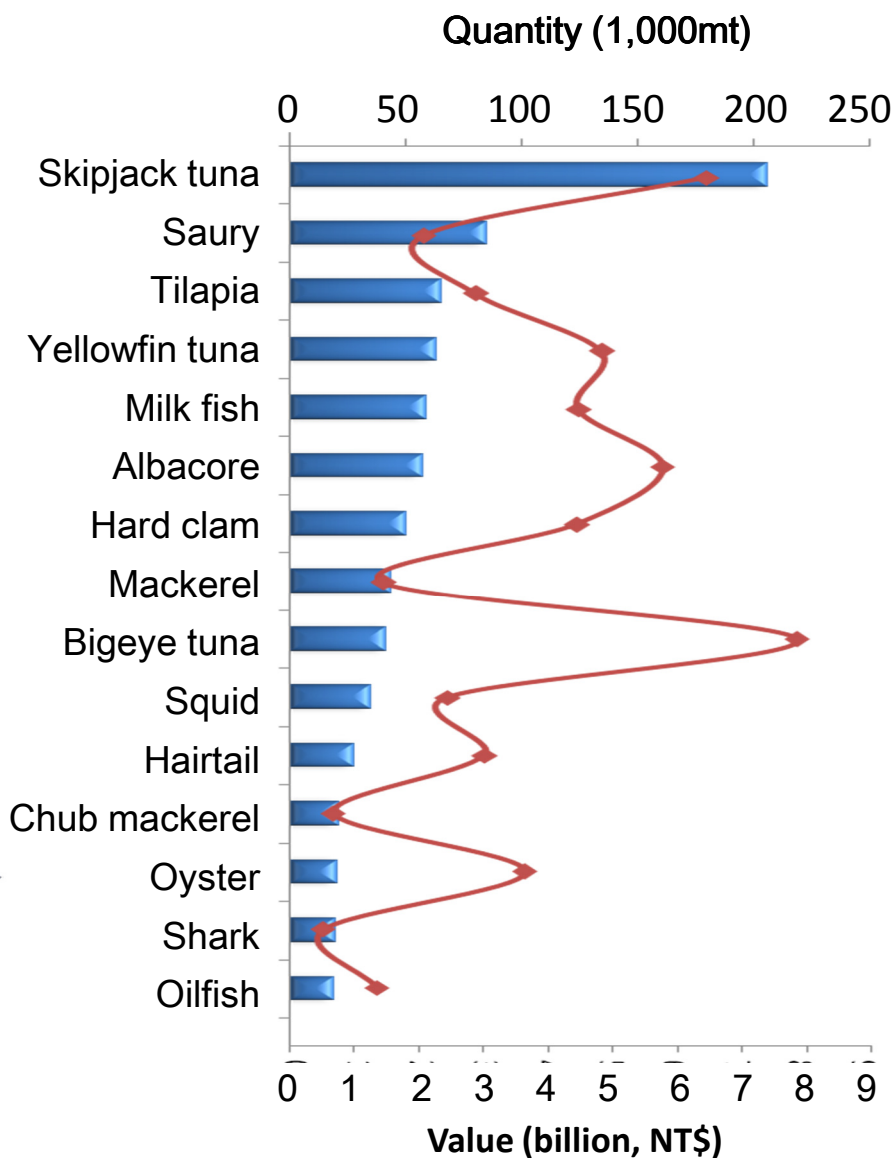


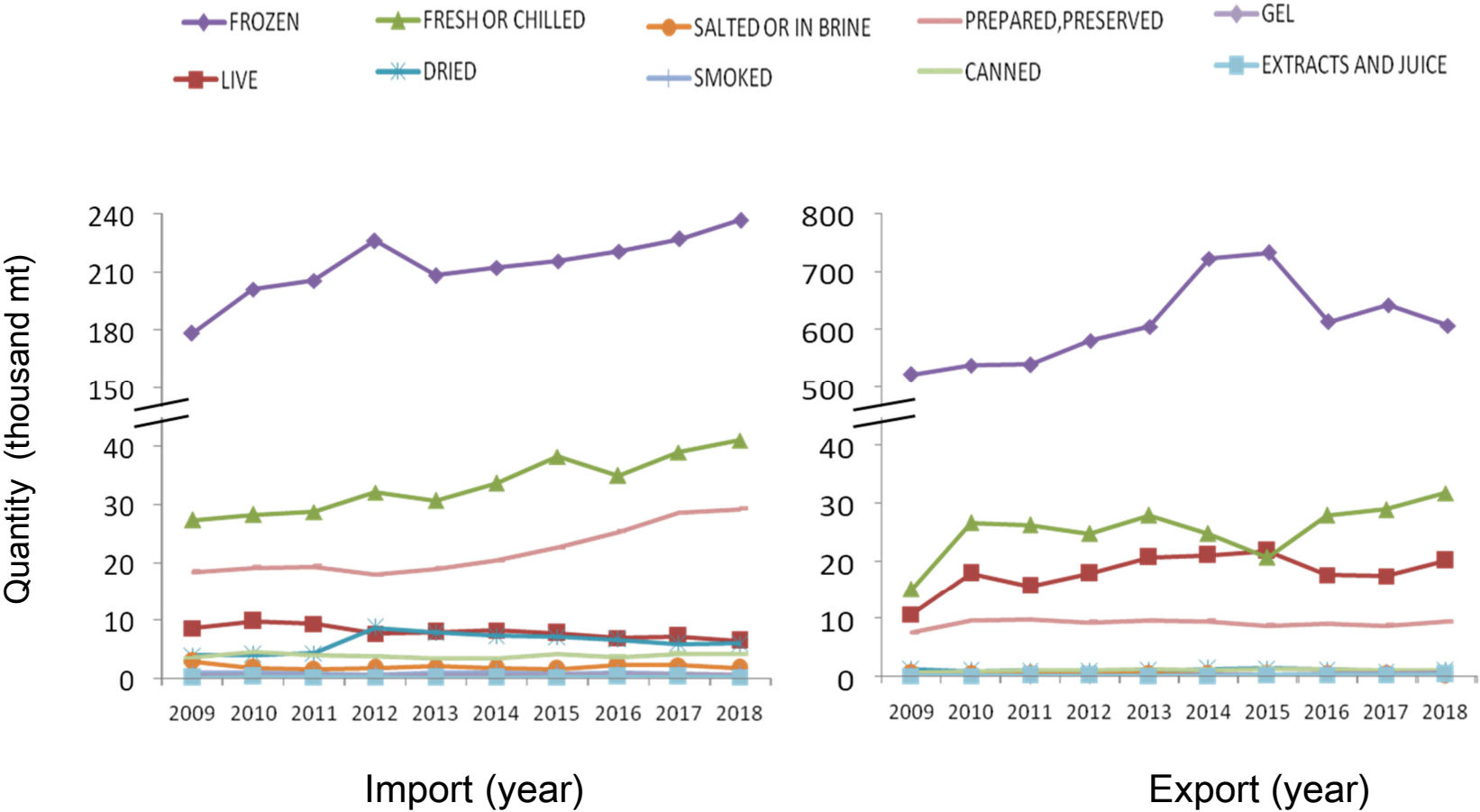
Figure. Fisheries production over the last decade from 2010-2019



