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BY DRS DOMITILA KYULE & JONATHAN MUNGUTI
Edits: Jane Kiguta

KMFRI and ICIPE poised to conduct joint study on fish feeds

The Kenya Marine and Fisheries Research Institute (KMFRI) aquaculture Directorate and the International Centre of Insect Physiology and Ecology ICIPE are set to collaborate in a ground breaking study on fish feeds at KMFRI Sagana research centre. The research initiative is aimed at providing smallholder and commercial fish farmers with better livelihoods, and supports the entire aquaculture value chain. The planned study aligns with the Kenya government's value chain Bottom-up Economic Transformation Agenda (BETA) approach, whose one of the objectives is to eradicate hunger through agricultural transformation.

KMFRI Aquaculture Director Dr Jonathan Munguti & Sagana Centre Director Dr Domitila Kyule with ICIPE team in KMFRI Aquaculture Centre in Sagana.

KMFRI, ICIPE & World Fish team in KMFRI Sagana research centre.

KMFRI's and ICIPE's research efforts are focused on improving food security and nutrition for economic and social well-being of the society, and will rely on the current experiments under study.

KMFRI Aquaculture Director Dr Jonathan Munguti sampling aquafeed

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Specifically, the researchers will seek to investigate the influence of Omega 3 fatty acid supplementation on the growth performance, and nutrient utilization efficiency of improved catfish strain at different life stages fed on black soldier fly larvae diet.

Omega-3 fatty acids play a crucial role in the growth, development, and health of fish. Growth performance of African catfish at different life stages fed on black soldier fly larvae diets supplemented with varying levels of omega-3 fatty acids is under investigation. The fatty acid profile of black soldier fly larvae diets also will be explored.

ICIPE and KMFRI team during a field activity

The findings of this study will contribute to our understanding of the nutritional requirements of African catfish at different life stages, and the potential of BSFL as a sustainable protein source in aquafeeds.

It will also provide valuable insights into the optimal levels of omega-3 fatty acid supplementation for enhancing the growth performance and nutrient utilization efficiency of African catfish fed on BSFL.

Additionally, the researchers will seek to establish the effects of omega 3 fatty acids supplementation on improved tilapia strain growth and nutrient utilization with black larvae diets. They will look into growth performance of Nile tilapia fed diets enriched with varying levels of omega-3 fatty acids and evaluate the nutrient utilization efficiency of protein ratio, protein retention and lipid retention of Nile tilapia fed diets enriched with varying levels of omega-3 fatty acids.

KMFRI Sagana Centre Director Dr Domitila Kyule makes a presentation

Fatty acid profile of Nile tilapia fillets derived from diets enriched with varying levels of omega-3 fatty acids will also be studied.

The outcomes of this research will enrich our comprehension of the nutritional needs of Nile tilapia and the viability of omega-3 fatty acid supplementation in augmenting growth performance and nutrient utilization. The results will also provide substantial insights into the most efficient levels of fat-soluble vitamins enrichment to improve the nutritional value and consumer acceptance of Nile tilapia fillets.

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KMFRI's hurdle in attempt to minimize fish post-harvest losses

Poor regulation and low investment in infrastructure are key factors leading to continued fish waste, affecting food and nutritional security, Kenya Marine and Fisheries Research Institute (KMFRI) study shows.

This was revealed in a study conducted to evaluate the effectiveness of SolCoolDry preservation system, a research innovation aimed at reducing fish post-harvest losses in Kenya's artisanal fishery communities. The survey was carried out taking into account how fishermen and fish farmers in selected coastal areas handle fish preservation.

Post-harvest management systems, including cold rooms and drying equipment, are underutilized, contributing to significant waste and losses.

KMFRI has, overtime, been unveiling research innovations aimed at minimizing fish waste among fisher communities in Kenya. According to KMFRI's research, fishermen often used ice blocks, but many lacked access to freezers or drying racks. KMFRI researchers noticed that ice being the primary preservation method had limitations, with only 18 per cent of the respondents using it effectively.

The SolCoolDry system which combines solar technology for cooling and drying was evaluated for its potential in reducing losses, especially during the rainy season. The findings showed that the system helped reduce post-harvest losses, but there was still a high percentage of loss in the fish value chain.

Despite the promise the SolCoolDry system holds in improving fish preservation, these challenges have manifested in the adoption of the technology and efficiency in practice.

