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Evaluation of Slurry Formulations for *Kilishi* Processing of African Lungfish (*Protopterus annectens*, Owen)

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Abstract: The *kilishi* of *Protopterus annectens* was produced for determination of appropriate slurry formulations for fish *kilishi* preparation. Thirty six freshly caught samples of *Protopterus annectens* with average weight of 331.00±22.64g from Kware Lake in Sokoto State were used. *Kilishi* of this species was prepared with three different slurry formulations of high (F_1), medium (F_2) and low (F_3) proportions of groundnut dough to spice mixture in the ratio of 1.3:1.0, 1.0:1.2 and 1.0:1.8, respectively. Results of proximate composition indicated that *kilishi* of the *P. annectens* prepared with formulation 3 (F_3) recorded significantly higher ($p<0.05$) protein content (45.18±0.02%) and lower lipid content (11.07±0.07%) despite recording significantly higher ($p<0.05$) moisture content (9.07±0.07%). Sensory score of *kilishi* of *P. annectens* processed with F_3 formulation rated significantly higher ($p<0.05$) for texture, taste and flavour with mean scores of 5.72±0.22, 6.14±0.23 and 5.69±0.20, respectively. It could be concluded that *kilishi* of *P. annectens* prepared with F_3 formulation was the most acceptable, hence, recommended for use in *kilishi* production.

Key words: *Kilishi*, *Protopterus annectens*, proximate analysis, organoleptic assessment

INTRODUCTION

The awareness of the need for adequate protein in human diet has greatly increased in developing countries and fish has been widely acknowledged as a rich source of dietary protein (Brown, 2007). Among the sources of good quality protein food such as beef, mutton, chicken and others, fish is the most perishable (Ames *et al*., 1991) and when one considers the many species of fish and shell fish available and the number of ways in which they may be processed, it may be seen that the range and variety of products which may be prepared are immense (FAO, 1974). In this regard, the need for alternative processing technology which will enable maximal use of raw material which reduces the problem of insufficient supply of fish to meet the increasing human demand is of paramount importance. In Nigeria, a large amount of fish is lost after harvesting both in terms of quantity and quality. This loss is mostly prevalent in the artisanal fisheries due to lack of adequate post-harvest technology (Ugwumba and Ugwumba, 1993). Other factors include discarding of trash fish, hot weather, poor handling methods which promote bacterial decomposition, fungal contamination and insect infestation. Fish stocks are threatened by other factors such as land based pollution and global warming leading to scarcity. There is therefore the need to gear up efforts towards preservation of fishery products because of their perishable nature. Value addition techniques help satisfy the rising consumer demand for processed fisheries products, enhance the acceptability of captured and aquacultured fishery products and generate employment and hard currency to many countries (Taylor and Francis, 2006). To reduce post harvest losses and for product diversification and value addition to fish, *kilishi*, a technique hitherto applied to the processing of animal meat in northern Nigeria (Igene *et al*., 1989) was subsequently applied to the processing and preservation of fish (Magawata and Oyelese, 1999).

Protopterus annectens was chosen for *kilishi* preparation because they are available locally, have less market value as fresh fish, low fat content and higher flesh to bone ratio. For product diversification, value addition and reduction of post harvest losses, an evaluation of *kilishi* processed *P. annectens* u sing 3 different slurry formulations was conducted. The aim of this study was to determine the nutrient contents of the fish samples and ingredients and to derive appropriate slurry formulations for the preparation of *kilishi* of *P. annectens*.

MATERIALS AND METHODS

Fish samples: Thirty six freshly caught samples of *P. annectens* with average weight of 331.00±22.64g were obtained from Kware Lake in Sokoto State, Nigeria in April, 2011. These were transported to the Forestry and Fisheries Laboratory of the Usmanu Danfodiyo University, Sokoto, where they were weighed, washed,

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Table 1: Proportion of ingredients and spices used for slurry preparation