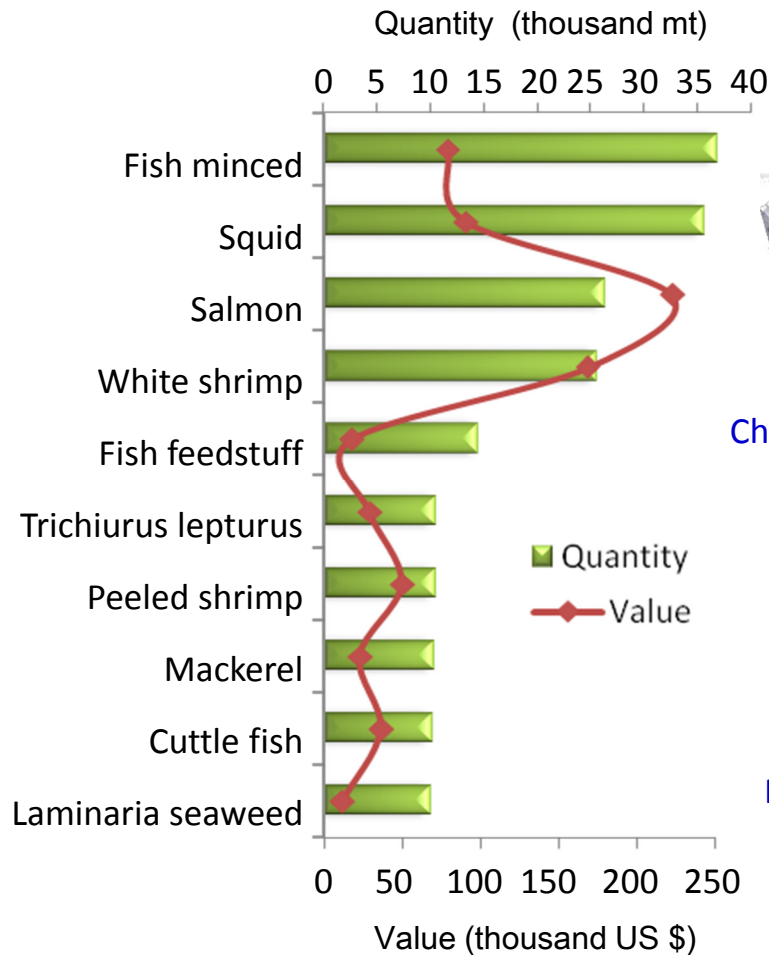
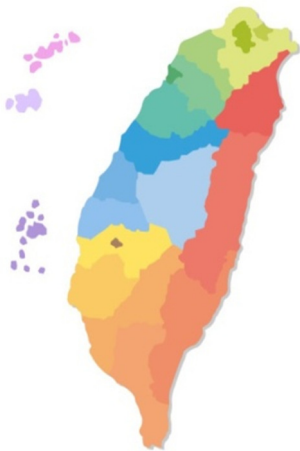
# Major species of the fishery products in Taiwan



# The trade quantities of fishery products in Taiwan



# Import categories and values of fishery products from Taiwan in 2019



Chilled or frozen salmon



Frozen fish minced



Frozen squid

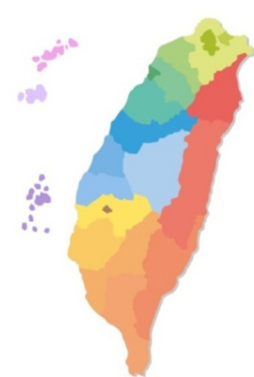
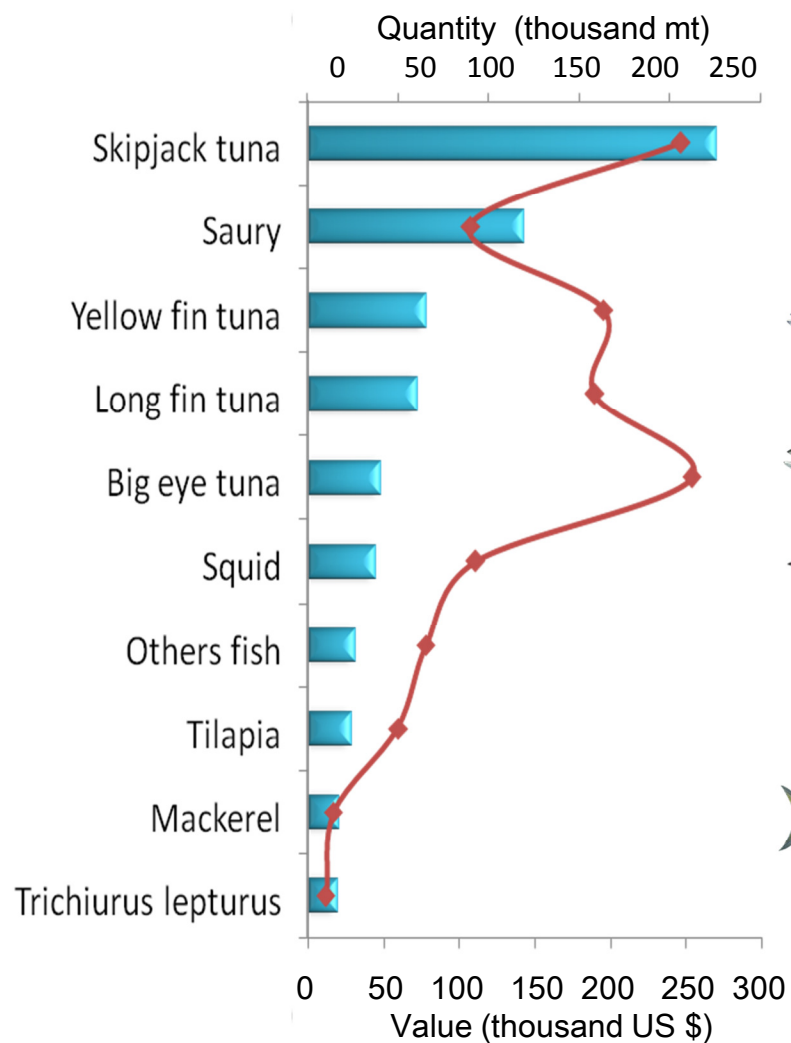


Frozen white shrimp



Fish feed

# Export categories and values of fishery products from Taiwan in 2019





# The categories of seafood processing products by export in Taiwan

1.



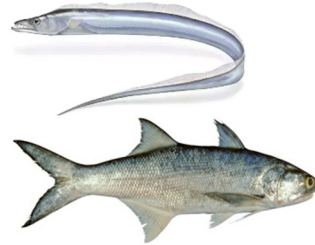
Frozen tuna & saury

2.

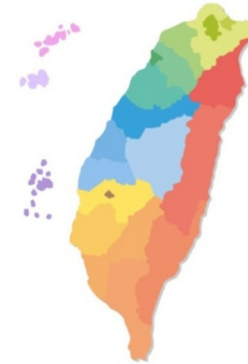


Live eel & grouper

3.



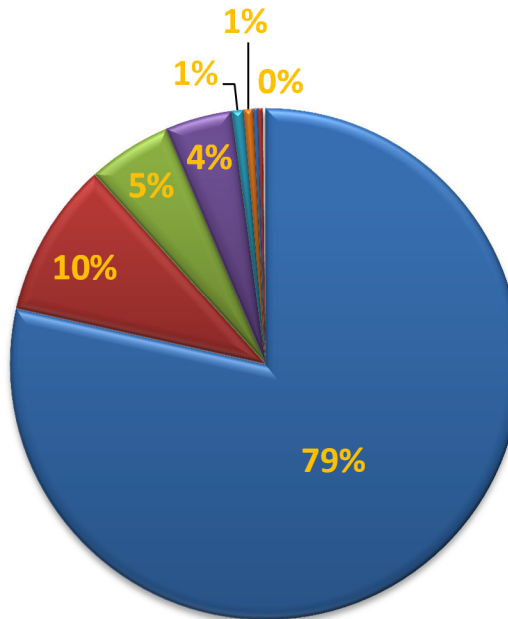
Chilled hairtail & fourfinger threadfin



Prepared surimi products



Dried peeled Shrimp & fish fin



- FROZEN
- LIVE
- FRESH OR CHILLED
- PREPARED, PRESERVED
- DRIED
- CANNED
- EXTRACTS AND JUICE
- SALTED OR IN BRINE
- GEL
- OTH. EDIBLE

# The GO and NGO of fishery relevant in Taiwan



- 1 national headquarter
- 39 district branch

National Fishermen's Association, Taiwan



Fisheries Agency, COA



- 1 headquarter
- 6 district center
- 2 research vessel

Fisheries Research Institute, COA  
General Headquarter

- Marine Fisheries Division
- Aquaculture Division
- Seafood Technology Division
- Planning & Information Division



