

NUTRIENT COMPOSITION AND ORGANOLEPTIC ASSESSMENT OF FISH KILISHI FROM *CLARIAS GLARIEPINUS* AND *MORMYRUS RUME*

Abubakar IBRAHIM * and Godwin ADAKA **

* Federal University of Technology, Department of Fisheries and Aquaculture Technology, PBM 1526 Owerri, ibrahimbkrsdq@gmail.com, revadaka@gmail.com, ORCID: 0000-0001-6584-8289.

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ABSTRACT

Fish samples from fresh fish, cleaned/washed fish; first stage dried, infusion slurry, and second stage dried, finished product and stored kilishi were analysed. Evaluation was carried out on finished products using a 10-point Hedonic scale. Microbial count and moisture content showed significant differences ($p < 0.01$). Proximate composition of sun and oven dried kilishi (T_1) record significantly of higher protein (34.13 ± 0.01), higher ether extract (29.45 ± 0.01), higher nitrogen free extract (17.45 ± 0.35), and have moisture content of (10.92 ± 0.29) despite having highest ash content (5.76 ± 0.69) with crude fibre (2.29 ± 0.23). Kilishi (T_2) significantly higher protein (27.13 ± 0.01), higher nitrogen free extract (37.18 ± 0.64), higher ether extract (19.45 ± 0.58), higher ash content (6.09 ± 0.06), despite having higher crude fibre (1.77 ± 0.06) with moisture content of (8.45 ± 0.52); the high proportion of departed groundnut dough mixture resulted in low protein of fish kilishi.

RÉSUMÉ: Composition en nutriments et évaluation organoleptique de kilishi de poisson à partir de *Clarias gariepinus* et *Mormyrus rume*.

Des échantillons de poisson frais, de poisson nettoyé/lavé, de poisson séché au premier stade, de boue d'infusion, et de kilishi séché au deuxième stade, de produit fini et stocké ont été analysés. L'évaluation a été réalisée sur les produits finis à l'aide d'une échelle de Hedonic en 10 points. La numération microbienne et la teneur en humidité ont montré une différence significative ($p < 0,01$). La composition proximale du kilishi séché au soleil et au four (T_1) présente une teneur en protéines plus élevée ($34,13 \pm 0,01$), un extrait d'éther plus élevé ($29,45 \pm 0,01$), un extrait libre d'azote plus élevé ($17,45 \pm 0,35$) et une teneur en humidité de ($10,92 \pm 0,29$) malgré une teneur en cendres plus élevée ($5,76 \pm 0,69$) et des fibres brutes ($2,29 \pm 0,23$). Kilishi (T_2) significativement plus élevé en protéines ($27,13 \pm 0,01$), plus élevées en extrait libre d'azote ($37,18 \pm 0,64$), plus élevé en extrait d'éther ($19,45 \pm 0,58$), plus élevé en cendres ($6,09 \pm 0,06$), malgré une teneur plus élevée en fibres brutes ($1,77 \pm 0,06$) et une teneur en humidité de ($8,45 \pm 0,52$); la proportion élevée de mélange de pâte d'arachide perdue a entraîné une faible teneur en protéines du kilishi de poisson.

REZUMAT: Compoziția nutrienților și evaluarea organoleptică a peștilor kilishi din *Clarias gariepinus* și *Mormyrus rume*.

Probe de pește proaspăt, curățat/spălat; au fost analizate în prima etapă suspensia uscată de pastă de infuzie și în a doua etapă produsul uscat, finit și kilishi-ul depozitat. Evaluarea a fost efectuată pe produse finite utilizând o scală de 10 puncte. Numărul de microbi și conținutul de umiditate au arătat o diferență ($p < 0.01$). Compoziția proximală a kilishi-ului uscat la soare și la cuptor (T_1) înregistrează semnificativ proteine mai mari (34.13 ± 0.01), extract de eter mai mare (29.45 ± 0.01), extract fără azot mai mare (17.45 ± 0.35) și are un conținut de umiditate de (10.92 ± 0.29), în ciuda faptului că are cel mai mare conținut de cenușă (5.76 ± 0.69) cu fibră brută (2.29 ± 0.23). Kilishi (T_2) proteine semnificativ mai mari (27.13 ± 0.01), extract mai mare fără azot (37.18 ± 0.64), extract de eter mai mare (19.45 ± 0.58), conținut mai mare de cenușă (6.09 ± 0.06), în ciuda faptului că are fibre brute mai mari (1.77 ± 0.06) cu un conținut de umiditate de (8.45 ± 0.52); proporția ridicată a amestecului de aluat de arahide a dus la o proteină scăzută de kilishi.

