Comparism of NIFFR Improved smoking kiln with the Traditional Smoking Kiln

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Abstract: Fish drying has been the traditional method of processing and preserving fish in developing countries. Traditional fish smoking using the Banda and the drum ovens has been adopted in the past. However as a result of the hazard and time consuming involved in traditional smoking of fish, the need for modern and mechanized fish smoking kiln is encouraged. The Design and fabricated of NIFFR Improved 200kg batch capacity smoking kiln was used for smoking fish. The smoking kiln uses either firewood or charcoal as heat source for drying of fish. Trials were conducted on the newly fabricated smoking kiln, and the output shows low consumption of heat source, the smoked fish were better than those from the traditional fish smoking kilns in term of appearance. Batch smoking operation is concluded within 36 hours with the consumption of 5kg fire wood. An excessive heat loss is minimized by the rock wool used as insulating material. Heat transfer was as a result of transient conduction and temperature of the smoking chamber was maintained at 140°C.

Key words: *Fish smoking, mesh wire, rook wool, damper,*

1. INRODUCTION

Fish drying or dehydration is a process of the removal of water from fish or fish products by evaporation, salting, application of pressure and using absorbent pads. Fish drying is the oldest method of fish preservation as observed by Eyo (1997). The main purpose of dehydration is to extend the shelf life of fish by reduction in water activity. Water plays an important role in the suitability of fresh and dried fish, it act as a solvent for chemical, microbiological and enzymatic reactions Olokor, *et, al.* (2007)

Fresh fish when out of water deteriorate fast except immediate step are taken to preserve its quality, despite the subsistence nature of our capture fisheries in Nigeria. Tawari (2006), also reported that most of the fish processing community in Nigeria employed traditional technique and they have been in existence for more than ten years. As much as 50% post harvest losses are recorded, the result of this is economic losses to fish farmers, fish processors and marketers is quite enormous.

The need to mechanised fish processing technique has drawn the attention of national agricultural research to devote utmost interest and resources to engineering research in fish processing operation, to reduce labour operation and unsanitary fish handling procedures that may be involve in fish smoking operations. Eyo A. A., (1999). Thus it is imperative to process and preserve some of the fish caught in the period of abundance, so as to ensure an all year round supply. This will invariably reduce post harvest loses, increase the shelf life of fish, and guarantee a sustainable supply of fish during off season with concomitant increase in the profit of the fish entrepreneurs. (Eyo, 2002).

JUSTIFICATION FOR THE STUDY

Consequently, the presences of these carcinogenic components in smoked fish make it not acceptable in international market (EFSA, 2005).It has also been observed that the existing NIFFR smoking kiln has low carrying capacity with low heat retention, which usually take long period of time before drying fish successfully. Consequently, the presences of these carcinogenic components in smoked fish make it not acceptable in international market (EFSA, 2005).It has also been observed that the existing NIFFR smoking kiln has low carrying capacity with low heat retention, which usually take long period of time before drying fish successfully.

MATERIALS AND METHOD

The materials used for this research work are

Galvanize metal plate 1.0mm and mild steel metal plate 0.8mm

Angle bar 1.0 inch

Iron pipe 1x1 inch

BRC wire mesh 2x1inch

Rook wool

Electrode

Hinge

The smoking cabinet is made up of two layer metal wall, lagged with insulating material called rock wool. The rock wool helps to prevent heat loss from the inner heating chamber of the smoking kiln. Galvanize metal plate with thickness of (1.0mm) was used for the outer wall of the smoking kiln, while mild steel plate with thickness of 0.8mm was used for the inner wall of the smoking kiln with structural dimension of (1.2 x 1.5 x 0.9) meters. The heating chamber is located in the lower part of the smoking kiln with a dimension of (0.3x 0.3) m. Above the heating chamber is the damper plate which is made up of stainless steel with thickness of (0.9mm) measured (0.7x 0.6)m which allow heat transfer to the mesh tray and prevent direct fire from burning the fresh fish product during smoking operation. At the same time the damper serve as a receptacle for the collection of melted fat and oil.

The smoking chamber is divided into two cabinets; each cabinet is measured (0.76 x 0.7) m. The racks are made of one inch angle bar and galvanize wire mesh (2 x 1)'' welded together. Each chamber of the smoking kiln contain ten racks with dimension (0.6 x 0.6) m

The smoking kiln has a dome shape at the top where the chimney is located. The chimney is made of galvanize metal plate with dimension 4 x 20 inch covered with a cap for opening and closing to enable the release of smoke from the chamber during smoking operation. The modified smoking kiln has the batch capacity of 200kg of fresh fish per batch operation as shown in plate 3 while plate 1 and 2 shows the traditional smoking kiln

The smoking kiln utilizes fire wood or charcoal as heat source. During operation heat is uniformly distributed to all parts of the smoking cabinets