Freshwater Aquaculture Research Center

Penghu Marine Biology Research Center

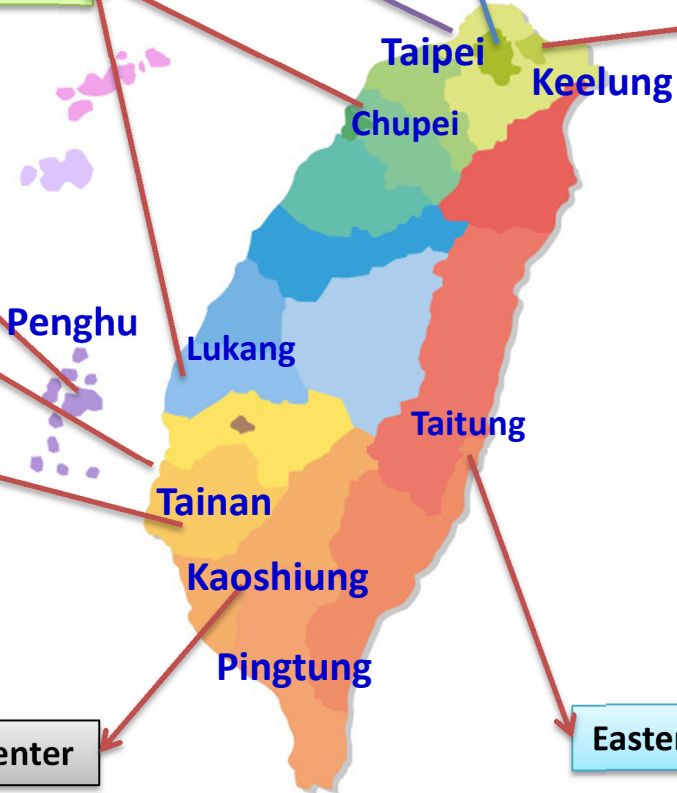
Mariculture Research Center

Coastal and offshore Resources Research Center



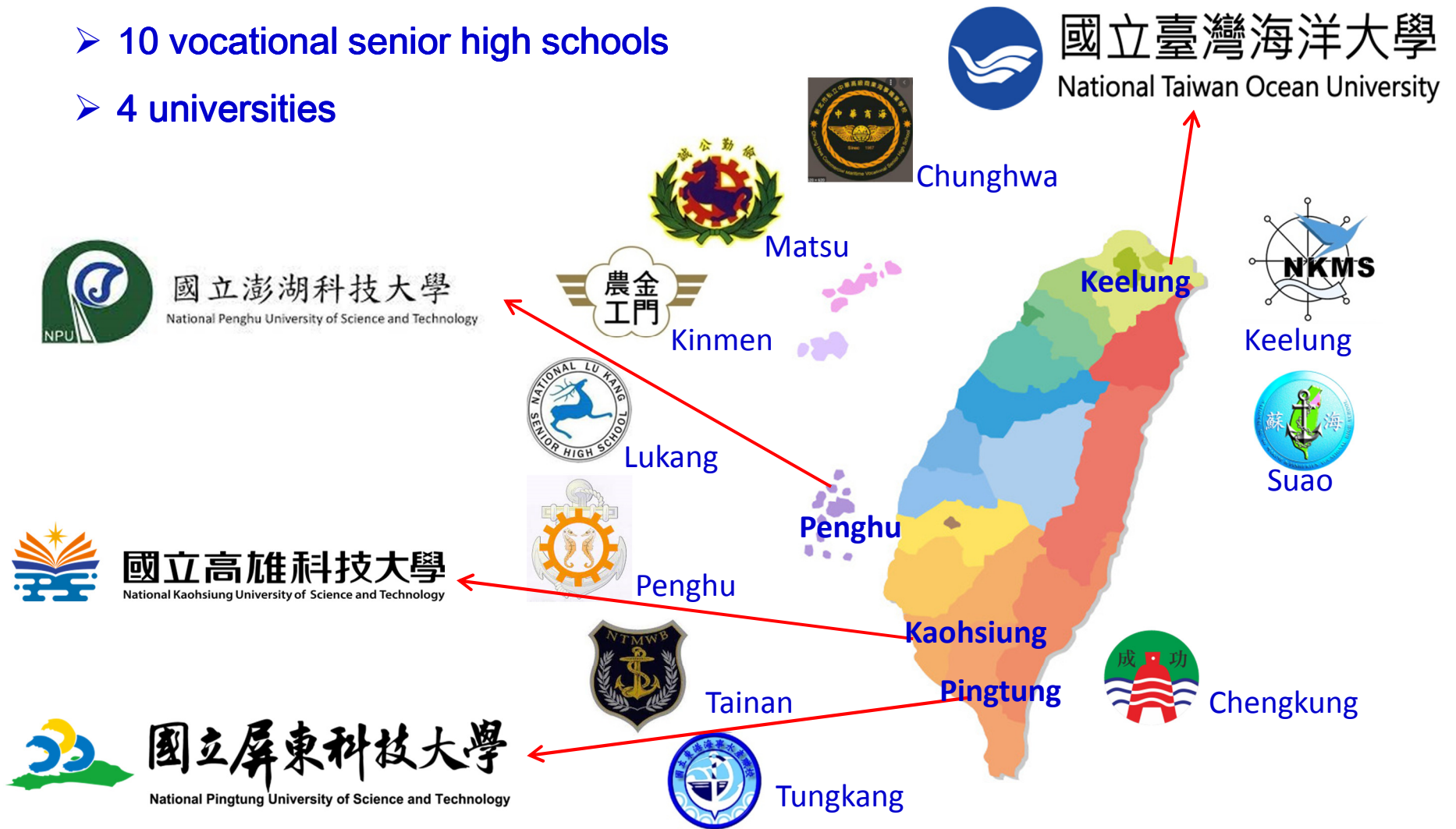
Tungkang Biotechnology Research Center

Eastern Marine Biology Research Center

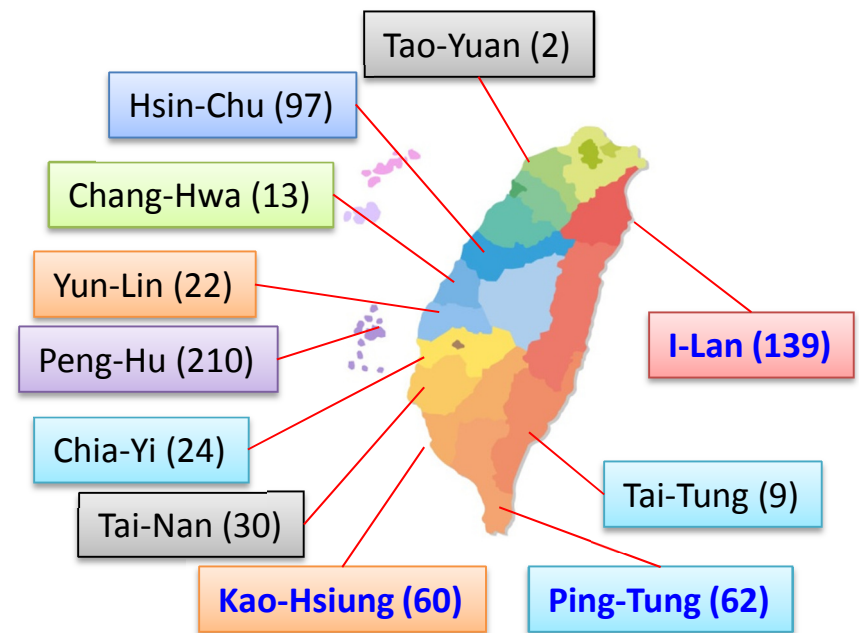
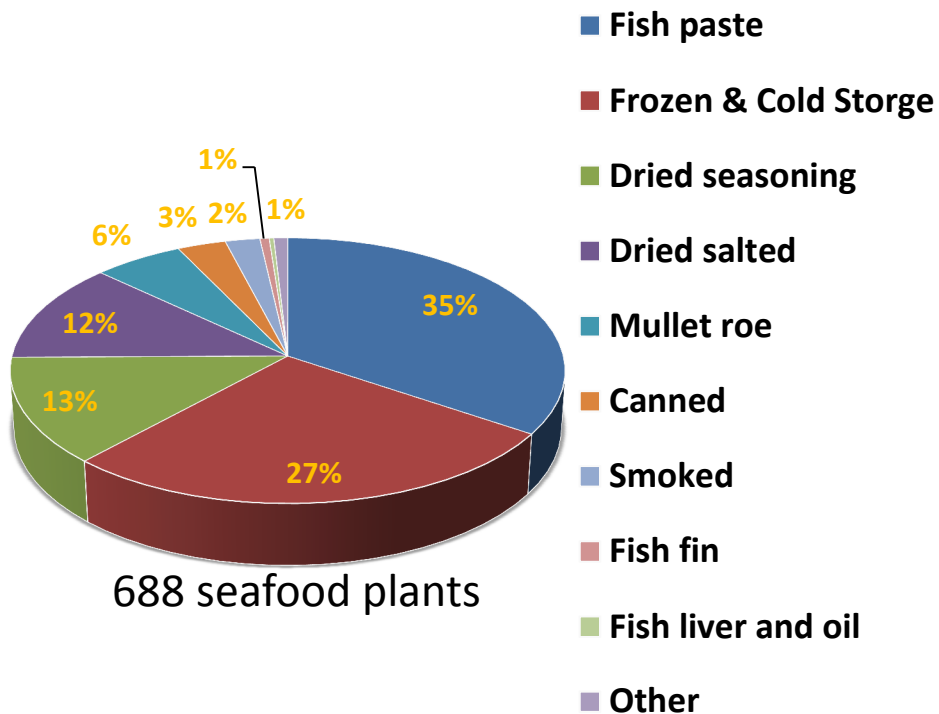


