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COMPARATIVE ASSESSMENT OF CATFISH (CLARIASGARIEPINUS) SMOKED WITH BRIQUETTES AND FIREWOOD

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Abstract - **Agricultural by-products can play a significant role in alternative energy generation. Briquetting from saw dust can reduce some of the problems of energy shortage being encountered world-wide during cooking and fish processing. This study was conducted to produce and compare the suitability and efficiency of saw dust briquettes as an alternative energy source to fuel wood in fish processing. Briquettes were made using a mixture of saw dust and paper to a ratio of 5kg to 2kg, It was mixed thoroughly and poured into a metal mold. A screw press machine with a rectangular die of dimension 30.5cm x 10.4cm x 9.5cm was used for the production of the briquettes. Fish samples collected were smoked using fire wood and briquettes using NIFFR improved smoking kiln. The smoked fish sample was subjected to sensory evaluation and the results were subjected to statistical analysis using Analysis of variance (ANOVA). Samples smoked with firewood were significantly different in colour and odour while samples smoked with briquette were not significantly different (p>0.05) in the (taste and texture) sensory. Fire used to smoke 10kg of fresh fish cost ₦250 while briquettes costs to smoke 10kg of fresh fish cost ₦70. The burning rate was recorded to be 0.55 and 0.18kg/h, for firewood and briquettes respectively. The quality of fish smoked with both firewood and briquettes were of good quality. The cost of using briquettes is less compared to firewood. In conclusion, the use of briquettes as an alternative source of fuel in fish processing is cost effective and environmental friendly.**

Keywords: **Sawdust, Briquettes, Fish, Firewood, Screw pressing machine**

I. INTRODUCTION

Fish is a highly nutritious food. It is particularly valuable for providing proteins of high quality comparable with those of meat, milk or eggs (Umar et al, 2018). However, fish is one of the most perishable of all staple commodities. They are therefore suitable media for the growth and proliferation of microorganism (Umar et al, 2018). Losses arising from bacterial and autolytic spoilage are enormous hence the need to preserve the fish. The most widely employed traditional methods to preserve and process fish for consumption and storage in the third world are smoking and drying. Salting, frying and fermentation are also used but to a lesser degree.
Traditional fish smoking, however, consumes lots of fuel wood and is bedevilled by lack of control over the drying process, exposure to dirt, dust, insect infestation, contaminants and low capacity. These limitations lead to production of unstable and unsafe smoked products which are grossly inadequate. The trade in traditional fish products such as smoked fish, from West Africa to Europe and other developed nations is coming under increasing scrutiny from authorities both in the exporting and importing countries. Ogali (2004). International trade legislation designed for relatively sophisticated industrial level processing is being applied to what is essentially a traditional process. As a result, processors and exporters fail to meet the required standards set by authorities in the country of export. Formal trade is therefore being constrained in what is, at retail level in importing countries, a high value product. Many kilns meant to be fuel efficient and produce better quality fish have been developed. Their major setback is poor adoption rate by traditional fish processors due to their high cost, complexity of construction and consumption of fuel wood.
FAO (2004) stated that for their daily energy needs more people depend on wood than on any single energy source. In this respect, wood can still be counted the world's most important fuel. Unfortunately it is also in desperate short supply. While over two million people still use wood for domestic heating and for cooking, the gap between what they need and what they can obtain easily is now large and grows larger every day.

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Catfish (Clariasgariepinus) is a very important freshwater fish species in Nigeria; it has enjoyed wide acceptability in most part of the country because of its unique taste, flavor and good texture. It is widely distributed, extensively cultivated in ponds, but under-priced Umar et al., (2018).
Studies by Olokor (2004) showed that one fish processor alone use about 16.54kg of fuel wood per day projected at 396,250kg annually estimated at over100 standing savannah tree to smoke fish annually. In Nigeria, dependence on fuel wood for fish smoking is almost hundred percent. It is therefore imperative to reverse the trend for the sake of protecting the environment with specific reference to desert encroachment, soil erosion and pressure on already depleted forest Danshehuet al, (2005). This research was conducted to determine and compare the efficiency of briquettes in fish smoking as an alternative source of energy to firewood utilization

