
UTILIZATION OF BONGA (*Ethmalosa fimbriata* Bodwich) FISH CONCENTRATE IN BREAD BAKING IN NJALA – MOKONDE COMMUNITY, SIERRA LEONE.

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ABSTRACT

Bonga fishmeal (BFM) used as Fish Protein Concentrate (FPC) in bread baking to address the problem of inadequate intake of protein at Njala – Mokonde community and also to determine acceptable proportion of FPC to wheat flour by consumers were bought from Tombo - the largest artisanal fish-landing site along the coastline of Sierra Leone.

The processed Bonga Protein Concentrate (BPC) was used in varying percentage proportion (0%, 10%, 20%, 30% and 40%, where the zero percent served as control) along with wheat flour. The prepared bread samples were baked in a locally made iron oven at a temperature of 120°C for fifteen minutes. A 5-point hedonic scale was adopted to evaluate the sensory properties of the fish products.

Evaluated samples differed in their proximate and mineral composition. 10% FPC had the highest percentage crude protein (33.67%), highest crude fat (3.64%) and highest crude fiber (1.42%) while the control (0%) had the least %CP (9.64%), least Cfat (1.06%) but not the least Cfiber. The mineral content of the 40% FPC was higher than those of the remaining samples except that 10% FPC had the highest Sodium content (0.86%). There were significant differences ($p < 0.05$) in all the sensory parameters evaluated. 0% FPC inclusion (Control) was like very much but 10% FPC was preferred while the 30% FPC inclusion was disliked much.

However, to make 10% FPC inclusion the best accepted it was recommended to include additives to shield the strong aroma of the bonga fish.

Key words: *Bonga, bread, FPC, Njala-Mokonde, sensory.*

INTRODUCTION

Hunger and malnutrition remain amongst the most devastating problems facing the majority of the world's poor and needy, and continue to dominate the health of the world's poorest nations (WHO, 2000). Tacon (2001) citing WHO noted that 30 percent of humanity, including infants, children, adolescents, adults and elderly within the developing world, are currently suffering from one or more of the multiple forms of malnutrition. Aquaculture (the farming of fish, other aquatic animals and plants), of the different global food production systems is widely perceived as an important weapon in the global fight against malnutrition and poverty, particularly within developing countries (Tacon, 2001).

Fisheries are an important part of food security, particularly for many poor people in developing countries. In low-income food deficient countries (LIFDCs), they make up 22% of animal protein consumption overall (FAO, 2005).

Fish is a highly nutritious food, containing high amounts of proteins with high biochemical value for humans. In addition, it is a very good source of polyunsaturated fatty acids (PUFA) known to be beneficial in preventing cardiovascular diseases, breast and colon cancer, psoriasis etc. (Kaushik, 2000). Malnutrition is a common index of inadequate protein in diet. Sierra Leone has the second – highest child mortality rate in the world, behind Niger. A recent survey by the government and UNICEF confirms that more than one child out of four does not reach his or fifth birthday

(Willemot and Alusine, 2006). Public Health Nutrition (2003) also revealed that 46% of child deaths in Sierra Leone are attributable to malnutrition, the single greatest cause of child mortality in the country. The rapid increase in the world's population and limited supply of world's food resources as well as shortage in protein intake requires urgent measures to fully utilize all fish resources (Olatunde as cited by Ibitoye *et al*, 2008). One approach according to Ibitoye *et al*, 2008 is to reduce the loss that occurs in post harvest sector. Among these post harvest losses are sometimes small unmarketable and unpopular fish like stunted tilapia and bony bonga (*Ethmalosa fimbriata*), which are wasted or regarded as wasted efforts by high-income earners. Bonga fish is low priced because of its numerous bones when cooked fresh and is mainly consumed by those below the poverty line. It is relatively cheap and of relative abundance when compared with other fish sold in the same market (Oyelese, 2006). It is therefore essential to learn how to make better use of the fish by converting it to another form of food such as snacks, cassava bread, and wheat bread, bonga balls etc, a form that will be acceptable and easily affordable by all. Fish protein concentrate (FPC) is any stable fish preparation, intended for human consumption in which the protein is more concentrated than in the original fish. According to FAO (2010), fish protein concentrate is defined as normal fishmeal produced under satisfactorily hygienic conditions. Fishmeal as produced throughout the world is a very cheap potential FPC, but it is not intended for human consumption. It is used for making fish, pig and poultry feeds. Fishmeal in its ordinary state is unsafe for human consumption because of the unhygienic conditions it is usually prepared.

