Sensory Assessment of Fermented Catfish (*Clarias gariepinus*) with Selected Spices

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Abstract: The sensory and organoleptic quality of fermented catfish (*Clarias gariepinus*) was studied after a fermentation period of three (3) days. Four whole fresh catfishes were fermented using roasted ground rice, sugar and salt, and distributed into four separate jars with spice treatments: FG (15 g ginger), FT (15 g turmeric), FP (15 g pepper) and control (FC) (0 g). They were then covered airtight and left to ferment in a cool and dry environment for three days. After the fermentation, they were fried till golden brown. They were then presented to a panel and assessed for sensory and organoleptic quality using parameters of color, taste and aroma on a nine-point scale. FP (15 g pepper) had the highest values of overall acceptability (8.2/9), then FG (15 g ginger) had a score of 7.9/9, closely followed by FT (15 g turmeric) which had a score of 7.8/9. The least score for sensory rating was observed in the control (FC) (0 g) at 6.5/9. Statistical analysis of results revealed significant difference ($p \leq 0.05$) in all parameters assessed. The use of spices, especially ginger, turmeric and pepper in fermenting catfish is recommended in order to enhance organoleptic properties. It was concluded that fermented fish has favorable organoleptic properties and is appropriate for introduction into Nigerian cuisine.
Keywords: catfish, fermentation, organoleptic properties, sensory evaluation, spices.

INTRODUCTION

Fish is lean animal flesh and a highly nutritious food source with high amounts of proteins, vitamins and minerals, low saturated fat and low carbohydrates (Ekelemu *et al*., 2021). It is the primary dietary source of omega-3 polyunsaturated fatty acid (PUFA), including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), both of which are well-known for their anti-inflammatory action against cardiovascular disease (Nestel *et al*., 2015; Siscovick *et al*., 2017; Vilavert *et al*., 2017). The World Health Organization (WHO) recommends a regular fish consumption of 1–2 servings per week to provide the equivalent of 200–500 mg of omega-3 PUFA (Tediosi *et al*., 2015; Wallin *et al*., 2015).

The African catfish (*Clarias gariepinus*) is one of the major sources of omega-3 fatty acids, proteins, selenium and vitamin D (Oyewole and Amosu, 2012). Over the years, catfish has maintained a level of popularity with Nigerian fish farmers due to the rapid rate of growth and reproduction of the species, its high selling price, its ability to survive in adverse aquatic conditions, and its reduced susceptibility to certain zoonotic diseases (Ogueji *et al*., 2018; Okoro *et al*., 2019). It has a high demand in restaurants where it is known as "point-and-kill" since it can be harvested from the pond and prepared for consumption on the spot. It is commonly consumed in soups, stews and peppersoup, fried or grilled as barbecue. *Clarias gariepinus* has been thought to be one of the most important tropical catfish species for aquaculture in West Africa (Amande and Nwaka, 2013).

However, in spite of its functional and nutritional value, catfish is extremely perishable and prone to microbial and enzymatic degradation. Generally, fish is characterized by a very short shelf-life, and must therefore be handled and preserved appropriately to slow down its deterioration and to ensure microbial safety as well as desirable shelf-life (Tavares *et al*., 2021). Kumolu-Johnson and Ndimele (2011) have observed that catfish deteriorates very fast if not properly preserved, resulting in the problem of post-harvest losses in the catfish production industry in Nigeria. As at 2017, about 25% of the world's fish supply, and 30% of landed fish has been reported lost through microbial activity (Ikape and Cheikyula, 2017).

When fish decays, it brings about the degradation of components as well as formation of new compounds which can result in unpleasant changes in flavor and appearance, as well as rancidity, lipid oxidation, and growth of spoilage and

pathogenic bacteria (Mei *et al*., 2019). Spoiled or spoiled-looking catfish is unsellable and can harbour food-borne pathogens. Thus, these problems of extreme perishability of fresh fish, and poor storage and transportation necessitated the demand for a means of maintaining fish that was relatively cheap and accessible, and did not compromise nutritional compositions.

One of the oldest ways of fish preservation is through fermentation. Other traditional methods are smoking and sun-drying. These methods of preservation originated long before the advent of modern technologies like refrigeration, freezing, etc. In instances where other methods of preserving highly perishable fish and seafood are absent or inapplicable, fermentation could be the method of choice for preserving fishes in large quantities (FAO, 1971). Fish fermentation is an easily accessible method of preservation (Kumar and Nayak, 2015), especially for low-income families and communities in Nigeria.

