

Research Application Summary

Comparative analysis of wood utilization and acceptability of fish from the smoking and frying technologies in Malawi

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Abstract

A study was conducted to compare wood utilization efficiency and acceptability of the processed *Engraulicypris sardella* and *Copadichromis* spp. using smoking and frying technologies. The study was conducted on station at Bunda College and at the fisheries beach in Nkhonkhotakota district, Malawi between January to May 2016. On wood utilization, result from the study show that frying a kilogram of fish uses more wood (5.8267 ± 0.20003 and 1.8433 ± 0.29339) than the rest of the technologies and that the newly improved fish smoking kiln uses the least amount of wood (0.9800 ± 0.07937 and 0.9633 ± 0.14655). The differences in *Copadichromis* spp were not significant ($P = 0.056$) whilst for *E. sardella* they were significant ($P = .000$). Interestingly the newly improved kiln used 32% and 46 % less wood for smoking *E. sardella* and *Copadichromis* spp., respectively compared to the traditional kiln. On the other hand, the fried products were highly accepted by consumers (8.3000 ± 0.16093) compared to other fish products. However, *Copadichromis* spp. smoked by the traditional kiln was liked most in comparison to the other smoked and fried products (7.3750 ± 0.23936). The findings show the potential of the newly improved smoking kiln in improving fish quality and reducing wood usage in fish processing.

Keys words: *Copadichromis* species, *Engraulicypris sardella*, Friismo kiln, frying, improved kiln, sensory analysis, wood usage

Résumé

La présente étude a été menée pour comparer l'efficacité d'utilisation du bois et l'acceptabilité des produits du *Engraulicypris sardella* et *Copadichromis* spp. en utilisant des technologies de fumage et de préparation. L'étude a été menée à la station de Bunda College et à la plage des pêches du district de Nkhonkhotakota, au Malawi, entre janvier et mai 2016. Par rapport à l'utilisation du bois, les résultats montrent que frire un kilogramme de poisson nécessite plus de bois ($5,8267 \pm 0,20003$ et $1,8433 \pm 0,29339$) que pour les autres technologies et que le four à fumage amélioré de poisson utilise moins de bois ($0,9800 \pm 0,07937$ et $0,9633 \pm 0,14555$). Les différences pour *Copadichromis* spp n'étaient pas significatives ($P = 0,056$).

mais elles l'étaient pour *E. sardella* ($P = 0,000$). Chose intéressante, le four amélioré utilisait 32% et 46% moins de bois pour fumer *E. sardella* et *Copadichromis* spp., respectivement, comparativement au four traditionnel. Par ailleurs, les produits frits ont été très bien acceptés par les consommateurs ($8,3000 \pm 0,16093$) par rapport aux autres produits de pêche. Toutefois, *Copadichromis* spp. fumé par le four traditionnel a été plus aimé comparativement aux autres produits fumés et frits ($7,3750 \pm 0,23936$). Les résultats montrent le potentiel du nouveau four dans l'amélioration de la qualité du poisson et la réduction de l'utilisation du bois.

Mots clés: Espèces de *Copadichromis*, *Engraulicypris sardella*, Four Friismo, frire, four amélioré, analyse sensorielle, utilisation du bois

Background

Fisheries resources contribute highly to the livelihoods and food security of many people. Nearly half a billion people globally derive their income from fisheries and fisheries products and fish provides about 15% of the animal protein in the diets of three billion people (Anon. 2011). In Malawi, over 350,000 people are involved in either fish processing or other fish related activities (Commonwealth/GTZ 2007). However, although fisheries support regional economies and livelihoods in different countries, gains from the industry are significantly reduced by post-harvest losses.

In Africa, fish post-harvest loss is reported to be widespread in fisheries sites and aquaculture resulting in revenue losses for producers along the value chain and reducing their potential for economic growth (Russell *et al.*, 2008). In Malawi, the fish post-harvest management field is still underdeveloped; losses in this sector are estimated to be as high as 40% during rainy seasons (FAO, 1981). Efforts have been made to improve fish processing in Malawi which is mainly based on smoking and use of energy efficient smoking kilns have been employed in some parts of Malawi. It is anticipated that improved technologies can promote fish quality and improve marketability of the *E. sardella* and *Copadichromis* species thereby improving livelihoods of small and large scale fish traders. Additionally, improved technologies will also reduce climate change impacts through reduced wood usage. The objectives of this study was to determine wood usage efficiency and acceptability of products from a newly improved kiln, Friismo and the traditional fish kilns as well as the frying technology. These were tested on *Engraulicypris sardella* and *Copadichromis* species.