II. MATERIALS AND METHODS

Experimental sites

The experiment was carried outat National Institute for Freshwater Fisheries Research, New Bussa, Niger State, Briquetting was carried out at the NIFFR Fisheries Technology Laboratory and Aviary on latitude 9^0 51' and 1^0 55^1N longitude 4^0 35' and 4^0 51^1E at a mass head elevation of 110m high, 24km width and a length of 136km situated in Borgu Local Government Area of Niger state with an area of 11,579.786 km² and a population of 172,835. Census (2006). It has an annual rainfall of 950mm, with the highest mean monthly in August and temperature ranges between 27 – 37 ^{0}C Mayomiand Olokor(2014). The maximum temperature was 40^0C in February to March and 35 ^{0}C in November to December.

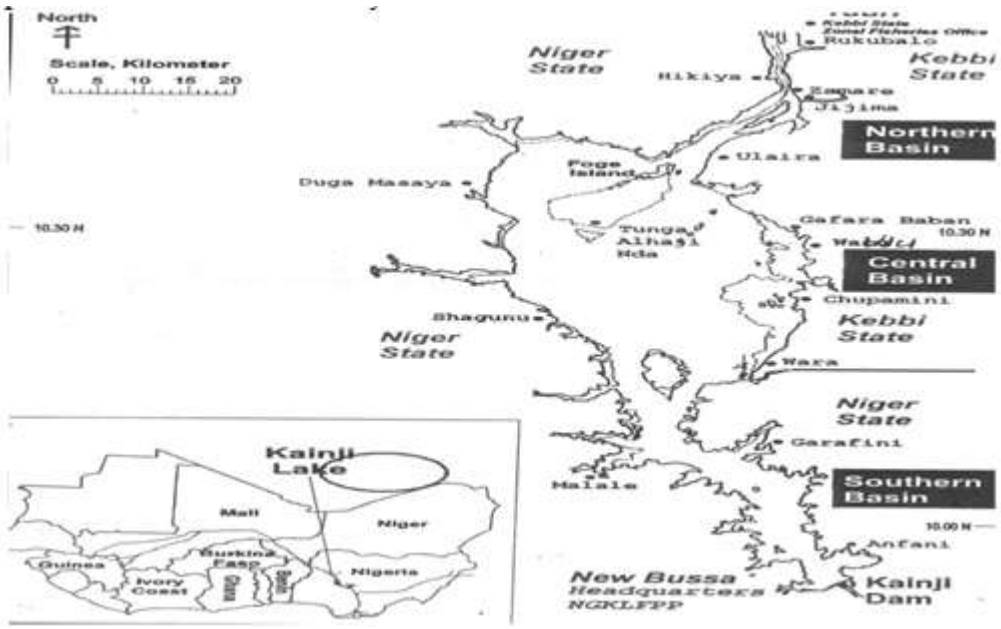

Figure 1: Map showing the location of kainji lake and the experimental sites, New Bussa. Raji et al. 2014

Energy sources

Collection of sawdust and paper

The sawdust was collected from a saw mill in New Bussa. A total of about 5Kg of sawdust and 2kg of paper was collected and then ground into small granules or fine particles and soaked in water for Briquetting.

Sawdust and paper Briquettes Press

Generally, the briquettes were made through the following procedure as shown in figure 2

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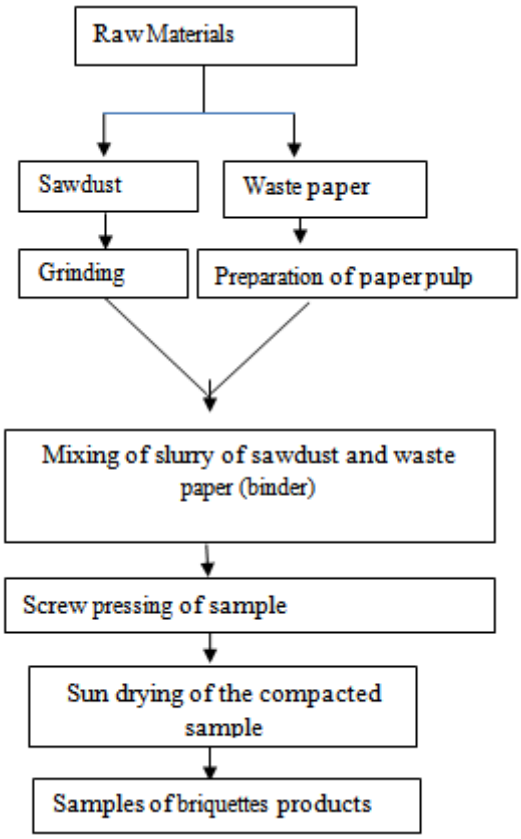

