International Scholars Journals

African Journal of Fisheries Science ISSN 2375-0715 Vol. 7 (5), pp. 001-003, May, 2019. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Short Communication

Proximate composition of catfish (*Clarias gariepinus)* smoked in Nigerian stored products research institute (NSPRI): Developed kiln

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Accepted 07 March, 2019

The effect of drying on proximate compositions of catfish (*Clarias gariepinus*) using Nigerian Stored Products Research Institute (NSPRI) developed kiln was determined. The purchased quantities of catfish were shared into two parts; one part was used to determine the proximate compositions of the raw fish and the other part was dried using smoking kiln at a temperature range of 60 to 70°C for 15 h. The proximate compositions of the fresh and dried samples were determined. Also, sensory evaluation was also determined using 9 point hedonic scale. Protein, carbohydrate, moisture content, fat, ash and nitrogen free extract (NFE) for fresh and dried fish were 16.24, 0.92, 78.70, 0.50, 1.33, 2.31% and 68.4, 1.80, 7.30, 12.50, 6.40, 3.60% respectively. The general acceptance as shown by sensory evaluation was equally high. It was therefore concluded that drying does have a positive effect on fish since there was an increase in embedded nutritional parameters.

Key words: Smoking kiln, sensory evaluation, protein, carbohydrate, moisture content, fat.

INTRODUCTION

Nigerians are large consumers of fish and it remains one of the main products consumed in terms of animal protein. It is cheap and highly acceptable, with little or no religious bias, which gives it an advantage over pork or beef (Eyo, 2001; Ligia, 2002). Only about 50% of the demand for fish is currently being met by local supply. The fishery sector is estimated to contribute 3.5% of Nigeria's Gross domestic product (GDP) and provides direct and indirect employment to over six million people (Trade invest Nigeria, 2010). Fish is a very important source of animal protein in the diets of man. Smoked or dried fish is a traditional part of the diet of a large section of the world's population. However, the gap between the demand and supply of fish is widening due to increase in population, poor postharvest handling, lack of processing and storage facilities and utilization of unconventional fish species (Ayuba and Omeji, 2006).

Spoilage is a metabolic process that causes food to be undesirable or unacceptable for human consumption due to changes in sensory and nutritional characteristics (Doyle, 2007). The processing and preservation of fresh fish were of utmost importance since fish is highly susceptible to deterioration immediately after harvest and also to prevent economic losses (Okonta and Ekelemu, 2005). If fish is not sold fresh, preservation methods should be applied to extend the shelf-life. These include freezing, smoking, drying and heat treatment (Sterilization, pasteurization, etc). Efficient preparation of fish is important when top quality, maximum yield and highest possible profits are to be achieved. Methods of drying and smoking fish vary between different countries and within the same country depending on the species of fish used and the type of product desired (Ogbonnaya and Ibrahim, 2009).

The African catfish, *Clarias gariepinus*, is easily cultured in Nigeria and of great economic interest. It is generally considered to be one of the most important tropical catfish species for aquaculture. It has an almost

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Abbreviations: NSPRI, Nigerian stored products research institute.

Table 1. Fresh and dried weight of catfish.

Sample	Total weight (g)	Mean weight (g)
Fresh catfish	19284	332.48±62.91
Dried catfish	5076	87.52±17.25

Table 2. Initial proximate for fresh and dried catfish.

Parameter (%)	Fresh catfish	Dried catfish
Protein	16.24	68.4
Carbohydrate	0.92	1.80
Moisture content	78.70	7.30
Fat	0.50	12.50
Ash	1.33	6.40
NFE	2.31	3.60

Pan African distribution, ranging from the Nile to West Africa and from Algeria to South Africa (Osibona et al., 2006). Fish is highly perishable and needs to be processed immediately if unrefrigerated to avoid wastages and economy fall out. Among the several methods of long term preservation of fish, smoking is perhaps the simplest method as it does not require sophisticated equipment or highly skilled workers. In an attempt to reduce the problems often encountered during smoking, Nigeria Stored Products Research Institute (NSPRI) fish smoking kiln was developed. Another point of major concern is what happens to the nutritional quality parameters of the fish after smoking therefore this study was conducted to evaluate the nutritional quality of catfish smoked with NSPRI kiln.