INTRODUCTION

Fish consumption provides health benefits to the human population. There is strong evidence that fish, in particular oily fish, lowers the risk of coronary heart disease (CHD) mortality by up to 36 percent due to a combination of EPA and DHA (FAO/WHO 2011). In many low-income countries with water and fisheries resources, fish is important for livelihoods, income and as food for the rural poor people who suffer disproportionately from undernutrition, including micronutrient deficiencies (Thompson and Subasinghe, 2011). Fish is by far the most frequently consumed animal-source and thereby makes a valuable contribution to the diversity of everyday diets, dominated by carbohydrate-rich staples. Fish can therefore be considered an irreplaceable animal-source, providing essential nutrients of high bioavailability which are found in limiting amounts in the diet. These nutrients include animal protein, essential fats, minerals, and vitamins. Small fish, eaten whole or as fish products, e.g. dried fish are particularly rich in calcium and other micronutrients (FAO 2014).

Fish is an extremely perishable food with deterioration commencing immediately after harvest (Agbo et al., 2002). Prior to death, the enzymes normally get involved in the digestion of ingested food and all microbial activities are controlled. As soon as fish dies, enzymatic action begins on the flesh and alimentary system leading to soft destructive changes. The process is referred to as autolysis. Post-harvest losses could be minimised by the application of proper preservation and processing methods (Eyo, 1997). Fish is liable to accelerated physiological, chemical, and microbial processes after harvests that invariably lead to deterioration and loss of wholesomeness. It is therefore necessary to come up with some measure of processing such as reduction in moisture content, denaturation of endogenous enzymes and microorganisms or packaging in order to curtail perishability (Eyo, 1997). Processing methods include raising the temperature by canning, boiling, and removal of moisture by natural drying, mechanical drying, smoking and salting, and fish products development such as fish sauces and pastes, marinades (Clucas and Ward, 1996) and of recent fish kilishi (Magawata and Oyelese, 1998).

Kilishi is a Hausa word which refers to slicing, dressing, sun-drying, application of slurry of spices, and roasting. Kilishi is a sliced heat-dried seasoned roasted ready-to-eat meat product known to have originated from the Hausa/Fulani speaking people of Northern Nigeria (Alonge and Hiko, 1981; Igene and Mohammed, 1983; Odusole and Akinyanju, 2003; Olusola, 2006; Okonko et al., 2013). Kilishi production involves dressing, slicing, air drying, application of slurry of ingredients and roasting over glowing coals (Igene et al., 1990) and which was first applied to processing and preservation of fish by Magawata and Oyelese (1998).

Kilishi is a nutrient-dense food that possesses good characteristics for industrial exploitation, contains over 50% protein, 7.5% moisture, 18% lipid, 9.8% ash, and is also very stable to microbial and chemical deterioration (Igene et al., 1990; Igene, 2012; Negbenebor et al., 1990).

The African catfish (*Clarias gariepinus*) is the most sought after species among fish farmers and consumers because it commands good commercial value not only in Nigeria but all over Africa (de Graaf and Janssen, 1996). It can tolerate a large variety of feedstuffs and is very resistant to changing and suboptimal water conditions. It can be farmed in high densities reaching production levels of six to 16 MT/ha on an annual basis when raised in monocultures and fed high quality fish feed (Faturoti, 1989). *Clarias gariepinus* was chosen for kilishi preparation because of its availability locally and higher flesh to bone ratio (Achionye-Nzeh and Omoniyi, 2002). It is commonly known as catfish and a valuable fish in Nigeria, which belongs to the family Clariidae.

Mormyrids or elephant snout fishes are curious looking fish, highly variable in shapes of their head and the extent of their unpaired fins. *Mormyrus rume* belong to the family Mormyridae and are found in freshwaters of tropical Africa (Greenwood et al., 1966).

Little has been documented on fish kilishi: Magawata and Oyelese (2000), Ipinjolu et al. (2004), and Aliyu and Falusi (2006). However Magawata and Oyelese (2000) and Ipinjolu et al. (2004) suggested further work on the appropriate mix of spices being used for production of fish kilishi in order to enhance quality. In view of this and in consideration for value addition, product diversification and reduction of post-harvest fish losses, an evaluation of kilishi processed from *Clarias gariepinus* and *Mormyrus* spp. was conducted.

