Ministry of Food Processing Industries
Government of India

NIFTEM
Knowledge. Innovation. Outreach

MARINE PROCESSING AND VALUE ADDITION

AATMANIRBHAR BHARAT

PM Formalisation of Micro Food Processing Enterprises (PM FME Scheme)

WHY SEAFOODS ?

Availability

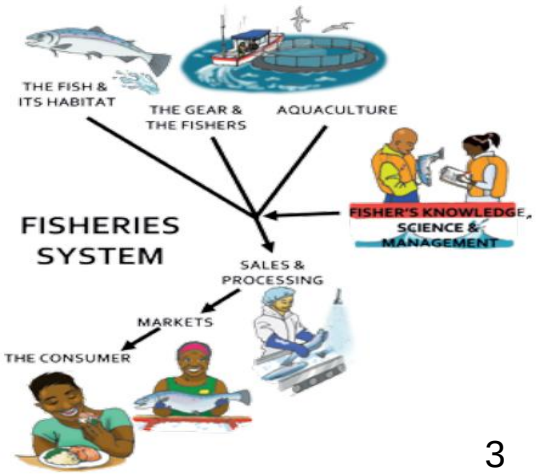
Quality and safety

Accessibility

Nutritional

- Seafood – globally a major food commodity
  - 20% of the average per capita intake of animal protein
  - More than 3.1 billion people consume globally
  - Excellent nutritive value: high digestibility and essential amino acids, PUFA especially omega-3 fatty acids, minerals and vitamins
  - Fish flesh: 60-84% water, 15-24% protein, 0.1-22% fat and 1-2% minerals

- The major problem - seafood preservation and its marketing:
  - Catch uncertainity
  - High perishability
  - Bulkiness of material
  - High heterogeneity
  - High storage and transportation cost
- Relevance for an effective handling, processing and marketing technology to deliver it to the customers in its prime quality



SEAFOOD MARKETING

- Technology & Value addition are key to market seafood
- Fish being highly perishable, proper technology to be adopted to process and preserve it
- Value addition will increase the diversity of products - improved value and consumer acceptability
- Wide scope of improving marketing in both domestic and export market by adopting proper technology and value addition

INDIA'S SEAFOOD MARKET: EXPANDING FOOD HUB

- Fourth biggest seafood exporter in the world, with exports of marine products worth to about USD 7 billion
- FAO projections: increase in the demand for seafood products
- Average per capita consumption - projected to be upto 25 kg/year in 2030
- The net supply to increase by 1.6 million tonnes (Mt)
- India have huge potential for value addition and product development, especially ready-to-eat/ ready-to-cook (RTE/RTC) products for the domestic as well as export market

RELEVANCE OF SEAFOOD PROCESSING AND PRESERVATION

- Extends shelf life of the product
- Improves palatability and sensory properties
- Maintains or improves nutritive properties
- Ensures safety
- Increases convenience
- Enhances the economic value of food

PROCESSING TECHNOLOGIES

- ✓ Simple preservation practices like chilling or icing, drying to most recent and advanced high pressure, electromagnetic field applications
- ✓ Based on the technology, shelf life extends from few days to extended shelf life of up to few years
- ✓ Low cost to highly cost intensive technologies are practiced

SEAFOOD PROCESSING TECHNOLOGIES

Thermal processing

- Retort processing
- Aseptic packaging
- Baking
- Frying
- Ohmic heating
- Microwave
- Radio frequency
- Infrared
- Drying
- Extrusion

Non thermal processing

- Chilling
- Freezing
- Freeze drying
- High pressure processing (HPP)
- Pulsed electric field (PEF)
- Pulsed Light (PL)
- Ultrasound
- Oscillating magnetic field
- Ozone
- Irradiation
- Gas, cold plasma

Aims to delay, lessen or hinder spoilage on account of chemical, enzymatic or microbial causes by controlling the storage temperature, maintaining proper water activity, proper pH, use of preservatives, alone or in combination

Value addition

- Any additional activity that in one way or the other changes the nature of product thus adding to its value at the time of marketing

