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Comparative Quality Study on Pneumatic Charcoal Kiln and Traditional Fish Smoke Kiln

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ABSTRACT

A comparative equality study on the Pneumatic charcoal kiln and Traditional smoke kiln was carried out at Federal University, Gashua. Yobe, State. The pneumatic charcoal kiln consisting three chambers (fan chamber, charcoal chamber and smoking chamber) was constructed with chaka plates and wrought iron metal sheets while the traditional fish smoke kiln (0.5m X 0.5m X 1.5m) was constructed with clayed soil. A total number of one hundred and fifty (150) Clarias gariepinus weighed 15.5kg on average were used for each of the two smoking kilns. Smoking process lasted for 12 hours in the traditional smoke kiln and 5 hours in the Pneumatic charcoal kiln. Initial and final weights of charcoals recorded during smoking process in the two smoking kilns showed that lower charcoal (40 kg) was used in pneumatic kiln while higher charcoal (75 kg) was used in the traditional smoking kiln during smoking process. Data obtained for appearance (7.9±0.04), texture (7.5±0.12), odour (7.7±0.00) and taste (8.3±0.27) showed that organoleptic tests of smoked fish from pneumatic charcoal kiln were better than the smoked fish from the traditional smoke kiln. The study showed that pneumatic charcoal kiln was not only environmental friendly but also more efficient than the traditional smoke kiln and the fish smoked from it had pleasant odour and better texture.

Keywords: *Smoke, traditional kiln, pneumatic kiln, Clarias gariepinus, quality.*

INTRODUCTION

Fish is a major source of protein and its harvesting, handling, processing and distribution provide livelihood for millions of people as well as providing foreign exchange earning to many countries (Al-Jufaili and Opara, 2006). 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 (Eyo, 1997). This will reduce post harvest losses, increase the shelf life of fish and guarantee a sustainable supply of fish during off season with concomitant increase in the profit of fisherman (Eyo, 1997). Fresh fish deteriorate very rapidly, especially when they have not been gutted due to the high temperature in the tropics and increased exposed surface (Saliu, 2000). It is therefore necessary to ensure that fish and fish products get to the consumers in acceptable quality (Arannilewa *et al*., 2002). Smoking is a popular traditional method of fish preservation in Nigeria and in most developing countries (Odiko and Abolagba, 2015). Smoke is produced as a result of incomplete combustion of burnt fuel (Enofe, 1996). Local fishermen spend between 7-10 hours daily on the average, smoking fish depending on the percentage of oil composition, size in relation to the rate of water loss per body weight of the fish (Odiko and Abolagba, 2015). Traditionally, fish food produce are dried by spreading in open sun in thin layer and smoking using wood (Idi-Ogede *et al*., 2017). Open sun drying and smoking processing requires longer drying time and product quality are difficult to control (Idi-Ogede *et al*., 2017). The disadvantages inherent in the traditional smoking method led to the development of smoking kiln for effective fish smoking process (ICAR, 2006). The pneumatic charcoal kiln is a mechanical drier for fish smoking under controlled; ensures faster drying and thus increases freshness of smoke fish; prevent dirt, sand and dust (Idi-Ogede, et al., 2017).

The objective of this study was to compare in quality of pneumatic charcoal kiln and the common traditional smoke kiln.

MATERIALS AND METHODS

Pneumatic charcoal kiln

The pneumatic charcoal kiln was constructed with Chaka plates and wrought iron metal sheets. It has three chambers, namely: Fan chamber, charcoal chamber and smoking chamber (Plate 1).

Plate1: *Pneumatic kiln*

The charcoal and the smoking chamber were insulated with a thermosetting polymer of 100mm thickness. The fan chamber (0.457m x 0.305m x 0.457m) has the same size with charcoal chamber while the smoking chamber was 0.609m x 0.914m x 0.609m; wider and longer than the other two chambers (Plate 2). The fan was fixed to the fan chamber connected to a solar panel which supplied the electricity that blow the fan with a regulator attached to control the blade speed.

Plate2: *Pneumatic charcoal kiln showing the charcoal, smoking and fan chambers*

The pneumatic pump was fitted at the base so as to allow recycling of warm air back into the kiln chamber. The inlet pneumatic pipe, chimney outlet and hot air inlet allows less dense air (methane and propyl compound) to escape out (plate 3).

Plate3: *Pneumatic kiln showing the inlets and outlets*

The complete pneumatic kiln is made up of the following parts:

- The motor/fan - This is fixed on the chamber connected to a solar panel with a regulator attached to control the blade speed.
- Fish trays – These are wire meshed, rectangular in shape (0.609 x 0.914m) found in the smoking chamber (R_1 and R_2).
- Pneumatic system – This is made up of pipes connected from the centre of the chamber welded to circulate heated air within the chamber.
- Pneumatic charcoal kiln assembly – This is made up of fan chamber, charcoal chamber, smoking chamber and the pneumatic pump welded together to form a pneumatic kiln (Figure 3 above).

Traditional fish smoke kiln

The traditional fish smoke kiln was constructed with clayed soil with 0.5m X 0.5m X 1.5m in dimension. The soil was thoroughly mixed with water and molded (Plate 4).

