

Paste Production From *Synodontis Membranaceus* Using Different Percentages of Ginger (*Zingiber officinale*)

Fakunle J.O.,¹ Sadiku S.O.E.² and Ime -Ibanga Uche¹

¹Department of fish processing and storage

Federal College of Freshwater Fisheries Technology. P.M.B. 1500, New-bussa. Nigeria

²Department of Water resources, Aquaculture and Fisheries Technology, School of Agriculture Technology of the Federal University of Technology, Minna, Nigeria

¹E-mail fakunleolubunmi@yahoo.com

Abstract:

Synodontis membranaceus was subjected to fermentation (34 ±3°C) for a period of 4- weeks (one month) with varying concentrations of ginger (5%, 10%, 15%, 20%) and 20% salt as spices to produce paste. The samples were analyzed for proximate composition, pH, microbial load and organoleptic properties at the beginning and end of the fermentation. Results showed steady increase in nutrients such as crude fat, ash, and NFE (nitrogen free extract) but decrease in crude fibre. There were fluctuations in the crude protein of the fermented fish samples. There was an increase in the microbial load of the fermented fish and a slight decrease in the moisture content. The organoleptic test showed preference for taste, aroma, and overall acceptability for fish fermented with 20% ginger.[Researcher.2009;1(5):1-8].(ISSN:1553-9865)

Key words: *Synodontis membranaceus* fermentation, paste and spice

1. Introduction

There is a decrease in animal protein intake as a result of decrease in animal production and the rising growth in human population. The short fall in animal population has resulted in an astronomical increase in the cost of eggs, meat, and poultry. Fish have thus become the main source of animal protein to the average citizen since the price is relatively cheap and constant (Eyo and Abakar, 1988).

The on-going reliance on fish calls for cursory investment into methods of fish preservation that would be capable of utilizing the available fisheries resources to produce fish products, which are organoleptically and nutritionally acceptable to consumers (Eyo and Abakar, 1988).

Fish preservation is a crucial aspect of fisheries sub sector in Nigeria especially because of the usually high prevailing temperature causing rapid deterioration of fish (Aluko *et al*, 2000). Fermentation is one of the principal methods of preservation and fish fermentation has been found over the years to be a cheap method of fish preservation (Essuman, 1992).

Fish fermentation is an ancient technology practiced in many tropical countries especially in South - East Asia, Africa and Latin America (Eyo, 2001). The principal objective of fermentation is the development of distinctive

flavour in the final product. The product is therefore mainly used as condiment in preparation of traditional sauces (Essuman, 1992). Fish fermentation involves addition of salt to fish in 1:3 to 1:5 w/w and allowing it to ferment in earthen jars at ambient temperature (FAO, 1971). Fish could be fermented to improve the shelf life and to prevent wastage in times of glut and later used during scarcity. Moreover, it was found that if these changes are controlled, desirable flavours could be conferred on the product. These could increase the acceptability of the fish and mask other less pleasant flavours and odour. Fermentation is the breakdown of organic substances into simpler compounds by the action of enzymes or microorganisms. Products obtained from fish fermentation are fish paste, fish sauce, and salted fish (Farnworth, 2003).

Fish paste is a fermented fish product obtained by partial fermentation of the fish prepared by mixing fish with coarse salt in the ratio 3:1 and left to mature in clay vats (Elmer – Rico *et al*, 2005). The genus *Synodontis*, known commonly as catfish in English, or as Kurungu in Hausa is of economic importance (Reed *et al*, 1967). The flesh is whitish in colour, slightly soft, and of excellent flavours, particularly suited to making the traditional religion dish of peppered soup and it is also suitable for smoking in the traditional manner, after which they have excellent keeping

qualities. The fish is fleshy hence, more paste may be produced and this may be another way of processing the fish apart from the common methods. The FAO has given the daily dose of ginger to be between 2-5g (Ginger people Htm 2007). This work is therefore aimed at producing paste from *Synodontis membranaceus* with varying percentages of ginger and determines the nutritional content, microbial load and the consumer acceptability of the paste.

2. MATERIALS AND METHODS.

2.1 Fish samples and pre fermentation treatment

Fresh fish (*S.membranaceus*) about 5-7 cm in length and 80-120g obtained from (Kara market) Kainji Lake Basin and kept in nylon bags. The fish samples were then transferred within 1hr to the laboratory where they were washed thoroughly, eviscerated, rinsed with clean water and allowed to drip for 15mins after which they were cut into tiny bits and weighed. They were then subjected to the following treatments.