Multiple formats/shapes/dimensions/flavour/texture profiles

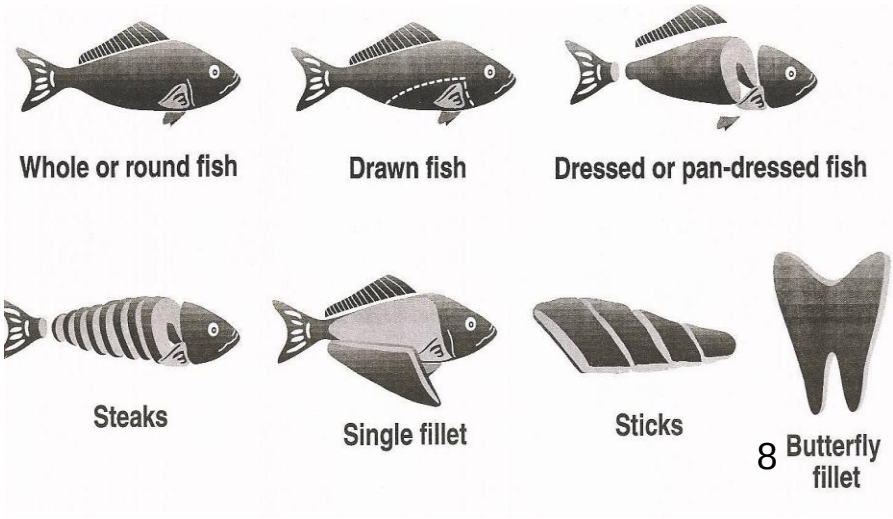
An innovative product

A new package

Ecolabelling

- For better income
- For improved processing utilization
- To keep in-phase with consumers needs
- To provide variety of products

Market forms of fin fish



CHILLING

- A low temperature preservation where temperature of the fish is lowered to a point near freezing (0 to 2^{o}C)
- Different chilling methods
  - ✓ Chilling with ice
  - ✓ Air chilling
  - ✓ Using chilled water- Refrigerated sea water (RSW), Chilled sea water (CSW)
  - ✓ Using dry ice (solid carbon dioxide), liquid nitrogen, cold ammonia or other refrigerants, etc.
- Icing of fish - most common - simple technique
- Icing - a thumb rule (1:1 (w/w) fish to ice) layering with good and fine quality ice
- Shelf life: varies - based on species - few days to upto one month
- Generally, fresh water, lean, tropical fishes have better stability than their counterparts

CHILLED PRODUCTS

- Common value added item of domestic importance as well as in foreign trade
- International seafood sector - sashimi/sushi grade tuna, which is raw fish fillets from tuna
- Domestic market - retail - especially among the urban entities - ready to cook/fry forms
  - ✓ Dressed fish/shrimps: steaks, fillets, butterfly style etc.
  - ✓ Mince/surimi based products: coated products, analogues etc.
  - ✓ Marinated seafoods
- Chilled products - air packed/vacuum packed - few days to months - depending on the raw material, ingredient composition etc.



FREEZING

- Freezing involves the conversion of water present in fishery products to ice
- Low temperature preservation - freezing at -40^{o}C and storage at -18$\pm$ 2^{o}C
- Retards the microbial and enzymatic action by reducing the water available for their action
- Freezing systems:
  - ✓ Air blast freezing: a continuous stream of cold air is passed over the product
  - ✓ Plate or contact freezing: where the product is placed in direct contact with freezer plates through which a cold fluid is passed
  - ✓ Spray or Immersion freezing: where the product is placed in direct contact with fluid refrigerant

FROZEN PRODUCTS

- Earlier - more export oriented - recently - innovative products - entered urban domestic markets
- Individually quick frozen (IQF) products fetch better price than conventional block frozen products.
- Shelf stability of six months and more is expected for frozen products
- Products range from whole fish/shell fish to dressed, fillets, steaks, mince, coated products, squid tubes, rings, headless shell on shrimps, butterfly forms etc.





FREEZE DRYING

- Freeze drying technique involves a combination of refrigeration, vacuum and heat
- Initially, raw food is frozen and by employing high vacuum conditions, the ice in the food is sublimed directly into vapour
- Adequate process control - satisfactory rehydration, with substantial retention of nutrient, colour, flavour, and texture characteristics

ACCELERATED FREEZE DRIED PRODUCTS

- Mainly for the preservation of high value food products - in ready to use format
- Quality comparable to fresh material
- Can be stored under ambient conditions in suitable packaging
- Light weight, ease of preparation as well as convenient to use
- Drawback: Cost involved - almost four times to that of conventional drying
- Used in pre-cooked ready to serve salads, instant fish soup mixes etc.
- Reports suggest a storage life of upto one to two years

