

An innovative way of fish drying and smoking: FAO Thiaroye Processing Technique (FTT-Thiaroye)



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Purpose of this policy brief

To introduce and trial a new cost effective method of fish smoking and drying which will reduce post-harvest losses, add value to the finished product and increase its shelf life.

Summary

Fish is the main source of animal protein in the Pacific region. Many of the residents of small islands are subsistence fishers whose livelihoods depend on fishing and fish preservation. Pacific islanders living in remote locations do not have proper access to electricity or cold storage facilities and as a result, spoilage often occur after capture and during storage prior to consumption. Smoking and effective drying of fish products can help to reduce such losses and waste. The FAO-Thiaroye Technique (FTT) a new fish smoking technology pioneered by FAO has greatly enhanced fish operators' livelihoods in tropical countries where fish preservation is essential to reduce spoilage due to insects, animals, humidity and temperature. Construction of the system can be done locally and fuel used comes from available local resources.

1. What is fish smoking and drying?

Fish "smoking" is a process of treating fish by exposing it to smoke from smoldering wood or plant materials. This process is usually characterized by a combination of salting, drying, heating and smoking steps in a smoking chamber. Drying is done to reduce moisture content to 10% or less).

Smoking and drying are important fish processing methods for small-scale fisheries in countries geographically located around the tropics.

Fish is a highly perishable food. Smoked and dried fish are two techniques that represent the main and, at times, the only ways to supply people located far from fishing sites with fish. This type of product is even more necessary when poor infrastructure and an inefficient cold chain impede the supply of fresh foodstuffs.

2. Why do we smoke and dry fish?

- To extend shelf-life (up to 5–6 months with appropriate monitoring)
- To facilitate transportation
- To maintain a consistent supply based on demand
- To reduce post-harvest losses
- To increased variety of textures and flavors, resulting in a greater choice for consumers.

3. How is fish smoking and drying traditionally carried out?

Kilns are types of ovens that have been used to produce smoked fish. They range from traditional kilns (round mud kilns, barrel-shaped kilns) to improved ones (e.g. multirack Chorkor, Cinderblock).

Sun is used for drying fish in open spaces often on raised racks. However, sun drying has important limitations in rainy or cloudy weather as drying becomes difficult and sometimes impossible. In addition, drying in the open air exposes the product to contamination by wind, dust, insects, rodents and birds.

4. Limitations of traditional smoking and drying methods

Using wood or charcoal to smoke fish increases the risk of contaminating fish with byproducts of combustion such as Polycyclic Aromatic Hydrocarbons (PAHs) and other contaminants. PAHs can be carcinogenic and can affect the safety of food. In addition, using traditional methods, there were losses to the by-products (oil), much longer time for processing and quality losses of the end product.

5. How the problem can be resolved:

Introducing the FTT-Thiaroye

The Thiaroye Processing Technique (FTT-Thiaroye) was pioneered by FAO. To date, it has been successfully introduced and used in several African countries, particularly with women focus groups as fish processors.

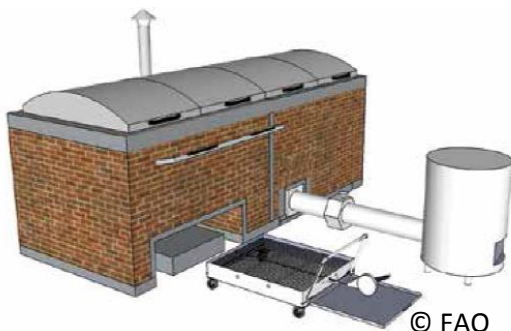


Image 1: The FTT-Thiaroye.

Table 1: Main differences between traditional and first-generation improved kilns and FTT-Thiaroye

Chorkor smoker/metal drum kilns (Traditional)	FTT-Thiaroye
Simultaneous cooking and smoking	Separate cooking and smoke flavouring unit operations
Direct smoking	Indirect smoking reduce PAH
Smoke not filtered	Smoke filtered
Fish fat drips into fire	Fish fat drains out over fat collection tray into an extension container

6. Benefits of using FTT Thiaroye

- Meet higher international food safety requirements.
- Give the products a premium quality and constant and uniform characteristics.
- Functioning regardless of weather conditions. This results in a minimization of post-harvest losses.
- Possibility to have additional revenue from process by-products, e.g. fat gathered which can be used in soap, or it can be used as cooking or frying oil.
- Easy to construct through expertise of local artisans and available local materials
- Time savings in processing (from 5 hours for cooking and smoking time depending on the size, thickness and number of fish per operation), thus allowing processors to attend to other business
- Contributes to safeguarding the environment by reducing by half the fuel consumption

and/or by using plant materials, which are often bulky for the environment, such as coconut husks and shells or corn cobs, as fuel. In addition, this reduces the PAHs contaminants.