Sample A 750g fish + 20% salt.

Sample B 750g fish + 20% Salt + 5% ginger.

Sample C 750g fish + 20% Salt + 10% ginger.

Sample D 750g fish+ 20% Salt+ 15% ginger.

Sample E 750g fish+ 20% Salt+ 20% ginger.

2.2. Fermentation of samples

Each Sample was mixed thoroughly and pounded in mortar with pestle according to the method described for *patis* production in Asia (Martin, 1994). It was divided into three equal parts and kept in airtight plastic bottle, sealed with cellophane paper. These bottles were kept in a plastic buckets sealed with paper tape and then buried in a one-and-a-half-meter-deep hole for a period of one month around Fish Processing Laboratory of Federal College of Freshwater Fisheries Technology, New -Bussa.

2.3. Physicochemical analysis

The temperature of the environment was taken on week- days (Monday-Friday) 4 wks while the pH of each sample was taken before fermentation and after fermentation using

standard pH meter. The crude protein, crude lipid, ash, crude fibre and moisture content of all the Samples were determined at first and fourth week in the Department of Zoology, University of Jos, Jos, using the methods of A.O.A.C. (2000).

2.4. Sensory evaluation

Sensory quality attributes such as taste, odour, and overall acceptability were evaluated on a 9-point hedonic scale. A Panel of ten Judges was used after being briefed on what to do and necessary precautions taken to prevent a carry-over of the taste. Stew sauce was made and divided into five equal portions to which one tablespoon each of the sample was added. Each was warmed for three to five minutes on the same oven until boiled. It was served hot with white rice.

2.5. Microbiological analysis

For each fish sample 9ml of distilled water was measured into ten test tubes for serial dilution and 1ml each from slurry was measured into the 'whole' to make 10ml. Each dilution was pour-plated on nutrient agar and incubated at 30°C for total bacterial count (TBC). The logarithms of the colony unit per gram of the sample were calculated and recorded. The procedure was repeated for all the samples.

3. Results and discussion

Table 1 shows the pH of the fresh and fermented fish samples. The pH ranges from 6.2 - 7.45 throughout the fermentation period. In the first week, the pH dropped from 7.0 -7.2 to 6.2 - 6.6. At the second week of fermentation the pH increased slightly. The pH of the samples remained fairly constant at the range of 6.6-6.8 during the first 21 days of fermentation. After 21 days there was a drop in the pH of the samples compared to the pH of the control sample. The increase in the pH of sample A (control) was due to putrefaction with salt leading to the formation of basic nitrogenous compounds. The drop in the pH of sample B, C, D, and E could be attributed to the production of acids during bioconversion. According to Frazier and West Hoff (1988), the trend in the pH reduction may be due to the involvement of Lactic acid bacteria that are able to ferment sugars to produce lactic acid, which then resulted in the lowering of pH. Lee *et al.*, (1986) have also indicated such an inverse relationship between pH and Lactic acid and also pH and acid forming bacteria/yeast in a Lactic fermented fish called Sikhae.

The proximate compositions of the unfermented and fermented fish samples are as shown in Tables 2 and 3 below. The fermented products had slightly lower moisture content than the unfermented products, which might be due to the cryoprecipitant effect of the salt used (Achinewhu and Oboh, 2002).