BATTERED AND BREADED SEAFOODS

- Coated food products (enrobed products) - coated/applied with another foodstuff usually a liquid or a powder onto its surface to facilitate new properties
- Two types of coatings : the batter and the crumbs/breading
- Batter - liquid mixture composed of water, flour, starch and seasonings - as dips
- Breading - comprises of bread-based crumbs - as wraps
- As a convention, 50% fish portion is expected in any coated product

Production of coated products

Portioning/forming

⬇

Pre-dusting

⬇

Application of batter

⬇

Application of breading

⬇

Pre-frying or flash frying

⬇

Freezing

⬇

Packaging and Storage

- Better nutritional value, organoleptic characteristics and appearance of the products
- The most important advantage of coating is value addition as it increases the bulk of the product
- Better utilisation of low cost or underutilised fishes
- The most popular enrobed products are fish nuggets, cutlet, balls, finger, patties, shrimp products, squid products, clam products etc.
- Major Equipments/machinery required: Meat bone separator, mincer, silent cutter, moulding machine, battering and breading machine, fryer, cooker, blast freezer, packing and sealing machine.
- Average cost of Production……Rs.215/kg at 100 % capacity
- Expected average Selling Price……Rs.250/kg
- Net Profit Ratio: 21 %, Rate of Return: 18.1%

THERMAL PROCESSING

- Heat processing or canning is a means of achieving long-term microbiological stability for non-dried foods without the use of refrigeration, by prolonged heating in hermetically sealed containers, such as cans or retortable pouches, to render the contents of the container sterile.

THERMALLY PROCESSED READY TO EAT (RTE) PRODUCTS

- Do not require any further processing before consumption -Ready to eat/serve fish products - delicacy as well as convenience.
- Does not require refrigeration
- Retains the original taste and quality
- High shelf stability - ranges from one to two years at room temperature

- RTE products - retorted seafood curries/ masala recipes, seafood combos, seafood ethnic recipes, fried mussel masala etc.
- Retort pouches come in design variances, the most common being a 3-ply laminated material consisting of polyester/aluminium/cast polypropylene.
- Equipments: Horizontal over pressure retort with accessories, temperature recorder, sealing machine & minor equipments
- Market potential : Both domestic and export market
- Approximate cost of production : Rs.35/pouch at 100% capacity

MINCE AND SURIMI BASED PRODUCTS

- Fish mince or minced fish is the flesh separated from the fish in a comminuted form free from scales, skin and bones.
- Water leached fish mince is surimi and surimi is mixed with cryoprotectants before frozen storage.
- Surimi-based products - manufactured by grinding surimi with salts and other ingredients followed by extrusion, fiberization or composite moulding depending upon the desired form of final product -heated to get the shape, develop the texture, and pasteurize the product.
- Machinery required: Meat bone separator, meat mincer, silent cutter or bowl chopper, air blast freezer etc.

SURIMI AND MINCE-BASED PRODUCTS

- Fish cutlets/burgers
- Fish finger
- Fish balls
- Fish cakes
- Fish sausage
- Fish wafers
- Fish soup powder
- Fish momos
- Fish papad
- Surimi-based analogue products….

SURIMI-BASED ANALOGUE PRODUCTS

EXTRUSION TECHNOLOGY

- Extrusion processing - restructuring starchy and proteinaceous ingredients.
- Development of cheap, high-nutritive and convenient cereal based food products
- To utilize fish muscle recovered from by-products, by-catch and other underutilized fish
- Introducing attractive flavours and texture by optimized protocols
- Innovative packages adopting advanced techniques like modified atmospheric packaging, adding to its shelf life
- Market potential : Both domestic and export market; targetting all age group
- Approximate cost of production : Rs.4.50/pouch of 25 g

Advantages

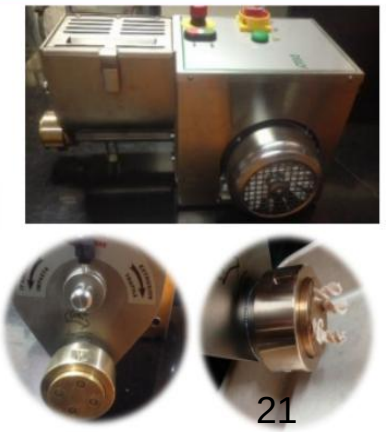
- Energy efficiency
- Lack of process effluents
- Versatility
- High production rate