Ingredients/spices (Common name) (Common name)	Scientific name	Reference formulation (F_0) Weight (g)	Proportion (%)	Treatment (proportion %) F_1 (High) High	F_2 (Medium) Medium	F_3 (Low) Low
Defatted groundnut dough		1980	66.0	56.0	46.00	36.00
Onion	*Allium cepa*	420	14.0	18.11	22.24	26.36
Ginger	*Zingiber officinale*	180	6.0	7.76	9.54	11.30
Dried (hot) pepper	*Capsicum frutescens*	90	3.0	3.88	4.76	5.65
Cloves	*Eugenia caryophyllata*	60	2.0	2.59	3.18	3.76
Candle wood	*Fagara zanthoxyloides*	60	2.0	2.59	3.18	3.76
Black pepper	*Piper guinensis*	90	3.0	3.88	4.76	5.65
Salt	Sodium chloride	30	1.0	1.30	1.58	1.88
Curry powder		30	1.0	1.30	1.58	1.88
Magi cube		60	2.0	2.59	3.18	3.76
Ratio (Groundnut dough: spices)				1.3:1.0	1.0:1.2	1.0:1.8
Total			100	100	100	100

descaled, degutted and deboned according to the method of Magawata and Oyelese (2000) and then sliced while still in their fresh form.

Ingredients and spices processing: The ingredients/spices used for slurry formulation were bought from Sokoto Central Market, Sokoto. The principal ingredient was the defatted groundnut dough which was bought from groundnut millers at Rijiya Dorawa Sokoto, Sokoto State. The proportions of each of the ingredients were as contained in Table 1.

Slurry formulation: Three different combinations of ingredients and spices were prepared using that of Ipinjolu *et al*. (2004) as a reference point. This formulation was too thick due to high proportion of the principal ingredient. The present formulations were varied with lower concentrations of groundnut dough and increase in proportion of spices to have high, medium and low proportion of ingredient to spice mixtures (F_1, F_2 and F_3) in the ratio of 1.3:1.0, 1.0:1.2 and 1.0:1.8, respectively as shown in Table 1. Each formulation was used on the 36 samples of *P. annectens* used for this study.

Experimental design and treatments: The three formulations (F_1, F_2 and F_3) constituted the treatments of the experiment and each was replicated three times in a Completely Randomized Design (CRD) so as to come up with the best slurry formulation for the species. The treatments comprised of high, medium and low levels of defatted groundnut dough in the formulation.

Fish *kilishi* processing stages: The stages followed in the fish *Kilishi* processing were as described by Magawata and Oyelese (2000) summarized in Fig. 1.

Quality assessment of freshly prepared fish *kilishi*

Proximate analyses: The proximate composition of the ingredients/spices used for slurry formulation, the samples of fresh (wet) fish and fresh *kilishi* of

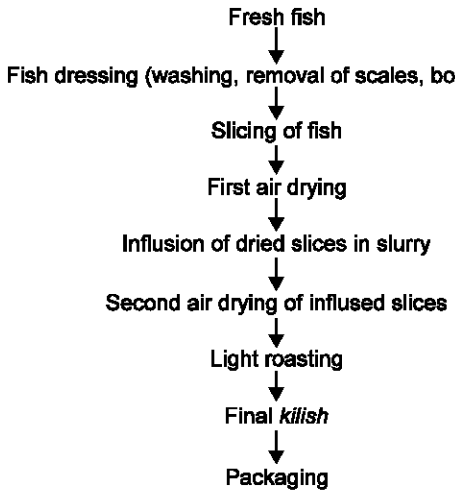

Fig. 1: Flow chart summarizing stages of fish *kilishi* processing. Source: Magawata and Oyelese (2000)

Protopterus annectens were analyzed according to the Association of Official Analytical Chemists (AOAC, 1995) procedures. The moisture content was determined after oven drying at 105°C for 24 h, protein content was determined using the Kjeldahl method, fat contents was determined using the Soxhlet Extraction method, ash contents was determined by placing 2.0g of the sample in the Muffle furnace at 500°C for 3 h and then cooled in a desiccator while nitrogen free extracts was obtained by difference.

Organoleptic assessment: Samples from the freshly prepared *kilishi* products were weekly subjected to sensory evaluation for 3 weeks to obtain data for the selection of the best out of the three formulations for each species before storage. A 12-member taste panel consisting of staff and students of the University was constituted. The samples were blind coded to reduce bias. Organoleptic parameters assessed include texture, taste, flavour and general acceptability in

accordance with Post *et al.* (1991). A 7-point hedonic scale ranging from highly acceptable, very acceptable, slightly acceptable, acceptable, slightly unacceptable and very unacceptable to highly unacceptable was adopted for each quality parameter. Pencils, tissue paper and water were provided to the judges.