MATERIALS AND METHODS

Description of NSPRI kiln

The smoking kiln is rectangular in shape of dimension 60 x 60 x 120 cm in depth, width and height respectively. The structure has an internal wall made of galvanized iron (GI) sheet, lagged with 2.54 cm asbestos particles and covered with ½ in plywood. It has a unit compartment for drying, heating and smoking with removable four trays made from 25.81 cm square wire mesh placed on 2.54 cm angle iron. The structure was incorporated with three axial fan powered by ten 1.5 V battery to increase air supply to the heating chamber. The heating chamber was also made up of two sections which may be used together or independently, they are the heat producing section which can produce heat using charcoal, coal or coconut shell; and the smoke producing section using sawdust. Four of the ½ in diameter pipe exits were also provided at the top of the structure to aid the escape of water vapour during the smoking process while 6 of the ½ in diameter pipe were provided for air-inlets. The structure works by burning charcoal to produce heat for the drying of the fish and by burning sawdust to generate smoke which imparts desired aroma and color to the smoked fish. The structure may be used to dry the fish alone without smoking and vice versa.

Fish processing

Sixty seven freshly harvested Catfish (*Clarias gariepinus*) aged six months were obtained from Fagam Farm through Kano State Department of Fisheries in Kano State, Nigeria. All were killed, beheaded, eviscerated and washed thoroughly. They were brined using a teaspoon of salt per fish. They were packaged into NSPRI Fish boxes which were insulated and the fish to ice in ratio 1:1 and were transported to the laboratory for further treatments. The fish-smoking kiln was operated by first loading charcoal into the heat chamber, preheating for some minutes, and then loading the salted pieces of fish onto the trays in its central chamber. The kiln was closed for some time to allow the smoking to take place. The capacity was 100 kg per barge. The smoking time, temperature and ambient conditions were monitored during the smoking operations. The smoking was terminated when the fish were properly dried after 15 h. The fresh and smoked samples were analyzed for lipids, protein, moisture content, ash, crude fibre and nitrogen free extract (NFE). The sensory evaluation was also conducted using nine unit hedonic scales conducted by six semi trained panels.

Proximate analysis

The proximate compositions were assayed as described by AOAC (2000). All chemicals used were of analytical grade and supplied by Sigma Co. (St Louis, USA). Each analysis was carried out in triplicates.

RESULTS AND DISCUSSION

The design of the dryer ensured that the fish come out with a very low moisture content and long shelf life. The weight of the fresh and dried catfish as shown in Table 1 revealed that there was a drastic weight reduction. The total weight of the fresh fish purchased after de-heading was 19.28 kg and was dried to 5.08 kg after 15 h at about 70°C. This amounted to 73.68% of the moisture lost in the catfish, which showed that catfish is three quarter water and highly perishable. Thus, an urgent step must be taken for its protection against destructive agents like microorganisms. The fish species examined belonged to high-protein (15 to 20%) and low-oil (< 5%) category. The low ash, carbohydrate, fat, nitrogen free extract (NFE), high protein and moisture content values obtained from the proximate analysis as shown in Table 2 agreed with other analysis carried out by earlier researchers such as Effiong and Mohammed (2008), Mumba and Jose (2005) and Abdullahi (2001).

The moisture content of the dried catfish which is of great importance in storage is still at safe level of 7.3% which is in between the recommended safe moisture content of dried fish (6 to 8%). The significant increase in protein levels ($P < 0.05$) in dried catfish, when compared with the raw fish, suggested that protein nitrogen was not lost during drying. This is also in accordance with the findings of Puwastien et al. (1999), Gokoglu et al. (2004) and Tao and Linchun (2008). Fishes with lipid content below 5% are considered lean (Stansby, 1982; Ackman,

Table 3. Sensory evaluation.

S/N	Parameter	Scores
1.	Smell	6.63
2.	Texture	6.90
3.	Colour	7.78
4.	Taste	6.75
5.	General acceptance	7.02

1989) and hence *Clarias gariepinus*. The lipid content also falls within the range previously detected in fish (Mendez et al., 1996).

In general, there were significant influences of drying on proximate compositions of catfish. Lack of negative influence of the drying processes on the protein, lipids, ash, fibre, vitamins and mineral contents of catfish is of great practical importance, although drying resulted in a significant loss of energy value. These results showed that different nutritional components of fish undergo different changes at elevated temperatures.

The sensory evaluation as shown in Table 3 which was conducted by six semi-trained panelist on a 9 point hedonic scale of smell, texture, colour taste and general acceptance showed that, the fish were in good quality and condition and can be widely accepted.

Conclusion

The kiln proved to be effective in drying the fish to safe moisture content which can make it suitable for export. There were also positive significant influences of drying on the proximate compositions of catfish making it nutritionally suitable for all.

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