The crude protein content in fermented samples A, B, C, D and E, 13.68%, 12.24%, 12.78%, 14.41% and 14.94% respectively were lower than those of the unfermented fish samples which were 14.46%, 15.56%, 15.75%, 16.04% and 16.20% respectively. The crude protein in the unfermented fish samples was higher than those of the fermented fish samples. During the four weeks of fermentation there was a relative decrease in the protein content of the fermented fish samples. This is in agreement with the result of Eyo (1993) who fermented *Alestes nurse* and associated the low protein level of the samples with proteolysis during the fermentation process with the production of volatile substances, which could be responsible in part for the subsequent odour, and flavour of fermented fish. Such proteolysis are implicated in the production of the matured flavours of pickled herring (Luipjen, 1959). Also, trypsin and similar enzymes in the pyloric caeca are largely responsible for the liquefaction of fish during the manufacture of some fermented products (FAO, 1971). This disagreed with the work of Achinewhu and Oboh (2002), which showed a slight increase in the crude protein of *Sardinella sp* from 16 to 18% and attributed the increase in the crude protein to the activities of the microorganisms that took part in the fermentation processes. This difference however may be due to the different location of the experiment as well as the different type of fish used. The moisture content of sample E increased but the moisture of samples B, C, D, and E, decreased considerably. The crude fat content of the fermented samples A, B, C, D and E were 3.10%, 6.60%, 5.75%, 5.08% and 4.85% respectively, where as that of the unfermented fish samples A, B, C, D and E were 2.50%, 2.30%, 2.54%, 2.24% and 2.80% respectively. The crude fat (lipid) content of the fermented fish sample was higher than the fresh (unfermented) samples. The slight increase in the crude fat (lipid) content of sample A was related to lipid oxidation, which produces volatile compounds, and the lipids of fish are known to be very unsaturated and very prone to oxidation (Eyo, 1993). Oxidized fish oils have a very characteristic taste and paint-like smell, the acceptability of such flavours in fermented fish

being dependent on local taste (FAO, 1971). The increase in the lipid content of the fermented samples B, C, E, may be due to the ginger spice added which contains antioxidants that prevented the fish from becoming rancid and spoilt (Voskrenensky, 1965) and so makes an available carbon source for the microorganisms responsible for fermentation to utilize. Other studies (Achinewhu, 1986; Beuchat and Worthington, 1974) have shown no difference in lipids of fermented plant products reaching the conclusion that microorganisms did not use lipids as carbon or energy source during the fermentation of African oil bean seed and peanuts.

The ash content of the fermented samples A, B, C, D and E were 18.15%, 18.25%, 17.60%, 16.50% and 22.30% respectively while that of the fresh samples A, B, C, D, and E were 19.90%, 14.60%, 17.00%, 17.40%, and 18.40% respectively. The ash content represents the mineral content. Fermented fish has more minerals content than unfermented fish. Loring Windblad, (2008) established that fermentation breaks down the cell wall (membrane) making them more easily digestible as the basic nutritional vitamin and minerals are directly made more accessible.

The crude fibre content of the fermented samples A, B, C, D and E were 0.67%, 0.84%, 0.95%, 1.02% and 1.13%, respectively, whereas that of the unfermented fish samples A, B, C, D and E were 0.90%, 1.21%, 1.30%, 1.40% and 1.52% respectively.

The NFE (Nitrogen free extract) of the fermented sample A was negligible while B, C, D and E were 1.92%, 3.57%, 3.84%, and 4.03% respectively. The NFE of the unfermented fish sample E was negligible but samples B, C, D and E were 6.03%, 2.76%, 1.82% and 4.18% respectively. Table 4 shows the microbial count in CFU/g of the fresh and fermented fish samples. It ranged from 5.0×10^6 – 40×10^6 at zero day to, 158×10^6 - 16×10^6 at the end of the 4th week for sample A. Others fall between these range except for samples C and D, which are far above others. Generally, there was an increase in the microbial population in all the treatments because the microorganisms responsible for fermentation were multiplying as a result of abundant substrate and suitable condition for their growth (Pelczar *et al.*, 1986). The highest microbial population was found in sample C even at the initial time of fermentation and this was maintained throughout the fermentation period. This is in agreement with

Eyo (2001) who stated that the microbial load of the environment/habitat of the fish reflects in the processing. The progressive increase in the microbial load of sample A agreed with the result of Soyiri *et al.*, (2003) who showed a systematic increase in the microbial load of salt treated fish samples. Thapa *et al.*, (2004) also fermented fish into Ngari, hentak and Tungtap, which are traditional fermented fish products and recorded increase in the microbial load of the fish samples. The physical examination of the population showed different colonies including yeast and fungi together with other types of rod shape and round shape colonies e.g. bacteria.

Table 5 shows the mean sensory scores of the fermented fish samples for aroma, taste, and overall acceptability. Sample E with 20% salt and 20% ginger was the most preferred ($P < 0.05$) in terms of taste, aroma and overall acceptability. It was significantly different ($P < 0.05$) from sample A in terms of taste, but in terms of aroma and overall acceptability, there was no significant difference between the samples. The higher percentage of ginger (20% in sample E) might have contributed to its accepted sensory qualities. Ginger is a generally accepted spice in food processing. The volatile oil in ginger (Zingerone) might have enhanced the quality attributes of the samples. The fermented fish

samples can therefore be used as a condiment in dishes.