Akande, (1989) and Eyo (1988), investigated the utilization of Tilapia for other form of consumption such as fish cakes, fish fingers *e.t.c.* Ibitoye *et al*, (2008) also utilized Tilapia in chin-chin but information on the utilization of bonga (*Ethmalosa fimbriata*) in the development of any form of fish product is scarce. Therefore, this study evaluates the acceptability of bread products spiced with Bonga Fish Protein Concentrate (FPC) and determines the proportion (% inclusion) of Bonga FPC to flour that will be generally acceptable to consumers and to produce baseline information on the utilization of Bonga as Fish Protein Concentrate (FPC) in Sierra Leone.

MATERIALS AND METHODS

The experiment was carried out at the Department of Aquaculture and Fisheries Management, School of Forestry and Horticulture Njala University, Njala –Mokonde, Moyamba District in 2010. The climate of Njala is mainly tropical and has distinct dry and wet seasons. The wet season lasts from April to October, while the dry season extends from November to March. The mean temperature ranges from 21° to 23° for the greater part of the dry season (Gwyenne-Jones *et al*, 1978).

FISH PROTEIN CONCENTRATE PRODUCTS DEVELOPMENT

Bonga (*Ethmalosa fimbriata* Bodwich) used for this study were harvested from Tombo the largest artisanal fishing landing site along the coastline of Sierra Leone. They were properly dressed and steamed for 50 minutes, after which the bones were removed. The boiled mixture was pressed manually using a white straining cloth while hot to remove lipid and water. The cake was compressed over night and subjected to further 30 minutes steaming to make the cake lighter for drying.

Re-steamed compressed cake was then sun dried on a clean nylon sheet. The dried cake was ground to powder using hand operated meat mixer (pelletizer). It was thereafter packaged in airtight plastic bags and stored in cool dry place. Other ingredients used for the production of the FPC product were wheat flour, sugar, and salt, baking tablet, baking powder and yeast.

The bread produced from wheat flour fortified with FPC was prepared in the following percentage proportions:

Sample A 100% Wheat Flour (control – no FPC inclusion)

Sample B 10% FPC +90% Wheat Flour

Sample C 20% FPC+80% Wheat Flour

Sample D 30% FPC+70% Wheat Flour

Sample E 40% FPC+60% Wheat Flour

To each of the samples sugar, salt, yeasts, baking tablet and baking powder were added and thereafter properly mixed. Water was carefully added to each of the samples to form dough and later moulded into ball of proportionate sizes. The samples were thereafter baked in a locally made iron oven at a temperature of 120°C for a period ranging from 13-15minutes until a golden brown colour was obtained.

PROXIMATE ANALYSIS

The crude protein, crude fat, crude moisture, crude fibre and ash content of the 5 sample A, B, C, D and E were determined according to AOAC (1995). Mineral composition of the FPC – bread samples were determined according to the methods prescribed by Udo and Ogunwale (1986).

ORGANOLEPTIC ASSESSMENT

Semi - trained panellist of 29 carried out subjective evaluation of each fish product sample. These panellists were randomly selected from

Njala – Mokonde community residents comprising staff and students of Njala University, Njala Campus-Sierra Leone.

Labelled samples accompanied by questionnaires were presented to the panellists. Panellists were served tea with milk and sugar at interval of tasting samples to obliterate carry-over of taste. The quality attributes studied include, appearance, taste, smell, texture and general acceptability. The hedonic scale used was from 1-5 where a score of 5 was "like very much" and a score of 1 was "dislike" much.