# The represents of educational Institute on the seafood relevant in Taiwan

- 10 vocational senior high schools
- 4 universities



# The categories & distribution of seafood industries in Taiwan





# The main certificate on the seafood production

- HACCP (Hazard Analysis and Critical Control Point)
- CAS (Certified Agricultural Standards)
- TQF (Taiwan Quality Food Association)
- TAP (Traceable Agricultural Products)
- ISO22000
- Halal Certification



# Current status of various seafood processing industry in Taiwan

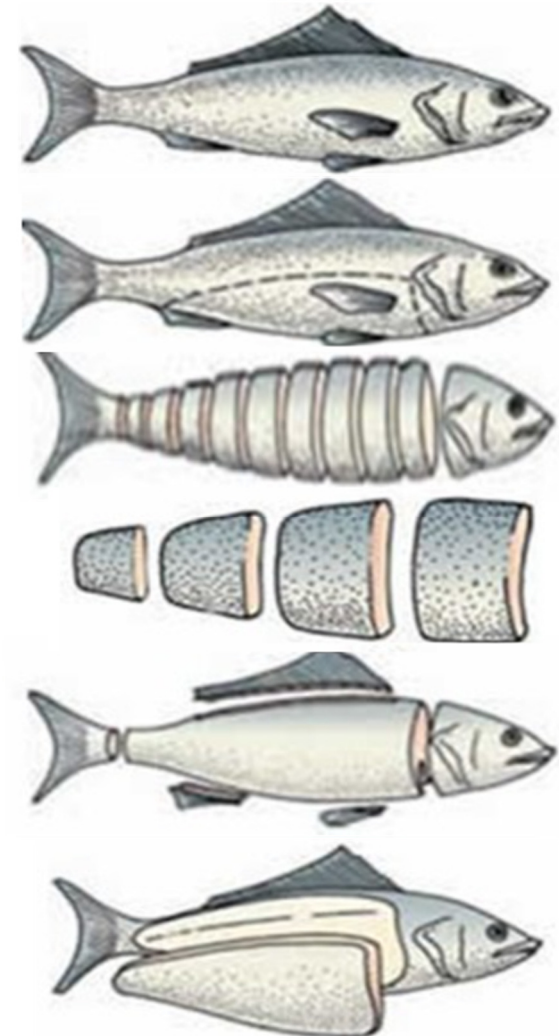
- Frozen Seafood Industry
- Canned seafood Industry
- Surimi Industry
- Cured & dried seafood industry
- Other marine resources and byproducts

# Seafood pre-treatment before processing

- Raw material pre-treatment
  - cleaning
  - sorting
  - grading
- Pre-cooling
- Freezing
- Post-frozen treatment
- storage

# Typical commercial specifications of the fishery product pretreatments

- **Whole or round:** completely intact, as caught
- **Drawn:** viscera removed
- **Steaks:** cross-section slices, each containing a section of backbone
- **Fillet:** boneless sides of fish with skin on or off
- **Dressed:** viscera, scales, head, tail, and fins removed.
- **Sticks:** cross section of fillets



# Frozen seafood

- The goal in freezing seafood is to bring the center of the product to a temperature of 0°F or lower as quickly as possible.
- The texture and taste of quickly frozen fresh seafood is nearly the same as fresh.
- Frozen-at-sea product is of much better quality than “fresh” fish that has been in a boat’s refrigerated hold for over a week.
- When seafood is frozen and stored at appropriately low temperatures (at least minus 10°F), bacterial growth is arrested, preserving the product and dramatically extending shelf life.

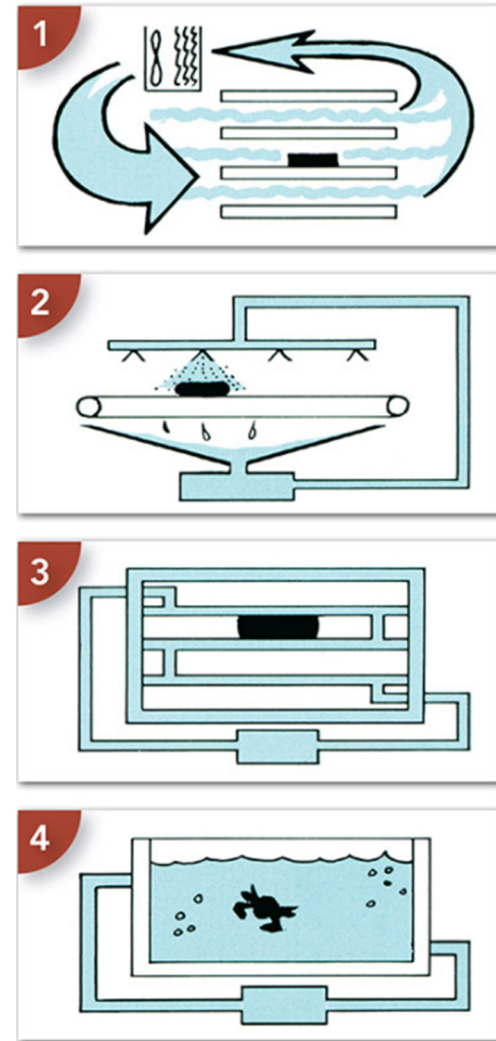


# The history of frozen seafood industry in Taiwan

- The frozen seafood industries were initiated in Taiwan in 1960s.
- The fisheries harvests were usually sorting, grading, cleaning and freezing in the harbor directly.
- In 1964, some of the ice manufacturer established the fish processing plants by using the simply freezing chamber.
- In the early stage, the freezing fillet and peeled shrimp were the major commodities for exports.
- With the advance of science, more and more various types of frozen technologies have been developed.