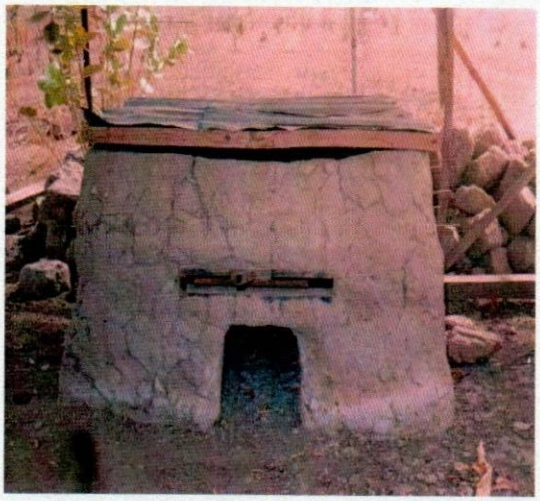
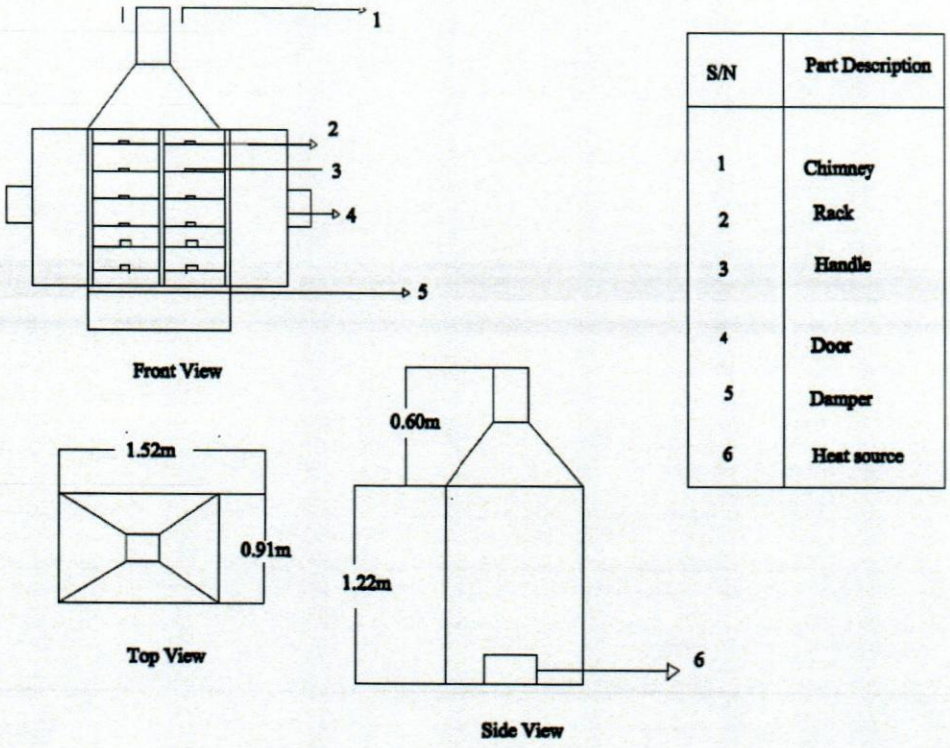


Plate 1: Mud smoking kiln

Plate 2: Drum smoking kiln



S/N	Part Description
1	Chimney
2	Rack
3	Handle
4	Door
5	Damper
6	Heat source

Fig. 1: Design of NIFFR Improved Smoking Kiln

Plate 3: Fabricated NIFFR Improved Smoking Kiln

Fish processing and smoking operation

The fresh fish used for this study was*Clariasgariepinus*species harvested from a fish farm in New-Bussa, Niger State. The fish were degutted and washed, then placed in a bowl of brine solution for 30 minutes. The brining solution was prepared with 250g of table salt in 3.5 litres of water 12kg of fish each. The fish were removed from the brining solution to drip and arranged on the racks then placed in the pre-heated kiln for smoking operation. The smoking chambers were pre-heated to initial temperature before the fish were loaded in the kiln. The

temperature inside the smoking chamber of the newly fabricated smoking kiln and the traditional mud kiln was monitored and recorded using a data logging machine. Smoking operation was concluded within 36 hours.

Result and discussion

Table 1: Temperature measurements at different time around the improved and traditional smoking kiln

Time	Ambient	Improved NIFFR KILN		Traditional Kiln	
	Temp. (°C)	Chamber Temp. (°C)	Outer wall Temp. (°C)	Chamber Temp. (°C)	Outer wall Temp. (°C)
1:00	38	130	45	39.6	10
2:00	36	135	40	39.6	30
3:00	34	140	45	45.0	20
4:00	32	150	50	47.8	35
5: 45	30	135	30	40.2	25

It was observed that there is build up of temperature within the improved NIFFR smoking kilnfar above the ambient temperature. A much lower temperature was recorded from different location in the traditional smoking kiln. The differences in temperature account fr the variation in processing time between the two types of smoking kiln. However heat transfer from the heating chamber to the smoking chamber was a situation of transient heat conduction. The magnitude of distribution of heat within the walls of the NIFFR Improved smoking kiln increases as temperature increase in the smoking chamber. This agrees with Okouzi *et al.*, 2015 and Cenger, 2006 that heat transfer is proportional to temperature difference.

Heat retention in the NIFFR improved smoking kiln was encouraging as the kiln was able to retain heat for up to six hours provided the door are permanently locked and heat source extinguished. This attribute was as a result of the rock wool insulating material in between the two walls of the smoking kiln. This attribute has been observed in other smoking kilns such as the NIFFR/WAAPP hybrid smoking kiln and NIOMR smoking kiln. Other smoking kiln such as the drum smoking kiln and mud smoking kiln lack this attribute as resultant heat losses are excessive.

In terms of fuel wood consumption the smoking kiln utilizes 5kg of fire wood to complete one batch smoking operation.

Conclusion

In this research a portable and easily maintained fish smoking kiln with 200kg batch capacity was designed, fabricated and tested for smoking. Its performance was evaluated, the result shows that its performance is better than the mud and the drum smoking kiln in terms of low carbon content and high batch capacity of smoked fish products. Smoked fish from the smoking kiln had a characteristic golden brown colour.
The heat temperature from the burning wood can be easily controlled by constant observation and monitoring as the wood is burning. Smoked fish from the fabricated smoking kiln were easily identified from there appearance.

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