Types of extruded products

Puffed snacks | Pasta | Noodles

Extruders are the tools used to introduce mechanical shear and thermal energy to food ingredients
On the basis of operation - 2 types of food extrusion process – Hot and Cold extrusion

Twin Screw extruder



Noodles /Pasta maker

ETHNIC SEAFOOD PRODUCTS

- Ethnic seafood products are region specific ones
- Centuries-old indigenous knowledge of processing techniques like fermentation/drying/smoking etc.
- Globalization has boosted the demand for Ethnic seafood products
- Adopting diverse processing techniques - new outlook for these commodities
- A few among these include dried and cured products like dried fish, fermented seafoods, pickles, wafers/papads etc.

DRYING TECHNOLOGY

- Even though an age-old practice, opens up new dimensions and possibilities towards value addition in domestic as well as overseas markets
- In India - about 17-20% of the total catch is converted to dried products and dry fish export contributes to about 7.86% of total fish exports
- New recipes - spiced and dried products, flavour incorporated products, coated and dried products - conquering the modern market

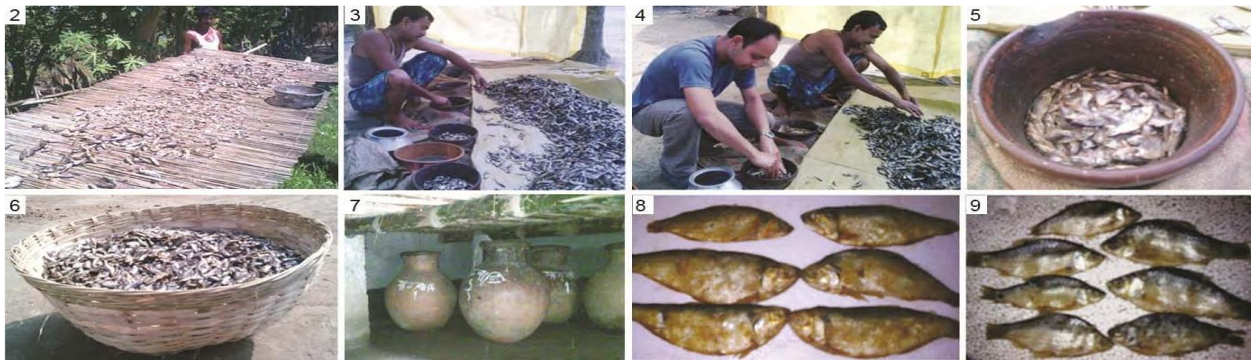
ADVANTAGES

- Highly concentrated
- Reduced microbial Activity
- Enzymatic and chemical process retarded
- Less expensive to produce
- Storage at ambient temperature
- Distribution costs minimum
- No complicated machinery involved

Highly profitable with huge market potential

FERMENTATION

- Traditional technique - more common in the north eastern region
- Use of their indigenous knowledge for fish preservation without use of preservatives
- Recently products with improved nutritive value, appearance and taste, etc. attempted
- A few among the fermented fish products include *ngari* and *hentak* of Manipur; *tungtap* of Meghalaya; *shidal* of Tripura etc.
- Fermented extract from Ngari - rich in antioxidant peptides - soups, curry preparations



SMOKING

- Involves a combination of drying, deposition of naturally produced chemicals resulting from thermal breakdown of wood and salting
- Intermediate step in the preservation of canned smoked products
- In advanced process, preparation of products with typical flavour extracts are incorporated to reduce the process time and better texture
- Smoked products - unique taste and flavour
- Typical smoked fish products of the northeast include *Gnuchi*, *suka ko maacha* etc., masmin of lakshadweep

PICKLING

- The basic principle of pickling is curing of fish by salting, acidifying by addition of vinegar and/or oil and spices
- Fluid portion by weight of the product should be a maximum of 40%
- Addition of vinegar/acetic acid - product with a pH in the range of 4 to 4.5
- Seafood pickles are packed and sealed in air tight glass containers or in food grade polyethylene pouches
- Shelf stable under ambient conditions for a minimum period of six months

BENEFITS / UTILITY

- Ready-to-serve convenient form of products
- Effective utilization of by-catch fishes
- Shelf stable nutritious commodity

MAJOR EQUIPMENTS/MACHINERY REQUIRED

- Pulveriser or grinder, heating and frying arrangements, Bottle washing machine, pickle filling and sealing machine, weighing machines and packing machinery