Figure 2: Flow diagram of briquette production process

Trials on the compaction on the slurry samples were carried out using a screw press machine. A metallic rectangular die of dimension 12.3cm x 9.2cm x 7.3cm length, width and height respectively, were used for this study. The die was freely filled with known weight for each sample mixture and positioned in the screw powered press machine for compression into briquettes. The screw iron rod was actuated through manual rotation of the Disc couple on the iron rod which move in other to compress the sample produce. A known pressure was applied at a time to the material in the disc and was allowed to stay for 4 minutes (dwell time) before ejection and the briquette formed was then being aired/sun dried. Stop watch was used for timing purpose. Figures 3 and 4 below shows sample of briquettes production using the screw press machine while figures 5 and 6 shows smoking process using briquettes and firewood

Figure 3: screw press used in briquettes compaction.

Figure 4: Samples of briquettes

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Figure 5: Smoking process using briquette

Figure 6: Smoking process using firewood

The initial weight of the sample was determined (W_1) before drying in the sun. During the drying process, the reduction in moisture content was recorded every 4 hours for 48hours. The samples were removed from the sun and reweighed (W_2). The moisture content of the sample was calculated using the following expression,

$$Moisure\ content = \frac{W_1 - W_2}{W_1} X\,100 \qquad 1$$

$$Burning\ Rate = \frac{Total\ weight\ of\ the\ burned\ briqettet}{Total\ time\ taken} \qquad 2$$

Collection of firewood

The firewood materials were purchased from local wood seller at Popo kere along New Bussa road, which is a hardwood known to be preferable for smoke concentration than soft wood and may give products with lower pH and more bacteriological stability the choice of this type of wood is that due to it, higher content of some phenolic compounds, it is also one of the most common woods used in fish smoking in the savannah zone of Nigeria. Eyo (2001). Consumption of the various wood materials were measured by weighing a load of each wood material at the beginning of the smoking process and weighing all the remaining and partial burnt at the completion of smoking. SFC was computed as:

$$Specific\ fuel\ consumption = \frac{Mass\ of\ fuel\ consumption}{Total\ mass\ of\ smoked\ fish} \qquad 3$$

Smoking process

Preparation and smoking of fish samples.

The fish species used for this experiment were catfish Clarias spp. Twenty (20) fresh Catfish C. gariepinusof average weight ranges of 600 - 900g each, were purchased from Babawo in Monai village, New Bussa, Niger State, Nigeria. They were degutted and then washed thoroughly with clean tap water to remove blood and slime. Thereafter fish sample were divided into two groups of 14 each and the bigger once were cut into different sizes while the smaller once were folded, for smoking with firewood and sawdust Briquettes respectively. Using the Improved NIFFR Smoking Kiln was used for the smoking; the initial mean weight of the fish was recorded in kg. The fish was then brined in 20% salt, ginger and garlic solution for 30minute to improve their flavour, taste and enhance their shelf life. They were then allowed to drain for about 10 minutes before smoke drying in an improved smoking kiln. The fish were arranged on top of wire mesh placed in a smoking kiln for each of the treatments (firewood and sawdust paper pulp briquettes). The fish were turned after 2 hours of heating in other to prevent them from burning. There after the fish were allowed for 24 hours until dried to a constant weight. Samples of the smoked fish were taken to the laboratory for proximate, sensory Analysis.

Sensory evaluation

This was undertaken to determine the taste, odour, texture and general appearance (colour) of the Smoked Fish products. Taste panels of five members already familiar with scoring smoked fish were given the product scores at every three-week interval. Products were scored on a 5 point hedonic scale of 5 - Excellent, 4 - Good, 3- Fair, 2 - Poor, and 0 - Bad. (Eyo, 2001).