MATERIAL AND METHODS

The experiment was carried out at the Fish processing unit of the Experimental Farm of the Department of Aquaculture and Fisheries Management of the Faculty of Agriculture, Nasarawa State University Keffi, Shabu-Lafia Campus. Lafia is located on latitude 8°35'N, longitude 8°32'E, altitude 181.53 m above sea level with a mean temperature of 34°C, relative humidity of 40-86% and average day light of 9-12h (NIMET, 2011).

Clarias gariepinus and *Mormyrus rume* were purchased from fish sellers in Lafia fish market and were transported to the experimental location. The ingredients/spices used were the defatted groundnut dough, table salt (sodium chloride), Maggi seasoning and curry powder while spices included dried hot (chilli) pepper (*C. apsicum frutescens*), cloves (*Eugenia caryophyllata*), candle wood (*Fagara zanthoxyloides*), ginger (*Zingiber officinale*), and onion (*Allium cepa*).

The fish were divided into two samples based on their species and were prepared separately using the same spices, ingredients, and quantity. Sample 1 was Kilishi made from catfish while sample 2 was Kilishi made from *Mormyrus rume*.

Slurry was prepared using the same formulation and quantity. The formulations was thick due to high proportion of the principal ingredients (defatted groundnut) used. There was no variation in the spices used. The fish samples were washed thoroughly with saline solution and the scales, bones, fins, heads, and tail removed using dissecting set. This enhanced easy filleting of the fish.

The samples were exposed to air for 10 minutes so as to reduce the moisture content and the freshly prepared fillets were introduced to sun drying raft to reduce its moisture content by evaporation for one hour. The dried fillets were infused in the prepared formulated slurry containing spices and ingredients thoroughly for 10 minutes to ensure absorption of the slurry.

The infused fillet samples were mounted again in a sun drying raft for 21 hours to undergo second drying. This was to ensure a permanent absorption of the slurry on the fillet.

After drying, the dried fillets were roasted for seven minutes in the departmental smoking kiln (to ensure blending of ingredients into the dried fish fillets and to enhance taste of the finished products). The product obtained after roasting is the final prepared kilishi of the samples.

The fish products were packaged in separate clean air tight containers and were labeled according to their respective samples and the fish kilishi was stored at room temperature for the experimental period. The proximate composition of each of the samples were analyzed according to the Association of Official Analytical Chemists (AOAC, 2000).

Samples from the prepared kilishi products were subjected to sensory evaluation immediately to obtain data for the selection of the best out of the two fish species used. The test utilizes the sense of texture, aroma, appearance, taste, and general acceptability for quality assessment of dried kilishi fish. A 40 member's panel was constituted which consisted of staff and students of the faculty. A 10-point hedonic scale ranging from A (Excellent) = 10; B (Good) = 8; C (Fair) = 6; D (Unsatisfactory) = 4, and E (Unacceptable) = 2 was adopted for each quality parameter. Pencils, tissue paper, and water were provided to the judges. Data obtained was subjected to One-way Analysis of Variance (ANOVA) in a completely randomized design using SPSS statistical package. Significant mean differences were separated at 5% significance level.

RESULTS AND DISCUSSION

The results of mean organoleptic qualities of kilishi made from *Clarias gariepinus* and *Mormyrus rume* is presented in table 1. Kilishi made from *Clarias gariepinus* had the highest mean values of 9.50 ± 0.89 , 9.10 ± 1.71 , 9.90 ± 1.71 and 10.00 ± 0.00 in texture, aroma, taste and general acceptability of the product, while appearance of kilishi made from *Clarias gariepinus* and *Mormyrus rume* had mean values of 9.50 ± 0.89 each. There was difference ($p < 0.05$) in texture, aroma, taste, and general acceptability of the two fish products.

Table 1: Organoleptic of kilishi made from *Clarias gariepinus* and *Mormyrus rume*; ^{a-b}Means with different superscript along the column differ significantly at $P \leq 0.05$.