Data analyses: The data obtained were subjected to Analysis of Variance (ANOVA) using SPSS version 16.0 (2007) computer packages. Duncan Multiple Range Test (DMRT) was further used to separate treatment means where there was significant difference. Tables and figures (graphs) were also used to illustrate results as appropriate.

RESULTS

Proximate composition of ingredients and spices: The mean proximate compositions of the ingredients and spices used in the preparation of the three different slurry formulations are presented in Table 2. The highest value of all the constituents determined was the nitrogen-free-extract. This ranged from 19.49±0.95% in onions to 82.03±0.32% in candle wood stem. The lowest concentration of moisture was in maggi cubes (1.50±0.00%) while onion recorded the highest (60.67±1.00%). The defatted groundnut dough recorded the highest crude protein (20.60±0.20%) and lipid content (15.00±0.29%) while salt had the lowest crude protein (0.02±0.01), lipid (trace) and moisture (trace) contents.

Proximate composition of fresh *P. annectens*:: The results of proximate content of fresh samples of *P. annectens* indicated that it contained 68.03±0.06, 2.13±0.09, 1.50±0.00, 0.50±0.00, 16.16±0.48 and 11.67±0.60% moisture, ash, lipids, fiber, protein and nitrogen free extracts respectively (Table 3).

Proximate composition of fresh *kilishi*: The results of the proximate compositions of the *kilishi* immediately after processing from *P. annectens* according to formulations are presented in Tables 4. *Kilishi* prepared with F_3 formulation recorded significantly higher ($p<0.05$) protein (45.18±0.02%) and lowest lipid (11.07±0.07%) despite having the highest moisture content (9.07±0.07%). The nitrogen-free- extracts was significantly lower ($p<0.05$) in *kilishi* prepared with F_3 (23.72±0.09%).

Organoleptic characteristics: The results of sensory analysis of the freshly prepared *kilishi* of *H. niloticus* and *P. annectens* are presented in Table 5. The sensory scores of *kilishi* prepared with F_3 formulation was significantly higher ($p<0.05$) for texture (5.72±0.22), taste (6.14±0.23) and flavour (5.69±0.20). The results of general acceptability indicated no significant difference (Table 5).

DISCUSSION

Nutrient contents of fish samples and ingredients: The proximate composition of fresh *P. annectens* was within reported limits. The protein content (16.16±0.48%) observed conforms to the values reported by Magawata (2008) and Samuel *et al.* (2010) who worked on *Protopterus annectens* and *Clarias gariepinus*, respectively. According to Magawata (2008), who studied

Table 2: Proximate composition of ingredients and spices

Ingredients/spices	Moisture (%)	Ash (%)	Lipid (%)	Fibre (%)	Protein (%)	NFE (%)
Defatted groundnut dough	18.83±0.00	3.50±0.00	15.00±0.29	0.04±0.17	20.60±0.20	42.19±0.34
Onion	60.67±1.00	8.56±1.00	0.83±0.02	Trace	10.45±1.05	19.49±0.95
Ginger	8.47±0.06	6.67±0.29	7.33±0.29	1.50±0.00	4.83±0.15	71.20±0.62
Chilli pepper	1.67±0.28	9.33±0.29	12.50±0.00	2.50±0.00	4.63±0.15	69.37±0.42
Cloves	27.01±0.12	10.50±0.06	11.50±0.00	1.50±0.00	3.73±0.12	45.76±0.21
Fagarasanthox loids	4.50±0.00	6.50±0.00	3.50±0.00	1.83±0.29	2.13±0.06	82.03±0.32
Black pepper	17.83±0.17	11.00±0.00	13.86±0.29	3.17±0.29	6.50±0.12	47.47±0.36
Salt	Trace	98.47±1.00	Trace	Trace	0.02±0.01	1.51±0.10
Curry powder	1.67±0.28	15.50±0.29	7.50±0.00	1.07±0.00	5.87±0.12	68.57±0.12
Maggi cubes	1.50±0.00	71.50±0.10	5.00±0.00	0.17±0.12	3.87±0.15	17.9±0.15