7. Equipment needed for the FTT-Thiaroye

7.1. The dual compartment frame for the vibrated kilns



Image 2: Dual compartment frame (left: cement, right: bricks)

7.2. Lids

Lids are used not only to cover the product during smoking and drying but also to protect it afterwards. Where the processor already has a dual compartment kiln, it is important to have FTT-Thiaroye accessories that meet the measurements of this particular kiln.



Image 3: FTT Thiaroye lid

7.3. Racks

The drying/smoking racks are removable and are made of suitable materials to facilitate cleaning, heat resistance, thereby ensuring a long life span.



Image 4: fish smoking/drying racks

7.4. Ember furnace (specific to FTT-Thiaroye)

The ember furnace is designed to hold the fuel used to cook the fish. Loading it in the fireplace concentrates the heat on the product, reducing the heat and smoke losses that might otherwise affect the operator during smoking. This feature also reduces fuel consumption.

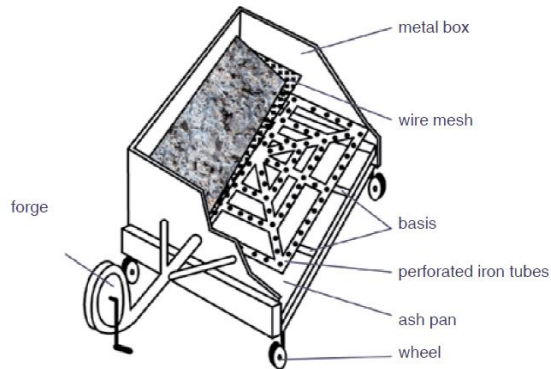


Image 5: Ember furnace model

7.5. Fat-collection tray (specific to FTT-Thiaroye)
The fat-collection tray is a system for collecting fat while cooking the fish.



Image 6: fat collection tray

7.6. Indirect smoke generator system (specific to FTT-Thiaroye)

The generator system is comprised to 2 main parts: (1) the barrel and the metal pipe that can be shaped into a spiral or circular tube; and (2) the filter system which includes a metal casing in which the filter is inserted - all of these are then inserted into a metal housing.



Image 7: FTT indirect smoke generator system

7.7. Hot-air distributor (specific to FTT-Thiaroye)
This system is composed of two metal boxes. Inside each of these, horizontal fins match the number of drying racks and perfectly fit them.

The drying racks are stacked and arranged vertically.



Image 8: Hot air distributor of FTT

8. Supply/purchase of fuel

For smoking fish products, wood is generally used. However, agricultural biomass such as bagasse (plant material derived from sugar cane) and coconut husks or shells can also be used as fuel.

The choice of fuel is an important aspect to consider in order to avoid potential food contamination. For example, food contamination by PAHs differs depending on whether wood, stalks or hay are used. Oilseed contamination with PAHs is higher when coconut husks are used, instead of coconut shells, which are less rich in lignin.

Wood species used also influence the formation of PAHs. Thus, it is recommended that the potential of PAH formation for each species of wood or plant material be evaluated before using it for smoking. Moreover, it is preferable to use non-resinous wood.

The use of fuels other than wood and plant material for smoking food is prohibited. Fuels such as diesel, rubber (including tyres) or waste oil should never be used even as a partial component, as they can significantly increase PAHs.