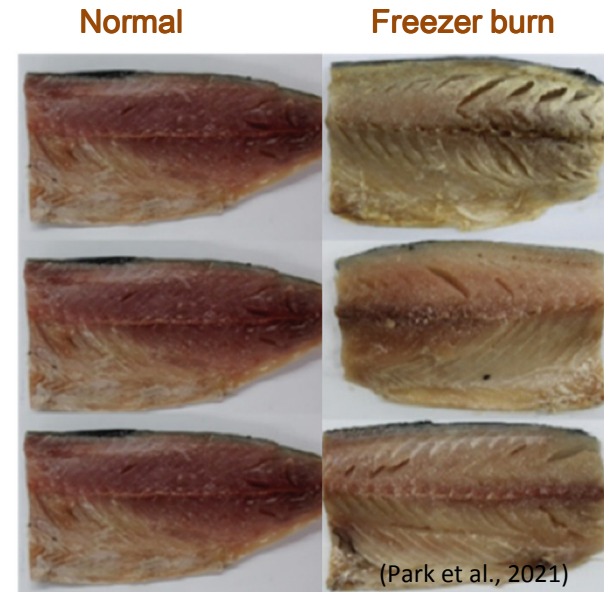
# Typical freezing types

- Air blast Freezing
- Cryogenic freezing
- Contact freezing
- Immersion freezing
- IQF-individual freezing



# Common problems of frozen seafood

- Rusting and Freezer burn
- Brown meat
- Green meat
- Sponging
- Protein denaturation
- Dehydration
- others



**Mackerel fillet**



**Tuna steak**

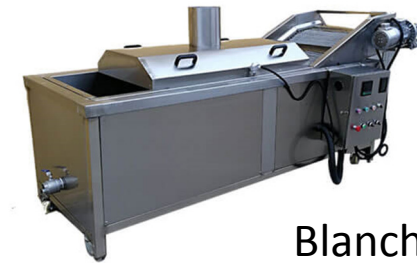
# Evolution of the canning industry in Taiwan

- In the 1980, there were about 200 canning factories in Taiwan and the canned products included meat, vegetable, fruit, bean, and seafood.
- At present, there are about 20 seafood canning factories, mostly located in Yi-Lan, the northern Taiwan.
- Recently, due to the price of the seafood materials are enhanced, the processing wages are rising, and the production cost is relatively higher.
- The export market is gradually being replaced by developing countries.

# Canning general process



Washing



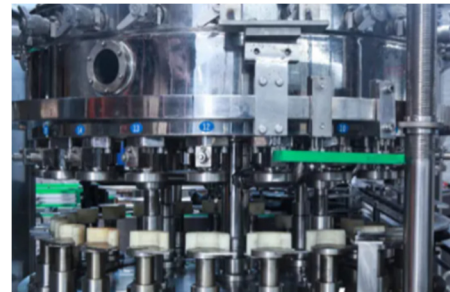
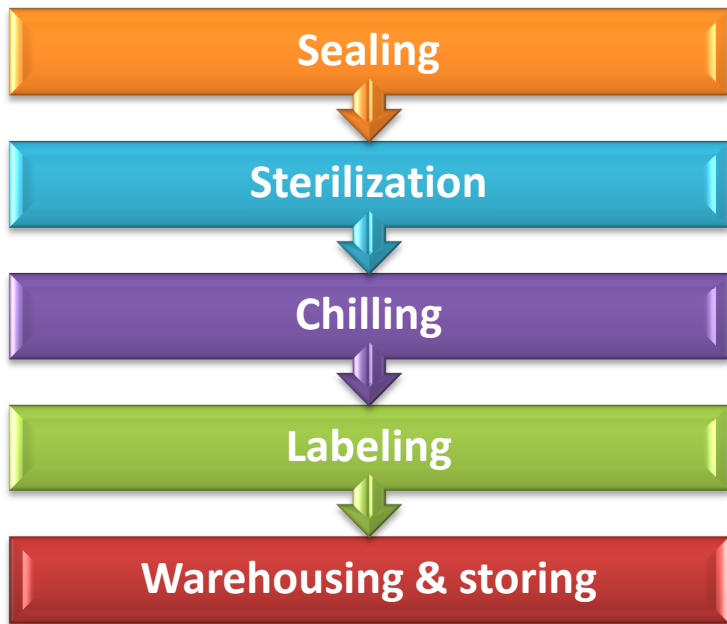
Blanching



Exhausting



# Canning processing



Sealing



Sterilization



Cooling



Seasoning mackerel



Seasoning eel



Tuna in oil

# Common problems of the canned food

## ➤ Microorganism

- pre-process spoilage, under processing, cooling problem, and leakage through seams

## ➤ Physical changes

- faulty technique in retort operation, under-exhausting, over-filling, damage the panel

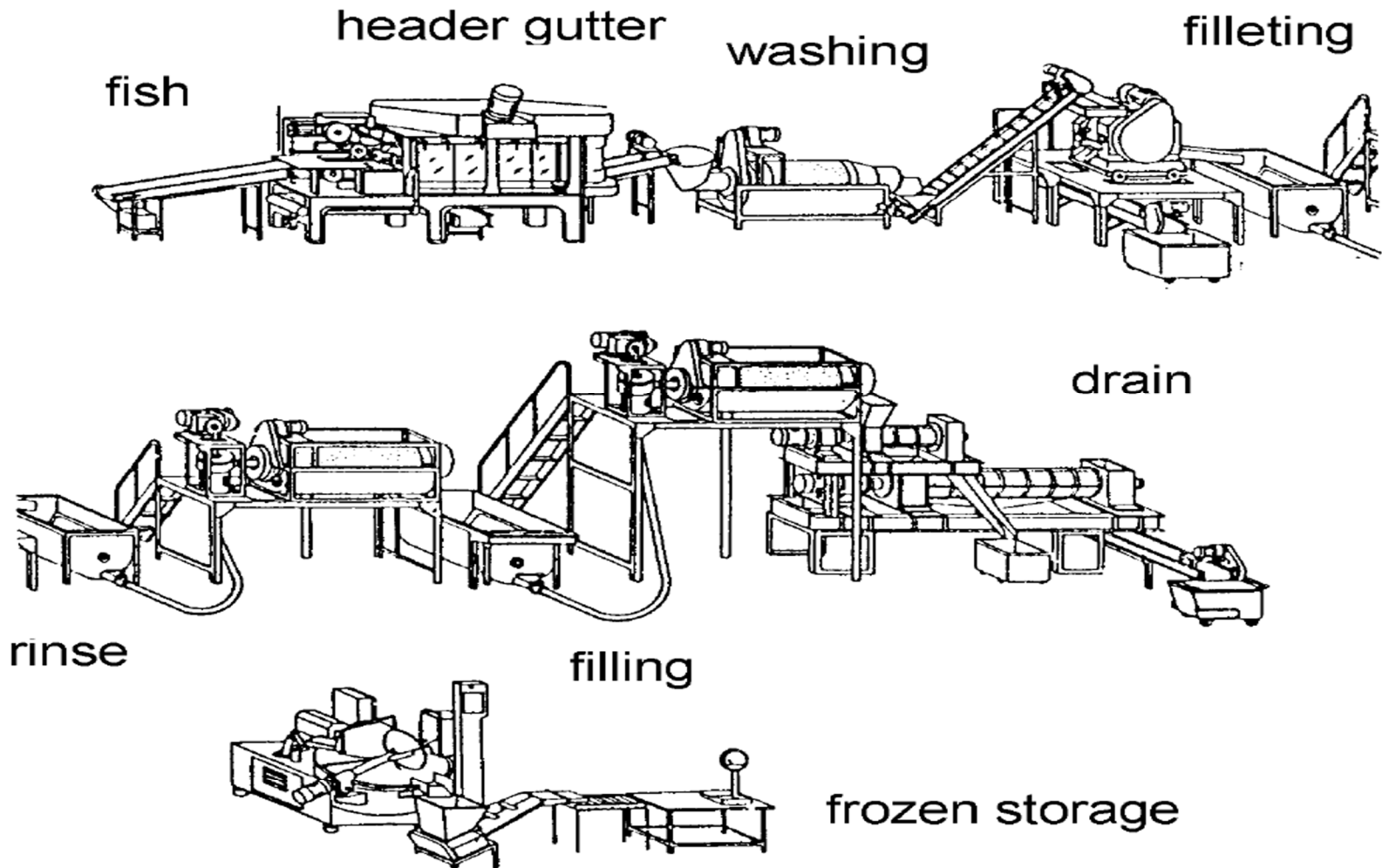
## ➤ Chemical changes

- corrosion, decompose, discoloration, off-flavor, struvite crystals, curd meat, and adhesion meat

# Fish surimi technology

- Surimi can be defined as deboned, minced, and washed fish flesh usually from white-muscle fish.
- It should be washed with chilled water repeatedly for the removal of sarcoplasmic proteins and other unwanted components that may promote protein denaturation during frozen storage.
- Surimi products are made as the various preparation of imitation seafood.