Study description

To determine the amount of fuel wood used by each smoking kiln, the weight of the total wood used to finish the process of smoking from all kilns was calculated by weighing the wood being loaded into the smoking facilities from the beginning of the smoking process up to the end of the smoking process. To compare wood usage among the kilns, the average wood usage was calculated according to UN FWS Report (2012):



Figure 1. Friismo kiln, newly improved kiln and traditional kiln used in the study (left to right)

$$\frac{\text{Average weight of wood used/kg for tech 1} - \text{Average weight of wood used/kg for tech 2}}{\text{Average weight of wood used/kg for tech 1}} \times 100$$

Smoked fish from the traditional, Friismo and the improved smoking kilns in addition to the fried fish were subjected to organoleptic tests. Qualitative descriptive analysis (QDA) of the organoleptic properties of the processed fish samples was used for acceptability assessment using a nine-point hedonic test (Meilgaard *et al.*, 2008).

Results

The mean difference in wood usage for *E. sardella* processed by the different technologies was found to be significant ($P=0.000$). The frying technology used more wood per kg fish processed compared to the rest of the processing technologies. Processing *E. sardella* using the improved kiln used least amount of wood (0.9800 ± 0.07937). The traditional kiln used a much higher quantity of wood than the improved kiln (1.8133 ± 1.5857).

For *Copadichromis* species, however, processing technologies did not influence wood utilization significantly. Nevertheless, frying used more wood compared to the improved kiln as was the case with *E. sardella* (Table 1). In terms of the percentages, the results showed that the average amount of wood that was used in the improved smoking kiln for *E. sardella* was 46 % less than the amount that was used in the traditional smoking kiln. In the Friismo kiln, 44% less wood from the improved kiln than what was used in the traditional kiln to process *E. sardella*. The *Copadichromis* spp fish that was processed by the improved kiln used 32% less firewood and the Friismo kiln used 13% less firewood from the wood used on traditional kiln. However the differences were not significant ($P = 0.080$).

In terms of acceptability, fried *Copadichromis* spp. was liked most than all other smoked and fried products (Table 2).

Table 1. Wood utilization (kg) in processing fish using different technologies

Species	Technologies				P value
	Traditional kiln	Friismo kiln	Improved kiln	Frying	
<i>Copadichromis</i> spp.	1.4167±.17169 ^{ab}	1.2367±.06333 ^{ab}	.9633 ±.14655 ^a	1.8433±.29339 ^b	.056
<i>Engraulicypris sardella</i>	1.8133±.15857 ^b	1.0100±.17088 ^a	0.9800±.07937 ^a	5.8267±.20003 ^c	.000

Means with the same superscripts are not significantly different

Table 2. Mean sensory score of smoked and fried fish as influenced by different processing technologies

	Type of product				P value
	Fried .	Improved	Traditional	Friismo	
<i>E. sardella</i>	7.85±.213	7.75±.211 ^{bc}	7.00±.226 ^b	6.20±.183 ^a	.000
<i>Copadichromis</i> spp.	8.30±.197 ^c	7.88±.187 ^{bc}	6.10±.205 ^a	7.38±.228 ^b	.000

Discussion

The effectiveness of the improved kiln in the study is attributed to its nature. The improved kiln is enclosed hence more heat is retained than is lost. The larger part of the kiln is made of metal which also enhances the retention of enough heat in the kiln to facilitate cooking and smoking of the fish. A similar study was done on Matemba (*Barbus afrohamiltoni*) fish to compare the Friismo kiln and the traditional kiln and it was found that the Friismo kiln used 30% less wood than the traditional kiln (Chilora, 2012). This was also true in this study where the traditional kiln proved to be inefficient as compared to the improved smoking kilns. Similar results were found in Ghana for the improved kiln called the chorkor smoker which reduced wood usage by about 30% percent (Date-Bah, 1981).

The frying technology used much wood compared to the rest of the technologies. The major factor is that frying is done on an open space and not enclosed hence there is a lot of heat energy escaping to the atmosphere while in the smoking kilns, fish are smoked in an enclosed chamber. Another factor is that cooking oil is boiled for a long time before it becomes suitable for fish to be fried in it. Moreover, it takes long between frying one bunch before another bunch of fish is dropped into oil.

Overall, the results from the acceptability study showed that there were significant differences in consumer preference for fish processed using different technologies. The study showed that fried products for both species were the most preferred. For the smoked products, products from improved kiln were the most preferred. This was due to the unique taste and flavor imparted on the smoked product compared to the rest.

Based on the findings above, improved processing methods are appropriate for adoption because of their energy efficiency and high acceptability. Their efficiency can decrease fish post-harvest losses and reduce climate change effects as well as producing high quality fish products for the market.

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