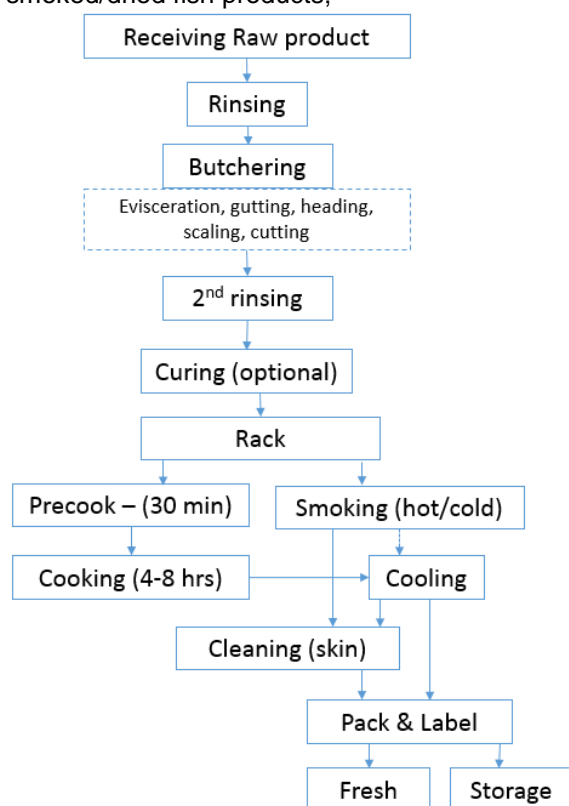
Wood treated with chemicals for preserving, waterproofing, fireproofing, etc. should not be used during smoking or producing condensed smoke. These treatments may cause food spoilage and introduce other contaminants such as dioxin from wood treated with pentachlorophenol.

Table 2: Technical data related to the smoking process with the FTT-Thiaroye

Parameter	Charcoal	Coconut shells	Coconut husks
Heat distribution	uniform	More or less uniform	More or less uniform
Cooking temperature	85 C	85 C	80 C
Smoking temperature	30-40 C	30-40 C	30-40 C
Cooking time	4h45	4h30	5h
Cooking and Smoking time	7h35	6h	6h35
% of water loss in fish	53.85	54.01	44
Texture	dry	dry	slightly soft
Max amount of oil recovered (ml) per 20 kg of fish	500	250	300
Smoked fish quality (appreciated)	Most	Normal	Normal

9. Using FTT Thiaroye

Several operations can be carried out thanks to the FTT-Thiaroye: 1) producing smoked fish products; 2) drying fish products; 3) storing smoked/dried fish products;



About this brief:

This technical brief is based on the original guide prepared in 2015 by FAO. Then for easy use and distribution, it was reduced with additions by Sayed M. Naim Khalid, Nutrition and Food System Officer, FAO-SAP, Apia, Samoa sayed.khalid@fao.org

10. Maintenance of the FTT

A better shelf-life and good quality of end product depend on properly maintaining the equipment during and after its use. Yet too often, the equipment is neglected in traditional processing centers.

Daily maintenance for the FTT-Thiaroye (kiln, cover, rack, and furnace) entails cleaning inside and around the kilns and removing the ashes and the waste stuck on the lids and on the mesh of the removable racks.

The following operations are also necessary:

- Remove the smoke generator, clean it with soapy water and then let it dry.
- Remove the collector containing the mixture of water and exudate located below the metal housing, empty it and put it back into place.
- Remove the housing and the filter loaded with tar from the smoke and clean it thoroughly.
- Change the sponge of plant origin (loofah) / filter before each new session, while the used one is washed and left to dry.
- Remove the fat-collecting tray, and clean the dried exudate and the grease ducts of the tray, and drain the pipe.

11. Cost of the FTT (based on average cost of materials in African small-scale fisheries)

Table 3: Estimated cost of FTT

Item	Cost (USD)
Average cost of the kiln	\$ 800
Average cost per rack	\$ 25
Average cost of the furnace	\$ 200
Average cost of the fat collection tray	\$ 100
Average cost of indirect smoke generator	\$ 250
Average cost of smoke distributor	\$ 95
Total	\$ 1,450

12. Further reading

1. FAO/WHO, 2003. *Code of practices for fish and fishery products - CAC/RCP 52-2003*. Rome: Codex Alimentarius Commission.
2. FAO/WHO, 2013. *Standard for smoked fish, smoked flavoured fish and smoked dried fish- CODEX STAN 311 – 2013*. Rome: Codex Alimentarius Commission .
3. Ndiaye, O., Komivi, B. S. & Ouadi, Y. D., 2015. *The FAO-Thiaroye Processing Technique (FTT-Thiaroye)*. Rome: Food and Agriculture Organization of the United Nations.