# Typical surimi production

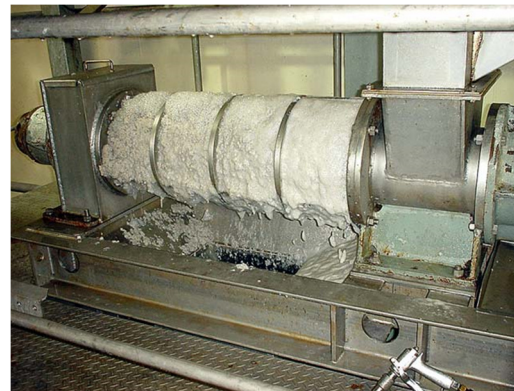


Typical surimi products processing ( Lanier and Lee, 1992 )

# Fish paste processing



Bleaching machine



Fine filter



Blending



# Various of surimi products



Frozen fish mince

Thawing

Forming

Cooling



Blending

Heating

Packaging



Imitation shrimp



Fish ball



Fish cake



Imitation crab stick



Fish tempura



Chikuwa

# Traditional chikuwa manufacturing procedure



**Thawing**



**Kneading**



**Manual shaping**



**Air dry**



**Product**



**Cooling**



**Rolling**



**Roasting**

# Cured and dried Seafood

- In order to prevent the growth of microorganisms, autolysis, spoilage, and can extend the shelf life of seafood.
- Cured or dried seafood products are those in which preservation is achieved by reducing moisture content and /or reducing water activity. •
- Common treating methods are including drying directly, salting, fermenting and smoking.

# Cured and Dried Seafood

- **Un-prepared dried seafood**
  - dried squid, dried shark fin, dried halibut
- **Boiled dried seafood**
  - dried clove fish, dried peeled shrimp, dried squid
- **Salted dried seafood**
  - mullet roe, salted cod, cod roe
- **Smoked dried seafood**
  - bonito stick or bonito flake
- **Freeze dried seafood**
  - freeze dried mussels, shrimp, salmon
- **Seasoned dried seafood**
  - dried shredded squid, fish floss, fish candy

# Plain (un-prepared) dried seafood

➤ Those seafood are made by directly drying fresh raw materials.



**Dried squid**



**Dried conger eel**



**Dried flat fish fillet**



**Dried shark fin**



# Boiled dried seafood

- The raw materials are first cooked in fresh water or salt water products made by further drying.



**Dried scallop**



**Dried shrimp**



**Dried white bait**



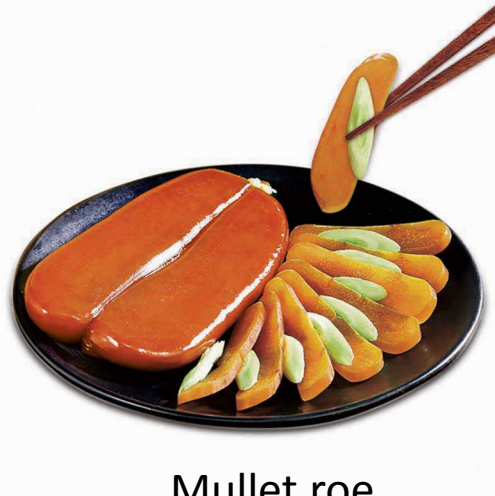
**Dried abalone**



**Dried sea cucumber**

# Salted dried seafood

➤ Salting is one of the oldest food preservation methods



Mullet roe



Salted cod



Cod roe



Salmon roe



Semi-dried fish

# Smoked dried seafood

- Bonito stick (Japanese naming Katsuobushi) is dried, fermented, and smoked skipjack tuna product.
- Shaved bonito stick as flakes are the main ingredients of stock that forms the basis of many soups and sauces.



**Bonito stick**



**Bonito flakes**



**Bonito flakes**



# Freeze dried seafood

- This kind of food usually appear on the brewing instant noodle or some health food for pet.