STATISTICAL ANALYSIS

Data obtained from the study were analysed using means and Analysis of Variance (ANOVA). Duncan's New Multiple Range Test (DNMRT) was used to test significant differences between mean. Differences were accepted as significant at $P < 0.05$. Mean values generated from the study were presented in tables.

RESULTS

The hedonic scale used for the sensory evaluation of the bonga FPC-bread products is presented in Table 1. The sensory evaluation ranking was from 1-5 where a score of 5 was "like very much; a score of 4 was like much; a score of 3 was like moderately; a score of 2 was like slightly" and a score of 1 was "dislike" much. The five samples differed in their proximate and mineral composition (Tables 2 and 3 respectively). Crude protein composition of baked bread was in the order 10% FCP > 30% FCP > 20% FCP > 40% FCP > 0% FCP. The 10% FPC sample had the highest percentage level of sodium (0.86%) with 40% FPC having highest potassium (0.73%), calcium (0.14%), phosphorus (0.32%), Magnesium (0.28%) and iron content (0.07%).

The control (0% FPC inclusion) had the least level of mineral composition. Mean scores of sensory evaluation of parameters of developed fish products are presented in Table 4. There were significant differences ($p < 0.05$) in all the sensory parameters evaluated. 0% FPC inclusion (Control) was liked very much with respect to Appearance (4.83), Taste (4.45), Smell (4.59), Texture (4.24) and General appeal (4.31) followed by 10% FPC with Appearance (4.10), Taste (3.66), Smell (3.72), Texture (4.14) and General appeal (3.66). While the 30% FPC inclusion was disliked much with respect to Taste (2.97), Smell (2.93) and General appeal (2.43).

DISCUSSION

Proximate composition of bonga (*Ethmalosa fimbriata*) FPC – bread products showed a crude protein of 9.64% and 33.67% at both the control (Liked very much) and 10% FPC inclusion level (Like much). These values differed from 0.85% and 10.46% obtained by Ibitoye *et al* (2008) for both control and 10% FPC inclusion in the development of fish products from small and under utilized Tilapia (*Oreochromis niloticus*) in Kainji Lake area, Nigeria.

Proximate analysis of the bonga FPC – bread products showed a wide range of variation in the crude protein composition. This ranged from the least in 0% FPC inclusion products to the highest in 10% FPC inclusion products as shown in Table 2. Also crude fat, crude fibre, percentage ash and percentage moisture showed variation. Fat was highest in 10% FPC inclusion (3.64%) but lowest in the 0% FPC inclusion – control (1.06%). Crude fibre was highest in 40% FPC inclusion but lowest in 10% FPC inclusion.

Mineral composition of the bonga FPC-bread products showed wide variation. 40% FPC inclusion recorded the highest mineral content – 0.73%K, 0.14%Ca, 0.32%P, 0.28%Mg and 0.07%Fe. While 0.01%Na, 0.06%K, 0.02%Ca, 0.08%P, 0.13%Mg and 0.01%Fe being the least was recorded for the control (0% FPC inclusion). 10% FPC however recorded the highest Na (0.86%).

Sensory evaluation results (Table 4) showed that there was significant ($P < 0.05$) variation in preferences of sensory attributes by the panellists. The results have shown that the appearance of the control (0% FPC) was highly preferred (4.83). Notwithstanding, the 10% FPC was like much with appearance rating of (4.10) while the 40% FPC was least preferred (3.66) in terms of appearance. One possible reason for this could be due to the fact that bonga – FPC laden products are denser than the un-laden control. The laden FPC – bread did not have the golden rosy attractive colour of the control as a result of slight burnt. And this then connote that the semi-trained panellists preferred the golden rosy bread although with lesser crude protein compared with the bread with bonga-FPC inclusion. This point can also be supported by the observation that panellists ranked the control (0% FPC) with the golden rosy colour and soft texture highest in general acceptability. Other reason adduced for preferences made were one, the dense aroma of the bonga in the bread. The aroma of the bonga FPC seems to be disagreeable to the panellists. The panellists hinted they would have preferred the 10% FPC above all but for the palpable aroma of the fish they opted for the control. The preference for control in this study disagreed with what was obtained by Ibitoye *et al.* (2008). Tilapia aroma used in their study probably had a milder aroma

than that of bonga used in this study. Other observation is the fish products developed. The effect of frying could have made the tilapia aroma in the chin-chin unnoticeable.