Statistical Analysis

The data collected was subjected to statistical analysis using one way Analysis of variance (ANOVA) and Duncan Multiple Range Test was used for mean separation. The statistical analysis was conducted by using IBM SPSS version 20 software.

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Table 2: Weigh of fish obtained before and after smoking with firewood and briquettes

Energy source	Fresh fish (kg)	Smoked fish (kg)	Weight loss (kg)	weight loss (%)
Briquette	2.5	1.2	1.3	52
Fire wood	2.5	1.0	1.5	60

Table 3: Materials used for smoking

Parameter	Units	Fire wood	Briquettes
Weight of fuel material used	Kg	15	4.5
Cost of fuel material used	₦	250	70
Weight of fuel for 5kg of fresh fish	Kg	11	4.0
Cost of fuel for 5kg of fresh fish	₦	110	40
Smoking duration	Hr	20	22
Smoking temperature	^{0}C	60-70	45-60
Specific fuel consumption	Kg	11.0	3.33
Burning rate	Kg/hr	0.55	0.18

Table 4: Sensory evaluation of smoked Clarias. gariepinususing firewood and sawdust briquettes

Parameter	Taste	Odour	Texture	Colour
Briquette smoked fish	4.60±0.55	4.20±0.44	4.20±0.84	4.20±0.84
Firewood smoked fish	4.80±0.45	3.80±0.83	3.60±0.55	3.80±0.67

III. RESULTS AND DISCUSSIONS

The result of Table 1 indicates the physical characteristics of sawdust and paper briquettes used for the smoking. Fifteen (15) pieces were produced each having 0.28m length, 0.1m breadth, 0.0899m thickness with mass of 5.0kg. The combustion characteristics were also calculated. Table 2 also show weight obtained before and after smoking with firewood and briquettes, while Table 3 shows firewood and sawdust briquettes consumption in the smoking of Clariasgariepinus.

The result shows that fish smoked using firewood yielded 60.0% of moisture content lost compared to 52.0% of briquettes smoked fish product (Table 2) Results of the analysis of fuel wood and sawdust briquettes consumption, smoking duration and temperature in the smoking of Clariasgariepinus(Table 3) showed that 11.0 and 4.0 kg of firewood and sawdust briquettes were used to smoke five kilogram(kg) of Clariasgariepinusat average temperature ranges of 60-70 °C and 45-60°C, respectively.

The results of statistical analysis of the sensory (organoleptic) parameters of the experimental samples in Table 4 showed that there was a statistically significant difference ($p<0.05$) in color and odour of the smoked fish. using firewood and sawdust paper briquette with a mean value of 4.20±0.84 and 3.80±0.67 for briquette and 4.20±0.44 and 3.80±0.83 for fire wood on the data obtained from the panel members.

The specific fuel consumption of the two fuel sources were 11.0 kg (firewood), and 3.33kg (briquettes) as shown in (Table 3).

The sensory attributes as observed by the response of the five member evaluator panel showed that people preferred fish, smoked using sawdust briquettes than the ones smoked using firewood in terms of taste and texture and colour. However, there was no significant difference ($p>0.5$) in the (taste, odour and texture) sensory attributes of fish smoked using sawdust and paper briquette or firewood on the data obtained from the panel members. Although there exist a statistically significant difference ($p<0.5$) in colour of the smoked fish using firewood and sawdust briquette with a mean value of 4.20±0.84 and 3.80±0.67 for briquette and 4.20±0.44 and 3.80±0.83 for fire wood, where by fire wood smoked fish product produce dark brown colour and that of briquettes gives a golden brown till the end of the smoking period Which might be as a result of phenolic and hemicellulose compound present in smoked of hardwood materials.

IV. CONCLUSION

The production and testing of briquette was successfully carried out, it was found to be compactable with other researches that carried out different work on briquetting. Therefore, the results obtained from this study have met the objectives set at the early stage of the research. That is to develop a briquette from the mixing of sawdust and paper in 4:2 ratios has been achieved successfully. The briquettes were compatible with each other and it is suitable as a new solid fuel sources that can be utilized in many application. The briquetting of sawdust with paper can improve its physical and mechanical properties. In view of this, the utilization of sawdust and paper in the production of briquettes can greatly provide alternative energy sources for fish smoking.

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