Table 3: Proximate composition of experimental fresh fish

	Moisture (%)	Ash (%)	Ether extract (%)	Fibre (%)	Protein (%)	NFE (%)
P. annectens	68.03±0.06	2.13±0.09	1.50±0.00	0.50±0.00	16.16±0.48	11.67±0.60

Table 4: Proximate composition of *kilishi* of *P. annectens*

Formulation	Moisture (%)	Ash (%)	Ether extract (%)	Fibre (%)	Protein (%)	NFE (%)
1	5.37±0.09^{b}	10.30±0.10^{a}	12.37±0.09^{a}	2.07±0.07^{a}	40.66±0.01^{b}	29.90±0.84^{b}
2	1.60±0.10^{c}	10.00±0.00^{b}	11.37±0.09^{b}	1.43±0.03^{b}	34.51±0.02^{c}	41.09±0.05^{a}
3	9.07±0.07^{a}	9.03±0.03^{c}	11.07±0.07^{c}	1.93±0.07^{a}	45.18±0.02^{a}	23.72±0.09^{c}
SEM	0.086	0.061	0.082	0.058	0.018	0.486

Values are mean±standard error of 3 replications. Means in a column with same letter are not significantly different ($p>0.05$). SE: Standard error of means

variations in proximate composition of species, the least species in terms of protein content of flesh and other organs was *P. annectens* (16.53±1.17) and opined that the nature of the muscles of this species with much resemblance to that of higher animals might have contributed to the lower protein content in comparison to other species. The moisture content obtained for fresh *P. annectens* was slightly lower than that recorded by Bhandary (1991) in fresh Catfish (*Clarias gariepinus*) (70.25±0.4). The protein content of the fresh *P. annectens* was similar to that obtained (16.24%) by Olayemi *et al.* (2011). These may be attributed to the quality and level of feeding of the two fish species.

Similarly, the results of the proximate composition of the ingredients/spices indicated that most of them had very small quantity of protein and fat and high proportion of carbohydrate. This is in line with Nwinuka *et al.* (2005) who noted that the highest value of all the parameters determined was the total carbohydrate composition (76.71%) in onion. The authors added that the samples were found to be good sources of carbohydrates only but poor sources of ash, protein and fat. These may be why these samples are used as mere spices and not as sources of nutrients. The proximate composition of defatted groundnut dough shows that it is a good source of protein and fat while salt, maggi and curry powder are good sources of ash thereby making *kilishi* nutrient rich. This is further confirmed by Ogunsola and Omojola (2008), who stated that processing meat into *kilishi* improves the nutrient composition especially the protein and ash thus making it nutrient dense.

Selection of more appropriate mix of ingredients and spices: From the results of proximate composition of *kilishi* of *P. annectens* (Table 4) prepared with three different formulations (F_1, F_2 and F_3), F_3 was considered more appropriate spice mix for *kilishi* production of the two species because it recorded the highest protein content (45.18±0.02%) and lowest lipid content (11.07±0.07%). The lower protein content recorded in the other two formulations (F_1 and F_2) must have been as a result of the higher proportion of groundnut dough in the mixture. Doe and Olley (1983) noted that heating (smoking) resulted in concentration of nutrients like crude protein. Mohammed *et al.* (2010) ascertained that it is important to assess the contents of proteins, fat and moisture in fish tissues as they could affect the post harvest processing and storage of the fish. The nutritional quality of fish depends largely on the quantity and quality of its crude protein (Oni, 2002). The lower lipid content observed in the F_3 could be attributed to lower concentration of groundnut dough. High lipid in fish could affect the storage quality because it is the hydrolysis of the lipid that leads to rancidity which is one of the causes of fish spoilage. Though *kilishi* prepared with F_3 formulation also recorded the highest moisture contents, these moisture levels were still below the limit beyond which spoilage can occur. Daramola *et al.* (2007) stated that moisture content of 12% is the level beyond which fish products begin to grow mould.

Kilishi of *P. annectens* produced with F_3 was also rated better in terms of texture, taste and flavour. The lower concentration of the groundnut dough in the F_3 formulation which enabled the 'fishy' taste to be more prominent must have influenced the panelist's decision. Overall, result of merit analysis conducted on the species indicated that *kilishi* prepared with F_3 was organoleptically more acceptable which suggests that the value addition had transformed the species product in the eyes of the consumers who hitherto could have rejected it if it were to be fresh.

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