Fermented fish is "fresh fish that has undergone a series of desirable biochemical changes through the action of microorganisms or enzymes" (Zang, *et al.,* 2019). One of such desirable biochemical changes is proteolysis: which is the breakdown of fish protein during fermentation (Kilinc *et al*., 2006). The degradation of proteins and lipids releases a bounty of flavoring compounds that enhance taste and nutrients that are more easily digestible and absorbable (Mouritsen *et al*., 2017).

For many consumers, the sensory appeal of any food product is just as important as the nutritional value or shelf life. The treatment or seasoning of fish with spices has been shown to enhance the taste and prolongs the shelf life of the products during storage (Abolagba and Osifo, 2004).

The spices used in this study have been shown to possess some desirable properties. Turmeric (*Curcuma longa*) contains curcumin as its active component/major compound and has been shown to have antioxidant, antimicrobial, anti-inflammatory, anticancer, hypoglycemia and anticoagulant properties (Sharma *et al*., 2019; Panpatil *et al*., 2013). It also has great aroma and imparts desirable taste when cooked with food. Ginger (*Zingiber officinale*) has several active ingredients, great taste and aroma, with several nutritional benefits (Ghosh *et al.,* 2011). It is available and accessible at low cost for everyone to use it, it is universally acceptable and well tolerated by most people (Jalal and Nasroallah, 2014). Pepper's (*Capsicum annuum*) active ingredient capsaicin has also been shown to have desirable properties (Koffi-Nevry *et al.,* 2012). These spices contain various bioactive compounds, in addition to adding to the flavour and fragrance of food. They may be used singly or in combination, acting in synergy to control food spoilage (Ekelemu *et al*., 2021). This has made them to be used doubly as bio-preservatives (Abdul *et al*., 2008; Yanishlieva *et al*., 2006) as well as seasoning agents.

Fermented fish is an integral part of the culture and regions where it is commonly consumed. In most parts of Nigeria however, preparation of fish by fermentation is uncommon. Therefore, this research work was intended to study the sensory and organoleptic properties of catfish (*Clarias gariepinus*) fermented with selected common Nigerian spices in order to determine fermentation as an alternative means of catfish preparation based on its sensory properties that appeal to Nigerian consumers.

MATERIALS AND METHODS

Catfish purchase

Four catfishes (*Clarias gariepinus*) of the mean weight 273 g were obtained live from the Uchi market, Auchi, Edo State, and placed in sterile airtight containers with ice, and transported directly to the Edo State University microbiological laboratory. Then the catfishes were decapitated, eviscerated, washed under running water to remove the blood, and then sliced.

Spices purchase

The dry, powdered spices {turmeric (*Curcumin longa*), ginger (*Zingiber officinalis*), and pepper (*Capsicum annuum*)} used in the study were purchased from Uchi market, Auchi, Edo State.

Fermentation of fish

Spices were weighed in an electric weighing balance (15 g each). The spices, salt, sugar, and crushed roasted rice were wrapped in aluminium foil and sterilized in an electrothermal oven at 100°C for 20 minutes. Each whole fish was cut into 3 cm high slices exempting the head, and distributed into separate bowls. Then, rice, sugar, and salt were mixed together in a sterile plastic bowl and applied to each fish in bowls. Then the spices: ginger, turmeric and pepper each were applied to three fishes. The fourth fish was fermented without any spice, and it served as control for the spice treatment of the other fishes. The fermentation took place for a period of three days (Essuman, 1992; Pierre *et al.,* 2011; Kwon *et al.,* 2014). After the period of fermentation, the catfish samples were fried in hot oil till golden brown.

Sensory and Organoleptic Assessment

Sensory assessment of fermented catfish with different spices were evaluated in the parameters: colour, taste and aroma on a 9-point hedonic scale. The fried fermented fish was presented to a 10-member panel (6 females, 4 males; 20-50 years old) for rating. This panel consisted of people from within and outside the laboratory who had previous experience in sensory assessment of catfish. The panel evaluated the samples considering the colour, taste and aroma, and overall acceptability of fried fermented catfish: fermented fish with pepper (FP), fermented fish with turmeric (FT), fermented fish with ginger (FG), fermented fish with no spice (FC), fresh fish (FF), and smoked fish (FS) using subjective methods. The light and temperature conditions of the laboratory, where the sensory analyses were carried out, were adjusted properly. Evaluators took sips of water at intervals between each new sample. The parameters rated on this 9-point scale were: 1 (dislike extremely), 2 (dislike very much), 3 (dislike moderately), 4 (dislike slightly), 5 (neither like nor dislike), 6 (like slightly), 7 (like moderately), 8 (like very much), and 9 (like extremely).