Organoleptic parameters					
Species	Texture	Aroma	Appearance	Taste	General acceptability
<i>Clarias gariepinus</i>	9.50 ± 0.89^a	9.10 ± 1.71^a	9.50 ± 0.89^a	9.90 ± 1.71^a	10.00 ± 0.00^a
<i>Mormyrus rume</i>	8.00 ± 1.45^b	7.80 ± 1.44^b	9.50 ± 0.89^a	9.00 ± 1.03^b	9.40 ± 0.94^a

The results of proximate composition of kilishi made from *Clarias gariepinus* and *Mormyrus rume* is presented in table 2. Kilishi made from *C. gariepinus* had the highest values of 34.13 ± 0.01 , 2.29 ± 0.23 , 29.45 ± 1.01 , and 10.92 ± 0.29 respectively in crude protein, crude fibre, ether extract, and moisture content of the fish product while *Mormyrus rume* had the highest mean values of 6.09 ± 0.01 and 37.11 ± 0.64 in ash and nitrogen free extract of the fish product. From the result, it shows that there was significant difference ($p < 0.05$) in all the nutrient contents assessed.

Table 2: Nutrient composition of kilishi from *Clarias gariepinus* and *Mormyrus rume*; ^{a-b}Means with different superscript along the column differ significantly at $P \leq 0.05$.

Nutrient composition (%)						
Species	Crude protein	Crude fibre	Ash	Ether extract	M. content	Nitrogen free extract
<i>Clarias gariepinus</i>	34.13 ± 0.01^a	2.29 ± 0.23^a	5.76 ± 0.69^b	29.45 ± 1.01^a	10.92 ± 0.29^a	17.45 ± 0.35^b
<i>Mormyrus rume</i>	27.13 ± 1.01^b	1.77 ± 0.06^b	6.09 ± 0.01^a	19.45 ± 0.58^b	8.45 ± 0.52^b	37.11 ± 0.64^a

The result of the sensory scores of kilishi prepared from *Clarias gariepinus* and *Mormyrus rume* presented in table 1 above revealed that kilishi made from *Clarias gariepinus* was preferred most in terms of texture, aroma, taste, and general acceptability of the product with mean scores of 9.50 ± 0.89 , 9.10 ± 1.71 , 9.90 ± 1.71 , and 10.00 ± 0.00 respectively. The reason for the preferredness of catfish over *Mormyrus* could be because of its flavour, juiciness and tenderness as reported by Safari et al. (2001). The species of the fish had been influenced by the panellist's decision. According to Moloney (1999), meat texture is an important component of meat tenderness and palatability and it has two major components – the first is the impression of wetness produced by the release of fluids from the meat during the first few chews, while the second is the more sustained juiciness that apparently results from the stimulating effect of fat on the production of saliva and the coating of fat that builds up on the tongue, teeth, and other parts of the mouth. Aroma is a major determinant of consumer acceptability of meat product at the retail counter; therefore one of the most important considerations in meat product merchandising is that of maintaining an optimum aroma or appearance (Hedrick et al., 1994). The sensory rating for aroma in this study was from 7.80 to 9.10. Badau et al. (1997) reported no significant difference for aroma and texture when a standardized kilishi mix powder was compared to traditional kilishi slurry. Igene et al. (1990) on the other hand reported significant differences when aroma and texture were evaluated for, in two prepared products in comparison to a commercial product. The result of this study is in line with the findings of Igene et al. (1990).

The texture of meat can be defined as the sensory manifestation of the structure of meat and the manner in which this structure reacts to the force applied during biting and the specific senses involved in eating (Moloney, 1999). It is how meat is felt in the mouth during mastication. Several factors are interwoven which cannot be separated when discussing flavour. It is suspected that many constituents of the tissue become flavour compounds upon being heated. Physiologically, the perception of flavour involves the detection of four basic sensations (including saltiness, sweetness, sourness, and bitterness) by the nerve endings on the surface of the tongue (Hedrick et al., 1994). The result obtained supports the observation of Melton (1990) that as the fat of meat increases so does flavour. The diet that an animal consumes can cause changes in the fatty acid composition and volatile substances in muscle. The sun and oven drying method prevents the kilishi from contamination with dust, flies, egg deposits, which affect the quality of fish kilishi during processing and drying. Therefore, the overall result of mean analysis conducted indicated that kilishi prepared with slurry of treatment one (T_1) and treatment two (T_2) formulation was organoleptically more acceptable. The value addition had transformed the species product and improved its acceptance by consumers who could have rejected it if it were to be presented fresh.

The result on weight loss shows that; the initial weight of fresh fillets has no significance difference ($P > 0.05$) in all the treatments. The result also revealed that treatment two (T_2) appeared relatively low weight, which has more moisture loss than those of treatment one (T_1).