Green lipped mussel



Freeze dried shrimp

# Seasoned dried seafood



Fish floss



Dried shredded squid



Dried Tuna Tidbit

# Sustainable Development Goals

## -Reducing the Seafood Loss and Waste



1 NO POVERTY



2 ZERO HUNGER



3 GOOD HEALTH AND WELL-BEING



4 QUALITY EDUCATION



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



7 AFFORDABLE AND CLEAN ENERGY



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND



16 PEACE, JUSTICE AND STRONG INSTITUTIONS



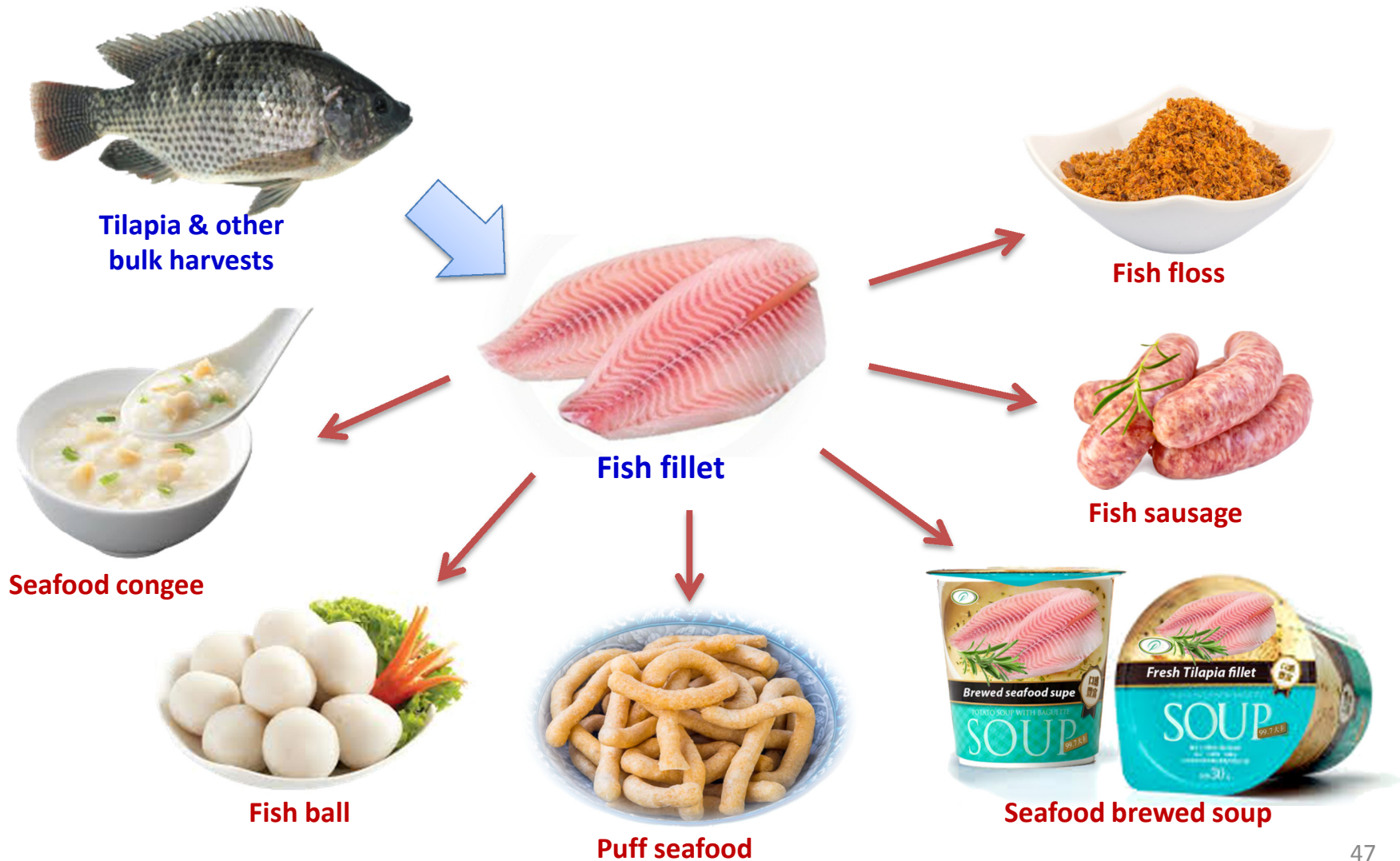
17 PARTNERSHIPS FOR THE GOALS





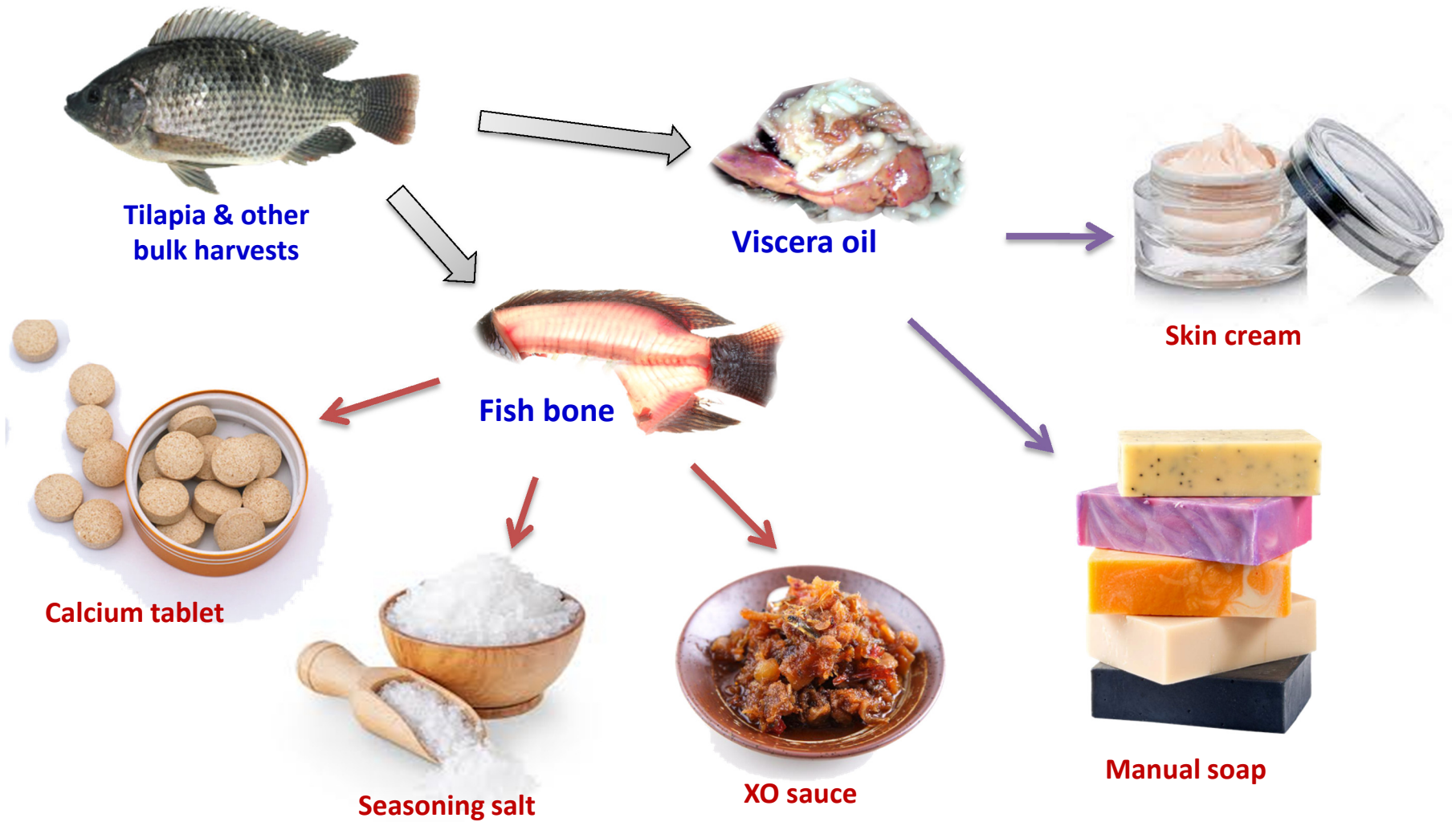
# Technologies for use of the whole fish