KMFRI further shows the "Evidence on food loss and waste – a case of Kenya fish value chains" explores the challenges within Kenya's fish industry, particularly focusing on food loss and waste.

It highlights the importance of fish as a protein source and its contribution to food security in Kenya. According to KMFRI research feedback, in 2021, Kenya produced 163,600 metric tons (MT) of fish, generating KES 30.4 billion in revenue. Despite this, the sector faces issues such as underdeveloped cold-chain infrastructure, inefficient marketing, bad weather, and lack of buyers. Let's explore other ways of prolonging fish shelf-life.

FISH PRESERVATION METHODS

Fish drying in Turkana | *Photo by Vitalis Omire*

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Source: Fish Recipe Book

Fish preservation involves preventing the growth of *bacteria, fungi (such as yeast), or any other micro-organisms* coupled with reducing oxidation of fats that cause rancidity. Different fish preservation types include sun drying, smoking, salting/brining/pickling, gutting, fermentation, canning, chilling and freezing and value added products

Sun drying

Spoilage and loss of quality of fish can be reduced by simple improvements in drying practices. Drying on raised solar driers (racks) or on clean and dry concrete and wooded racks is recommended.

Basically, the drying effect of the sun depends on the emission of heat from the sun. This is transferred to the fish. During drying, the fish undergoes irreversible changes. Water is removed from the surface and gradually from the fish muscles. Sun drying takes about *three to five* days depending on the intensity of the sun. The dried fish can stay for several weeks.

Ingredients for sun drying

- Whole gutted fish
- Salt
- ½ litre of water for making brine solution
- Drying rack

Method of drying

1. Remove scales from the fish immediately after harvesting.
2. Gut the fish
3. Prepare a brine solution with salt and clean water
4. Immerse the opened fish in the brine solution
5. Leave the fish for one day in the brine to marinate
6. Place the fish on the drying rack to dry
7. The fish will dry in ten days if the weather is cloudy and five if sunny
8. Keep the fish in a clean, cool place every night
9. When the fish is dry, store in a large container with a layer of salt on the bottom and cover with a lid

Smoking

This combines cooking and drying of the fish hence prolonging its shelf life. Properly smoked fish is dark brown in colour and is near perfectly dried and in good state. Smoking also improves the taste of fish, depending on the smoking ingredients. The smoking ingredients include; *rosemary leaves, eucalyptus wood or sawdust, cypress or any other aromatic plant.*

Ingredients in smoking

- Whole fish
- Ginger
- Salt
- Mixed spices
- Dried rosemary leaves
- A smoking kiln
- Charcoal
- Saw dust
- Hooks

Methods of smoking

1. After fish has been harvested; remove scales, gut and wash thoroughly with clean water
2. Make horizontal slits on each fish for spices to be absorbed
3. Marinate the fish in mixed spices, ginger and salt for at least six hours and drain excess water

4. Apply vegetable cooking oil on the kiln shelves sparingly to prevent fish from sticking on the shelves
5. Arrange the fish on the shelves ensuring that fish do not pile on top of each other
6. Light the charcoal in the firebox and fire the charcoal properly for the kiln to acquire temperatures of between 950Cto 110^{0}C.
7. Introduce sawdust in the chamber to produce smoke and tightly close the smoking kiln.
8. The fibre glass lined in the walls of the kiln acts as an insulating material to conserve heat and keep the working environment conducive for the operator.
9. Fish are required to be heated to an internal temperature of 70^{0}C for three hours to eliminate harmful pathogens, while the smoking kiln must be able to provide temperature between 95^{0}C and 110^{0}C.
10. Periodically add charcoal until the fish attains a moisture content of below 12.5 percent.

The fish will be ready after three to five hours. Let the fish cool inside the kiln at ambient temperatures before serving or packaging.

Fish gutting

- Gutting is the removal of visceral organs and intestines which harbor spoilage bacteria and digestive juices that hasten autolysis and putrefaction.
- Cut the fish along the ventral surface from the vent to the gill opening.
- Remove the offals and wash the fish thoroughly

Chilling and freezing

Fresh fish is an extremely perishable food when kept at room temperature. The rate of deterioration can be lowered easily by reducing the temperature at which the fish is kept. The process of cooling fish or fish products to a temperature approaching that of melting ice (0^{0}C/32^{0}F) is referred to as chilling. Chilling prolongs the shelf-life of fish by slowing the action of enzymes and bacteria, and the chemical and physical process that can affect quality.