Plate4: *Traditional fish smoke kiln*

Smoking process

Three hundred (300) *Clarias gariepinus* with mean average of 15.5kg was obtained from a reputable fish farm in Gashua. The fishes were transported from the fish farm in oxygenated polythen bag to the Federal University, Gashua where the research was carried out. A total number of one hundred and fifty *Clarias gariepinus* fish species were processed by each of the two smoking kilns. The fishes were gutted, washed and folded using sticks to hold them together (Idi-Ogede *et al.*, 2017). Wire meshes were laid on the traditional smoke kiln as well as inside the smoking chamber of the pneumatic charcoal kiln. Palm oil was rubbed on the wire meshes. Charcoal was weighed by a weighing balance (Atom Model 110C, electronic compact kilns scale) and put into the charcoal chamber of the pneumatic kiln. The

charcoal was ignited with fire; the burnt charcoal was later put inside the charcoal chamber. Electricity was generated through the solar panel connected to the fan chamber; air was blown from the fan chamber to the smoking chamber which channel heat through the wire mesh and thus dries the fish in the pneumatic kiln. The fire burnt the fish directly through the wire mesh in the traditional smoke kiln. The smoking process lasted for 5 hours in the pneumatic charcoal kiln and 12 hours in the traditional smoke kiln respectively. The heat efficiency of the two smoking kilns was first determined from the amount of charcoal used during the smoking processes in the kilns (Initial weight of the charcoal minus Final weight of the charcoal left).

Organoleptic test

Organoleptic assessment test was carried out by a panel of fifty (50) judges who ranked the smoked fish based on the quality of its appearance, texture, odour and tastes. The panelists were directed to brush their teeth with a set of newly purchased tooth brush met for the research. They were also instructed to rinse their mouth with distilled water provided for the experiment. An interval of twenty (20) minutes after every taste was given to enable the panelists to rinse their mouths and start the next assessment. Hedonic scoring method was designed for the fifty panelists as measuring properties for the assessment of the smoke fish with scoring factors where 1-Dislike extremely, 2-Dislike very much, 3-Dislike, 4-Dislike slightly, 5-Neither like or dislike, 6-Like slightly, 7-Like very much, 9- Like extremely as reported by Ajang *et al*., 2010.

Statistical Analysis

Data were analyzed by one- way analysis of variance (ANOVA) using Statistical Product for Service Solution (SPSS Version 16.0) for window. Statistical significance of difference between means was compared using Turkey (HSD) test.

Results And Discussion

Table1. *Initial and Final weights of charcoals used by the two smoking kilns*

Charcoal	Initial weight(kg)	Final weight(kg)	Consumed weight(kg)
Traditional kiln	100 kg	25 kg	75 kg
Pneumatic kiln	100 kg	60 kg	40 kg

Consumed weight of charcoal used by the two kilns

Table 1 shows the consumed weight of charcoal used by the two smoking kilns. The traditional smoke kiln consumed 75 kg of charcoal while the pneumatic charcoal kiln consumed 40 kg of charcoal respectively. The reason for the differences in the weight of charcoal consumed from the two smoking kilns might be due to the fact that the traditional smoke kiln was exposed to atmospheric air blown without any enclosed chamber which might have caused more burning of the charcoal.

Table2. *Organoleptic assessment of the smoke fish*

Organoleptic quality	Pneumatic charcoal kiln (mean score)	Traditional smoke kiln (mean score)
Appearance	7.9 ± 0.04^{a}	5.6 ± 0.21^{b}
Texture	7.5 ± 0.12^{a}	5.7 ± 0.05^{d}
Odour	7.7 ± 0.00^{b}	4.8 ± 0.33^{c}
Taste	8.3 ± 0.27^{c}	6.3 ± 0.12^{d}

Mean with the same superscript along the column are not significantly different at $p>0.05$

Table 2 above shows the mean result of the processed fish products as assessed by a panel of twenty members. It revealed that the processed fish from pneumatic charcoal kiln scored a mean of 7.9 in terms of appearance, while the processed fish from the traditional smoke kiln scored 5.6. Processed fish from the pneumatic kiln scored 7.5 in terms of texture, while the processed fish from traditional kiln scored 5.7. For odour, processed fish from pneumatic kiln scored 7.7 while those from traditional kiln scored 4.8. In terms of tastes, processed fish from pneumatic kiln scored 8.3 while those from the traditional smoke kiln scored 6.3. The results showed that the processed fish from the pneumatic charcoal kiln were better than those from traditional smoke kiln. Ayang *et al*., (2010) explained that the product presentation (appearance) determines the market value and price of processed fish. The smoking duration was not the same, while smoking process lasted for 5 hours in the pneumatic charcoal kiln; it lasted for 12 hours in the traditional smoke kiln. This is in contrary to Adewole *et al*., (2001) who observed no difference in the process time between traditional smoke kiln

and an improved smoking kiln (Banda). Percent weight loss also differ, while the products from the pneumatic kiln had a weight loss of 30%, the products from the traditional smoke had a weight loss of 70%. This is in agreement with result of Ikenwewe *et al.*, (2010) who got a weight loss of 31.3% using a locally developed smoke kiln for smoking *Clarias gariepinus*.

CONCLUSION

The result of this study revealed that pneumatic charcoal kiln had more qualities and effective than the common traditional smoke kiln in all ramifications.

The study further revealed that:

- Pneumatic charcoal kiln was not only environmental friendly but also more efficiency and effective than the traditional smoke kiln.
- Smoked fish from the pneumatic charcoal kiln had pleasant odour and good texture compared to those of the traditional smoke kiln.

RECOMMENDATION

It is recommended that seminar should be organize for people using traditional smoke kiln, in order to train them how to operate and significant of pneumatic charcoal kiln.

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