Statistical analysis

The data obtained were analysed by the Kruskal-Wallis test conducted to compare the ordinal, dependent measure (colour, taste and aroma) between the six treatment groups (i.e., the independent variables (turmeric, ginger, pepper, fresh fried fish, control, smoked fish).

RESULTS

The results of sensory evaluation of fermented catfish with and without spices, unfermented fried catfish, and unfermented smoked catfish are shown in Figure 1. Sensory evaluation of FT was found to have an overall acceptability rating of 7.7 on a 9-point hedonic scale, which was lesser than both FG and FP, which had scores of 7.9 and 8.2 respectively on a 9-point hedonic scale (Figure 2). The lowest score for any fermented fish sample was from FC, which was scored at 6.5 out of 9.

Among the fermented fish, the fish with pepper (FP) was most preferred, followed by the fish with ginger (FG), then fish with turmeric (FT). The fish fermented with no spice (FC) was the least favorite. The unfermented fish samples, fried and smoked, were the highest of all fish samples evaluated, with FF scoring 8.9 out of 9, and FS scoring 8.8 out of 9. Both FF and FS were close in score to FP (which had an overall acceptability score of 8.2 out of 9.) Thus, while it was revealed that the FF and FS were the most preferred for the consumers, FP also had a high acceptability rating, with 80% of evaluators rating its taste 9 out of 9. In comparison with all fermented fish samples (FT, FG and FP), the samples with spices are observed to have high acceptability rates, except the fermented fish sample with no spice (FF).

A Kruskal-Wallis test showed that there was statistically significant difference in color, taste and aroma between the different treatment groups ($p \geq 0.05$).

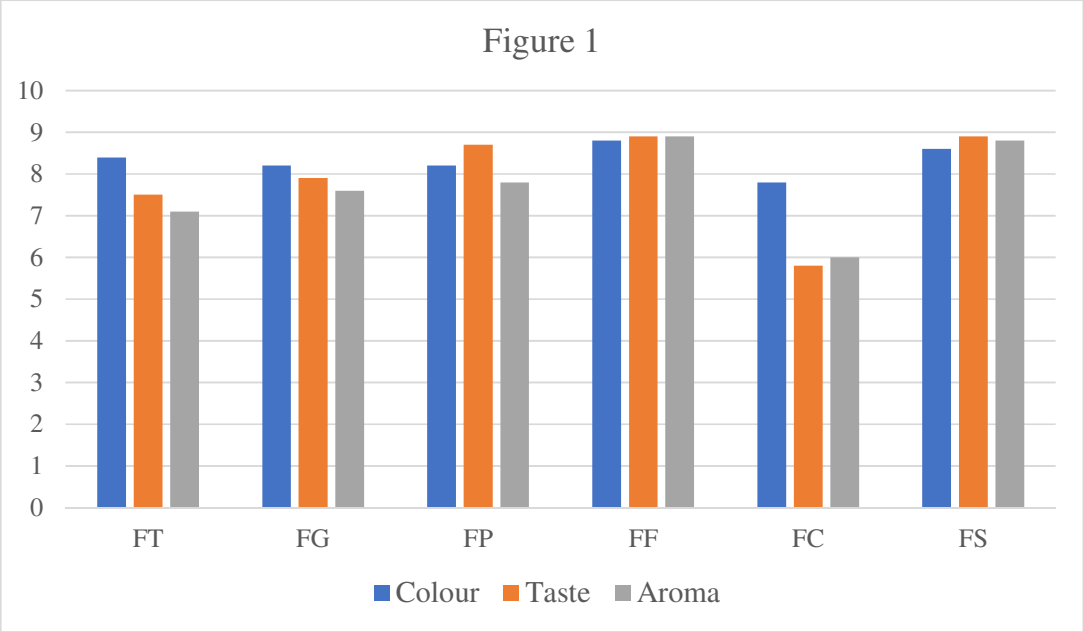

Figure 1: Sensory evaluation of fish samples

Legend: FT = fermented fish with turmeric; FG = fermented fish with ginger; FP = fermented fish with pepper; FF = unfermented fresh fried fish; FC = fermented fish with no spice (control); FS = unfermented smoked fish.