Freezing involves the removal heat. The temperature of fish from which heat is steadily removed first falls rapidly to just below 0^0, the freezing point of water. At this point, the temperature remains constant until most the water turns to ice. Temperature then begin to fall rapidly which further cools the frozen shelf.

❖ ***Salting***

There are four standard methods of salting fish. These are; *brine, dry, kench, and pickle salting.*

❖ **Brine salting**

Brine is prepared by dissolving 270-360g of salt in one litre of water. Fish is completely immersed in the solution. Due to salt uptake, the concentration in brine drops because of water exuding from the fish.

❖ **Dry salting**

Granular salt is spread and rubbed on this or fish fillets.

❖ **Kench salting**

Granular salt is rubbed on split fish are stored with salt placed between each layer.

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❖ **Pickle salting**

Fish is packed in watertight containers with salt between each layer of fish. The liquid formed is referred to us pickle. If the pickle formed does not cover the fish within four hours, saturated brine is added to the fish so that it becomes immersed by the pickle.

❖ ***Fermentation***

This is a traditional method of fish preservation. It prevents the ability of microbes to spoil fish by making the fish muscle more acidic. Bacteria usually cease multiplying when the PH drops below 4.5

Ingredients used in fermentation

- 8 pieces of tilapia or cat fish
- 2 white onions
- 1 teaspoon coriander seeds
- 20 bay leaves
- 2 teaspoons black pepper
- Dill herb
- 2 tablespoon sea salt
- 6-8 tablespoon whey
- 2 litres of water

Methods of fermentation

1. Skin the fish and remove the bones
2. Cut into bit-size pieces
3. Put the pieces of the fish into a jar mixing with black pepper, a few slices of white onion (optional), coriander seeds, bay leaves and dill seeds or dill herb.
4. In a separate jug with half litres of water, dissolve 1 tablespoon of sea salt and 3-4 table spoon of whey.
5. Pour this brine into a jar with the fish until the fish is completely covered.
6. If the fish is not covered just add more water.
7. Close the jar tightly and leave to ferment for 3-5 days at a room temperature, then store in the fridge

❖ ***Canning***

Canning is a method of preserving food. It provides a typical shelf line of one to five years. Canned fish is processed, sealed in an airtight container such as a sealed tin can, and subjected to heat

Ingredients used in canning

- 1 whole fish
- 1 tablespoon tomato soup
- 1 tablespoon white vinegar
- 1 teaspoon salt

Method of canning

1. Remove gut content, head, tail and fins and wash the fish
2. Cut the fish in 2-inch chunks
3. Place the pieces in a washed and dried 1 pint jar
4. To each jar, add tomato soup, white vinegar and salt
5. Put lids on loosely
6. Place in pressure cooker and process for 1hour 15minutes at 15 pounds of pressure
7. Tighten lids immediately after removing from cooker.

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Mtafiti Pictorials

KMFRI, alongside CS Hassan Ali Joho, with Governor Godhana Dhadho, PS Betsy N., and PS Elijah Mwangi, during a tree-planting exercise in Kipini, Tana River County

KMFRI Fresh Waters Director Dr Christopher Aura and Kegati's Centre Director Dr Paul Orina among panelists during the Lake Victoria Aquaculture forum.

KMFRI Ag. Director General Dr James Mwaluma giving his presentation at the first Lake Victoria Aquaculture Forum. The meet was aimed at fostering strategic collaboration and partnerships among diverse public and private stakeholders within the region's Blue Economy sector

Dr Rodrigue Yossa, Director, Biosciences at WorldFish during a visit to KMFRI for an update on Asia-Arica BlueTech Superhighway project activities they are implementing together. KMFRI Ag DG Dr James Mwaluma led KMFRI team

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Participants attending the Sustainable Agri-Food Systems Intelligence – Science-Policy Interface workshop in Mombasa gather for a group photo.

KMFRI's Dr. Judith Okello, mangrove ecologist, also the Chair of the National Mangrove Management Committee with AD Oceanography and Hydrography Dr. Joseph Kamau planting mangroves in Kipini, Tana River County

African Centre for Aquatic Research and Education (ACARE) reps during a courtesy visit to KMFRI Mombasa HQ. They held talks on strengthening the existing partnerships and fostering collaboration in aquatic research and education. The team was received by KMFRI Ag. DG Dr James Mwaluma

A delegation from the Embassy of Belgium headed by Ambassador to Kenya Peter Maddens on a tour of the just concluded Mikindani wastewater treatment plant. Community members joined them.