FINANCIAL ASPECTS

- Average annual cost of Production……43.63 Lakhs
- Turn over per annum…….Rs. 60.75 Lakhs
- Net Profit Ratio = 28.18%

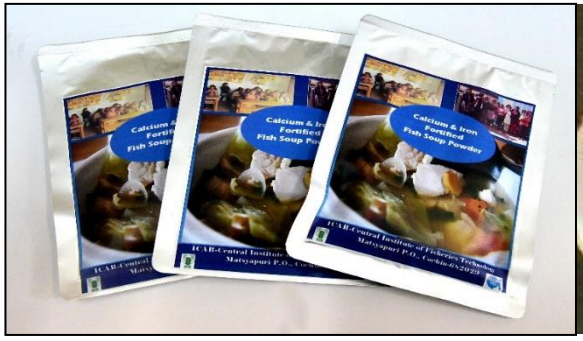
FISH WAFERS /CRACKERS

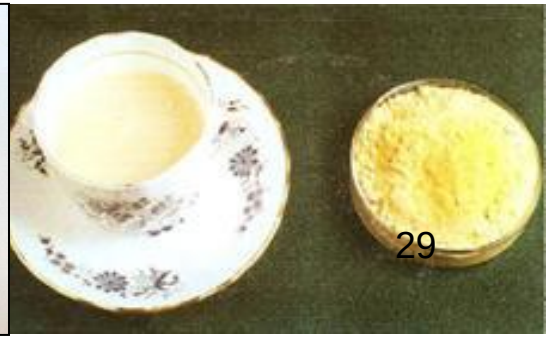
- Ready-to-fry or ready to serve convenient form
- Effective utilization of by-catch fishes as well as processing discards like frame meat
- Fortification of carbohydrate based commodities
- Product diversification based on customized demands
- Addition of starch into the fish mince together with spices and other ingredients which is blended, cooked for gelatinization and further cut and dried to a moisture content less than 10%
- Major Equipments/machinery - pulveriser/grinder, stuffer/moulder, steamer, chopper/cutter, drier, fryer, packing machinery
- Market potential - both domestic and export market
- Financial Aspects- Net Profit Ratio: 48.17%;

  Pay back period: 0.84 years

FISH SOUP POWDER

- Soup powders are popular and a delicacy world-wide
- Fortified fish soup powder is rich in iron, calcium and several other nutrients like easily digestible high quality fish protein, PUFA, vitamins and minerals
- Fishes of low economic value can be utilized
- Fish meat is blend well with water followed by reblending with fried ingredients
- It is dried and powdered followed by milk powder incorporation and packed.
- Product has a storage life of one year



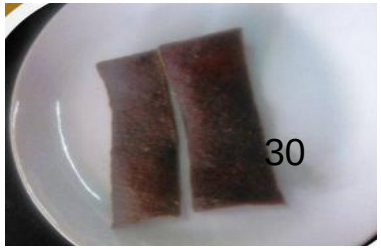


FISH/PRAWN CHUTNEY POWDER

- Is a delicacy in many parts of India
- Usually prepared from small variety fishes and shrimps
- About 20% of the base material is fish/shrimp powder
- Ingredients are fried, powdered and mixed

NUTRACEUTICALS

- A wide range of products can be developed utilizing the marine sources and their by-products
  - **Biscuits:** Collagen peptides incorporated, seaweed based etc are hydrolyzed forms of collagen.
  - **Energy bars/Jerky:** Protein based/seaweed based
  - **Health drinks:** Seaweed based, peptide based etc.



LIVE SEAFOODS

- Indian fisheries sector especially aquaculture segment is booming on account of global seafood demand
- A major issue - marketing of the harvested commodity in its best quality to the consumers
- Compared to the processed ones, the consumer demand and value realization for live ones are much higher
- Survival during live transportation - Focused research and development in this area - prime quality seafood commodity to the consumers
- India - live marketing - confined to shell fishes and a few air breathing hardy varieties
- International market - high demand - singapore, malaysia, other SE Asian countries

Seafood industry - a new era of consumption - a wide array of novel value added products - ready food formats - to cater the demand of seafood customers

Contact details

NIFTEM
Plot No. 97, Sector 56
HSIIDC Industrial Estate
Kundli, District-Sonepat
Haryana-131028
Phone: +91-130- 2281000 , +91-130-2219759-64
Email: info@niftem.ac.in