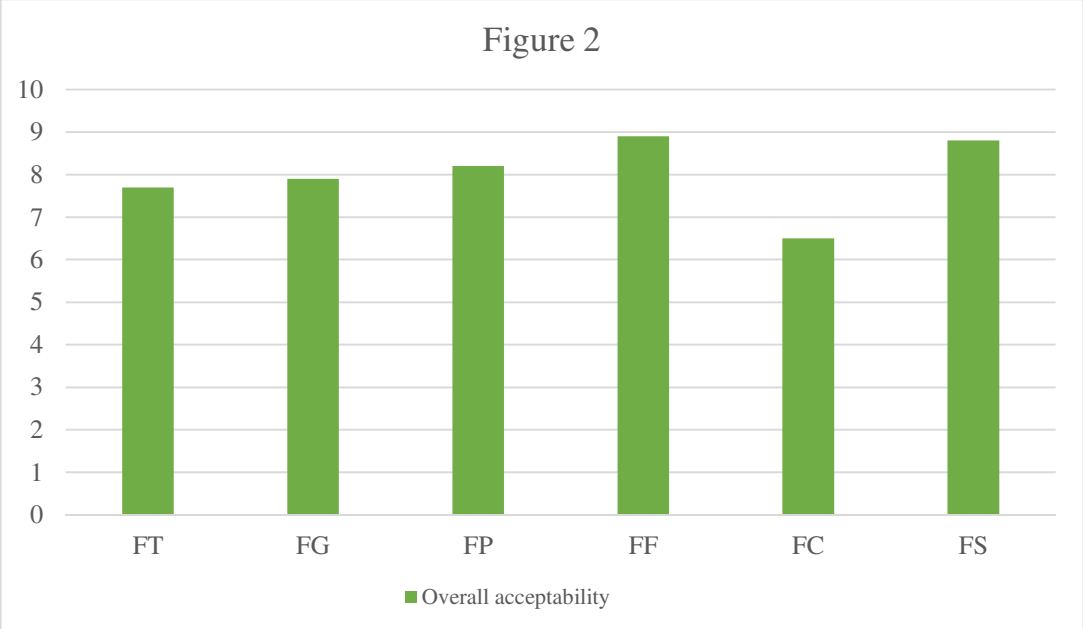

Figure 2: Overall acceptability of fermented and unfermented fish samples

Legend: FT = fermented fish with turmeric; FG = fermented fish with ginger; FP = fermented fish with pepper; FF = unfermented fresh fried fish; FC = fermented fish with no spice (control); FS = unfermented smoked fish

DISCUSSION

Sensory evaluation was performed on fermented fish, along with unfermented fish (FS and FF) which were included to serve as reference points for the fermented fish. The smoked fish and fresh fried fish had the highest overall acceptability scores. This is presumed to be a result of the level of familiarity with the panel of evaluators, as against the fermented catfish. For the rest of the fermented fish, the high score of fish fermented with pepper suggest potential acceptance among Nigerian consumers. These findings are similar to the findings of Ezeama and Udoh (2012) who incorporated fermented fish samples into blank stew and found that the stew containing fermented samples treated with 10% salt and spices (garlic powder and red pepper) as condiment were preferred. Achinewhu and Oboh (2002) had earlier stated that the use of locally available spices in fermentation of fish will no doubt enhance food flavour as well as provide some antibacterial effect on the fermented product. Ekelemu and colleagues (2021) concluded that spicing *Clarias gariepinus* enhanced its organoleptic properties and extended the shelf life. Ismail *et al*. (2021) also suggested that fermenting fish and incorporating with spices and salt is "the best" method to preserve fresh products due to the effects of both salt and spice in lowering water activity and the antibacterial effect on the microorganisms.

CONCLUSION AND RECOMMENDATION

This study showed that fermented fish with pepper (FP) had the highest sensory rating for the fermented fish samples and therefore, the most palatable in taste, aroma and appearance. It was also observed that the fermented fish with no spice had the lowest sensory rating and therefore that spices enhance the quality, taste and aroma of fermented fish.

Catfish should be handled, prepared and consumed hygienically. Spices should be applied to fermented fish in order to enhance organoleptic properties. The proliferation of extensive studies is recommended in order to characterise the benefits of fermented fish with spices and to bridge the knowledge gap in catfish fermentation in Nigeria.

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