The result of proximate composition of sun and oven dried kilishi prepared with different slurry formulation, kilishi of T_1 formulation dried with sun and oven tent record significantly of higher protein (34.13 ± 0.01), higher ether extract (29.45 ± 0.01), higher nitrogen free extract (17.45 ± 0.35), and have moisture content of (10.92 ± 0.29) despite having highest ash content (5.76 ± 0.69) with crude fibre (2.29 ± 0.23) kilishi of T_2 formulation dried with sun and oven tent record significantly higher protein (27.13 ± 0.01),

higher nitrogen free extract (37.18 ± 0.64), higher ether extract (19.45 ± 0.58), higher ash content (6.09 ± 0.06), despite having higher crude fibre (1.77 ± 0.06) with moisture content of (8.45 ± 0.52); the high proportion of departed groundnut dough mixture resulted in low protein of fish kilishi.

Catfish kilishi recorded the highest crude protein mean of 34.13 ± 0.01 percent; this differed significantly from the mean protein percent of the *Mormyrus rume* 27.13 ± 1.01 (Tab. 2). This indicates that processing fish as in kilishi production improves the percent protein of the product thus making it nutrient dense. Igene et al. (1990) reported a value of 50.02% crude protein for traditional kilishi after roasting. Bello and Tekwata (2015) also reported crude protein between 50.76 and 63.3 for solar tent and sun dried kilishi from bony-tongue (*Heterotis niloticus*). The major part of the protein comes from the groundnut cake which has 55.85% (Badau et al., 1997). All other ingredients contributed their quota of protein too.

The highest crude fibre content obtained in kilishi from *C. gariepinus* (2.29 ± 0.23) was significantly different from that of *M. rume* kilishi (1.77 ± 0.06). Badau et al. (1997) reported crude fibre range of 6.1-25.0% for ingredients used in kilishi production. Though the recipes were constituted from virtually the same ingredients, differences were obtained in the crude fibre values of kilishi products. It can therefore be deduced that the varied rate of absorption and adsorption of the dried raw meat slices in the different spice mixture is responsible for the significant differences observed in the crude fibre content of kilishi produced.

The ash content is an indicator of the mineral content of the fish. The ash content of the kilishi samples ranged from 6.09% in *M. rume* to 5.76% in *C. gariepinus*. The result of ash content is in line with the findings of Bello and Tekwata (2015) who reported ash content values of 5.00 to 5.33 for fish kilishi made from *Heterotis niloticus*. The pattern of ash content observed in this study revealed that the ash content is influenced by the fish species. Also, another reason could be because most of the ingredients in the slurry might have lost their mineral contents into the slurry hence, into the fish product and this agrees with the report of Elizabeth (1995) who observed that the ash content of any processed meat would be the content of the muscle tissue in addition to that of ingredients used.

The ether extract content obtained in this study was highest 29.45 ± 0.01 in kilishi made from *C. gariepinus* and lowest 19.45 ± 0.58 in kilishi made from *Mormyrus rume*. Similar higher values between 17.34 and 19.20 were reported by Iheagwara and Okonkwo (2016). Generally, the fat content of the kilishi samples were high and this can be attributed to the groundnut cake powder which represent a considerable proportion of the product (Igene et al., 1990).

The moisture content of the kilishi samples ranged from 8.45% to 10.09% with *C. gariepinus* having the highest moisture content of 10.09%. The reduction in moisture content of *M. rume* is desirable as this can affect the quality of the sample positively in relation to other kilishi sample (Apata et al., 2013). Generally, the moisture content of the kilishi samples indicates that the kilishi samples were sufficiently dried to minimize microbial growth though moisture values of 6.92%, 9.87%, and 10.00% were recorded by Jones et al. (2001), Apata et al. (2013), and Olusola et al. (2012) respectively.

CONCLUSIONS

It can be concluded that fish kilishi was highly accepted by consumers though the *Clarias* kilishi was mostly preferred. The groundnut paste used significantly affects the product quality of kilishi in terms of nutritional value, but slurry appears to be more acceptable to the consumers.

Based on the experimental result, it recommended that preparation of fish kilishi should be explored as a means of preserving fish to arrest spoilage especially during glut supply and to diversify fish products and this will increase the acceptability of *Clarias gariepinus* and *Mormerus rume* and reduce post-harvest losses.

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