4. Conclusions

At the end of one month a paste was made from *Synodontis membranaceus* with different percentage of ginger (5%, 10%, 15%, and 20%). The paste with 20% ginger and 20% salt was most preferred because it had the highest value in crude protein, crude fiber, NFE, ash content, and the lowest moisture content. Also the panelists showed preference for sample prepared with 20% ginger and 20% salt in terms of taste, aroma and overall acceptability. It also had the lowest microbial count in Cfug. It can be concluded that the higher the percentage of ginger, the better the product. Also the higher the percentage of ginger the lower the microbial load of the fish. This confirms the bacteriostatic effect of ginger on the microorganism. The active agent shagaol and zingerone may have enhanced this effect as the higher the percentage of ginger, the lower the microbial load of the fish paste.

5. Recommendation

It is therefore recommended that more research should be done on this work especially to identify the microorganisms present in the fermented fish (paste).

6. Results

Table 1: The pH of the fresh (unfermented) and fermented fish samples

Samples	pH				
	Fresh	Week 1	Week 2	Week 3	Week 4
A	7.20a	6.20a	6.80b	6.80b	7.45a
B	7.10a	6.40a	6.70b	6.70b	6.60b
C	7.20a	6.25a	6.80b	6.60b	6.20b
D	7.20a	6.60a	6.70b	6.60b	6.45b
E	7.00a	6.40a	6.85b	6.60b	6.40b

Table 2: Proximate composition of the fish samples before fermentation.

Samples	Moisture content	Ash %	Crude fat %	Crude fibre %	Crude protein %	NFE %
A	62.55a	19.90a	2.50ab	0.90b	14.46b	0.00e
B	60.30b	14.60d	2.30b	1.21ab	15.56a	6.03a
C	60.65ab	17.00c	2.54a	1.30ab	15.75a	2.76c
D	61.10ab	17.40bc	2.24b	1.40a	16.04a	1.82d
E	56.90c	18.40b	2.80a	1.52a	16.20a	4.18b

Key

A: Fish with 20% Salt alone, B: Fish with 20% Salt and 5% ginger:

C: Fish with 20% Salt and 10% ginger, D: Fish with 20% Salt and 15% ginger.

E: Fish with 20% Salt and 20% ginger

Table 3: Proximate composition of the fermented fish samples after 4 weeks

Samples	Moisture content %	Ash %	Crude fat %	Crude fibre %	Crude protein%	NFE %
A	64.80a	18.15b	3.10c	0.67b	13.68ab	0.00c
B	60.15ab	18.25b	6.60a	0.84b	12.24b	1.92b
C	59.35b	17.60b	5.75ab	0.95ab	12.78b	3.57a
D	59.15b	16.50b	5.08ab	1.02a	14.41a	3.84a
F	52.75c	22.30a	4.85b	1.13a	14.94a	4.03a

Table 4: Microbial count in CFU/g of the fresh (unfermented) and fermented fish samples after 4 weeks.

Samples	CFU/g	
Fresh	A	5.0 x 10 ⁶
	B	15 x 10 ⁶
	C	34 x 10 ⁶
	D	40 x 10 ⁶
	E	8 x 10 ⁶
WEEK 4	A	158 x 10 ⁶
	B	16 x 10 ⁶
	C	87 x 10 ⁶
	D	43 x 10 ⁶
	E	26 x 10 ⁶

Table 5: Summary of mean sensory scores for the fermented fish samples

Treatment	Samples				
	A	B	C	D	E
Taste	7.3a	8.0a	7.7a	7.6a	8.6b
Aroma	7.8a	7.6a	7.3a	8.0a	8.5a
Overall	8.0a	8.1a	7.5a	8.0a	8.5a
Acceptability					

Key

- A: Fish with 20% Salt alone,
 B: Fish with 20% Salt and 5% ginger:
 C: Fish with 20% Salt and 10% ginger,
 D: Fish with 20% Salt and 15% ginger.
 E: Fish with 20% Salt and 20% ginger

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