## -fillet processing

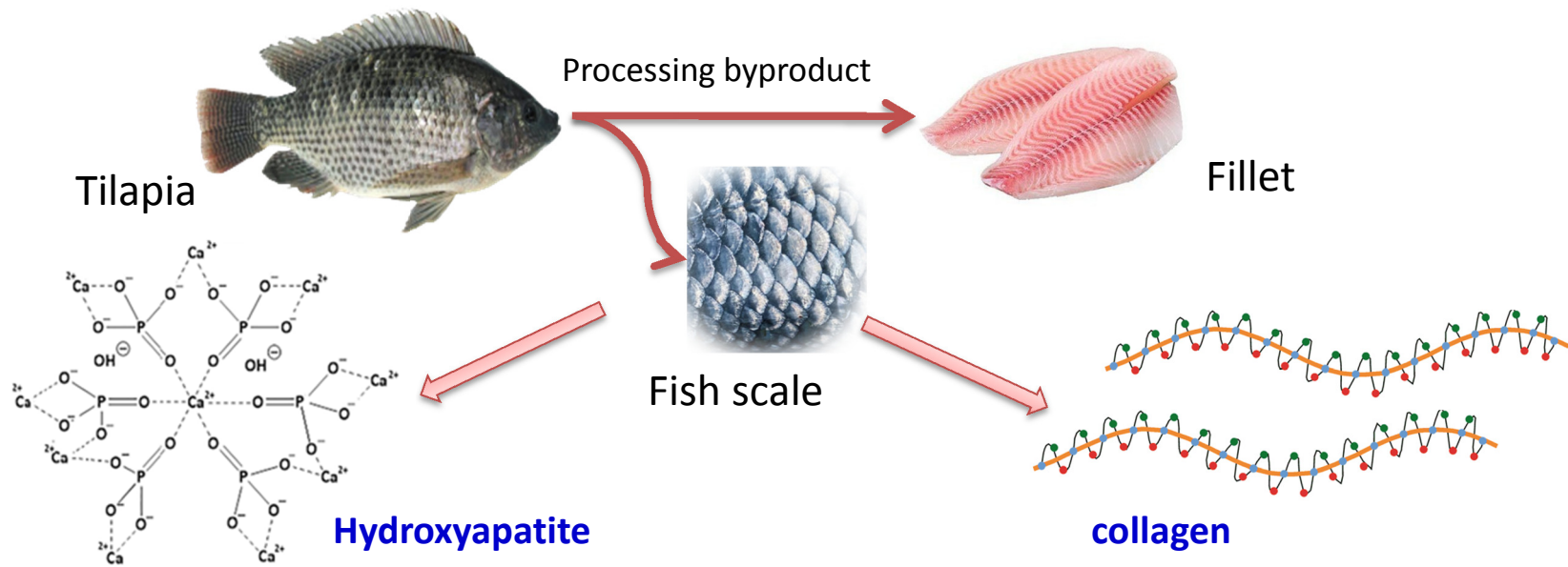


# Technologies for use of the whole fish

## -Viscera & bone



# The collagen & hydroxyapatite of fish scale have been made into various health and cosmetic products



**Toothpaste**



**Bone health food**



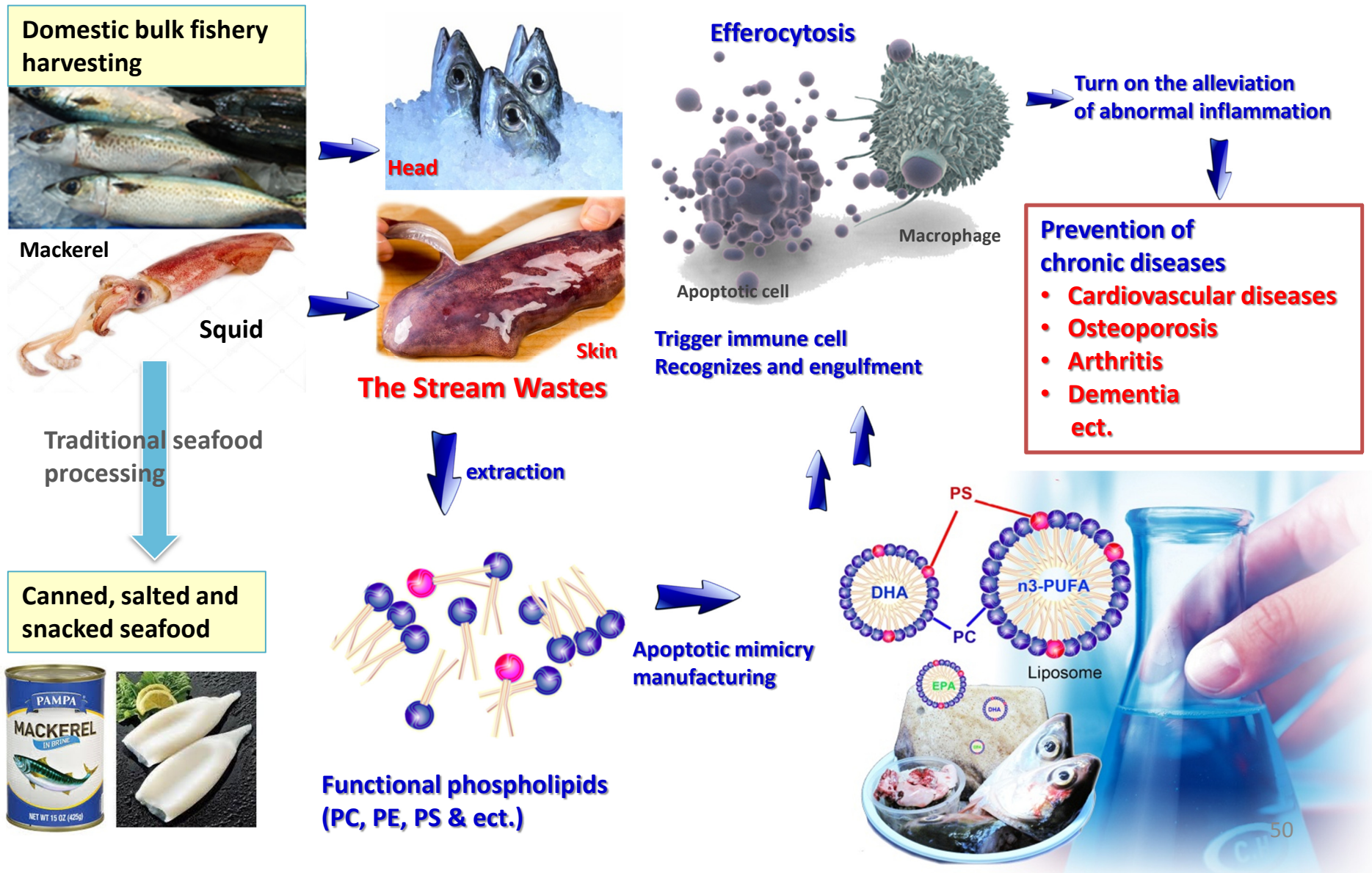
**Cosmetic**



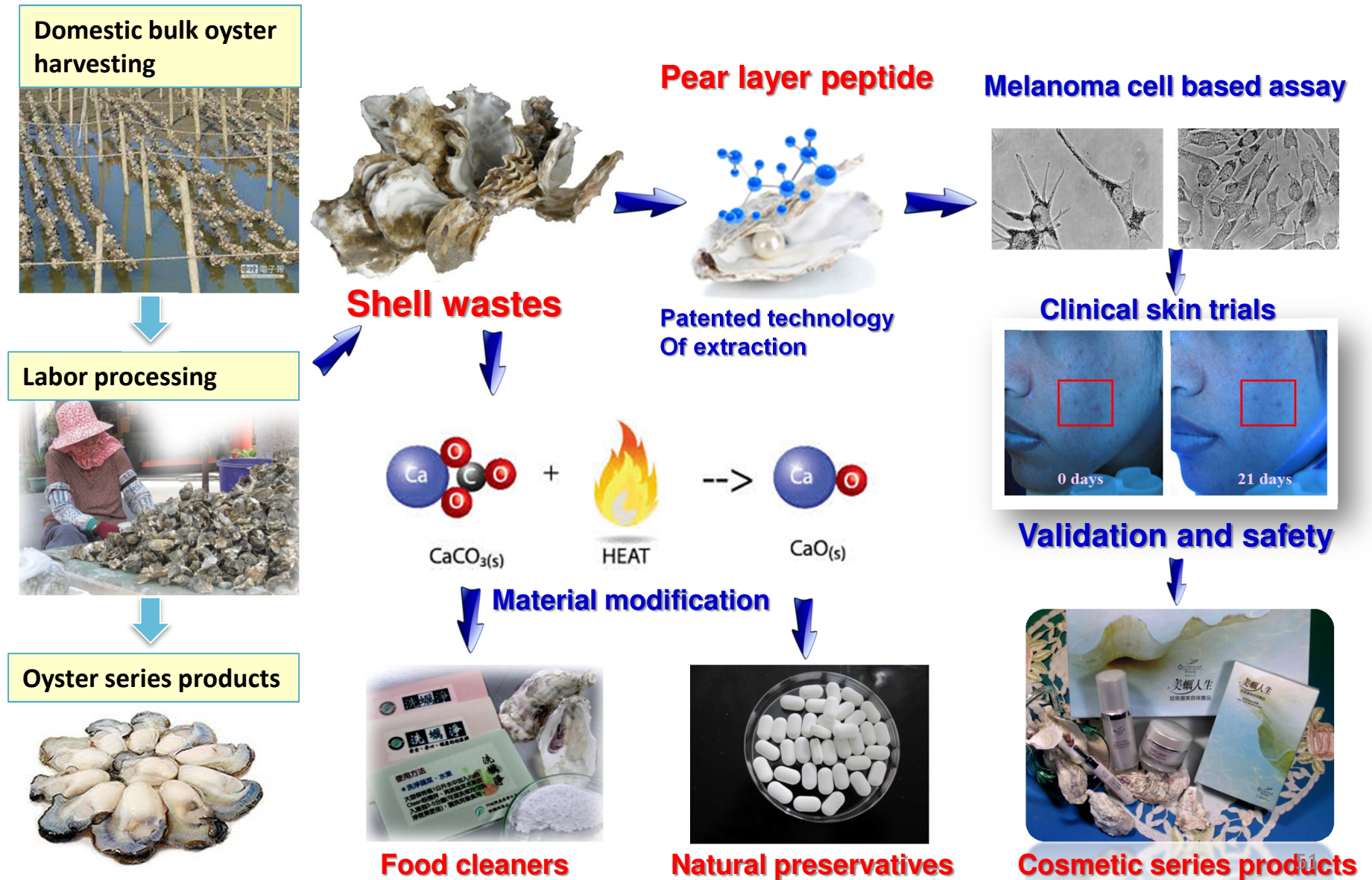
**Beverage & Tablets**



# The phospholipids extract from squid skin shows anti-inflammatory effects



# Application of oyster shell on cosmetic & food preservation



# Summary

- Stable seafood of raw material supply
- Improve the quality and hygiene of seafood products
- Strengthen quality control, inspection and management from farm to table.
- Expand the international market and open up the domestic market.
- Develop science and technology to improve marine processing level.
- Reduce the seafood loss and waste during processing streams.
- Diversified utilization of seafood byproduct, especially on healthcare and medical product development.



**Thank you for your attention**



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