In general, the control (0% FPC) was more highly preferred than all the bonga-FPC laden bread products in all the sensory attributes (appearance, taste, smell, texture and general acceptability). This could be attributed to another observation that the panellists were more accustomed to unladen bread and probably had never eaten any bread having fish protein concentrate. It was however noted that for all the attributes, both 10% and 20% bonga-FPC bread were not rated below 3.0 on a 5-point scale thus indicating that the

developed fish products were not disliked. The results from this study have shown that the people of Njala-Mokonde community would readily accept bonga fish protein concentrate (FPC) incorporated into bread or other forms of fish products if well processed. Improvement in the appearance, smell and texture of the bonga-FPC bread products will enhance its acceptance by the residents of Njala-Mokonde community. There were less significant differences ($P < 0.05$) in general acceptability of the bonga –FPC bread products and the control. This means that the products could be improved upon thus making it acceptable to all and by so doing improving the protein intake level of the poor in the community who could afford money to buy bread but not fish.

TABLE 1: HEDONIC SCALE USED FOR SENSORY EVALUATION

RANKING	QUALITY CHARACTERISTICS
5	Like very much
4	Like much
3	Like
2	Dislike
1	Dislike much

TABLE 2. PROXIMATE COMPOSITION OF THE FPC - BREAD SAMPLES

SAMPLES	%CP	%CFA T	%CFIBRE	%ASH	% MOISTURE
A- CONTROL 100% Flour only	9.64	1.06	1.21	2.06	13.67
B-90/10% Flour + Wheat	33.67 24.48	3.64 2.79	1.18 1.32	11.64 10.29	9.76 11.04
C-80/20% Flour + Wheat	29.26	3.16	1.32	10.37	11.56
D-70/30% Flour + Wheat	21.47	2.52	1.42	10.24	12.38
E-60/40% Flour + Wheat					

TABLE. 3: MINERALS COMPOSITION OF THE FPC-BREAD SAMPLES

SAMPLES	% Na	% K	% Ca	% P	% Mg	% Fe
A-CONTROL 100% Flour only	0.01	0.06	0.02	0.08	0.13	0.01
B-90/10% Flour + Wheat	0.86	0.29	0.04	0.17	0.15	0.03
C-80/20% Flour + Wheat	0.13	0.43	0.05	0.22	0.17	0.03
D-70/30% Flour + Wheat	0.15	0.58	0.09	0.25	0.21	0.049
E-60/40% Flour + Wheat	0.23	0.73	0.14	0.32	0.28	0.07

TABLE. 4: MEAN SCORES OF SENSORY EVALUATION OF PARAMETERS OF DEVELOPED FISH PRODUCTS

SAMPLES PRODUCTS GROUP	N	APPEARAN CE	TAST E	SMEL L	TEXTUR E	GENERAL ACCPTABILI TY
A-CONTROL Flour only	29	4.83 ^a	4.45 ^a	4.59 ^a	4.24 ^a	4.31 ^{a*}
B -10% Flour + Wheat	29	4.10 ^b	3.66 ^b	3.72 ^{bc}	4.14 ^a	3.66 ^{ab*}
C-20% Flour + Wheat	29	4.10 ^b	3.45 ^{bc}	3.28 ^c	3.38 ^b	3.28 ^{bc}
D-30% Flour + Wheat	29	3.69 ^{cd}	2.97 ^{cd}	2.86 ^{cd}	2.93 ^b	2.45 ^c
E-40% Flour + Wheat	29	3.66 ^{bc}	3.31 ^{bc}	3.14 ^c	3.07 ^b	2.93 ^{bc}

Mean in the same column followed by the same letter are not significantly different ($p < 0.05$) as determined by ANOVA result and Duncan's New Multiple Range Test. Rating scale: 5=Like very much; 4=Like much; 3=Like; 2=Dislike; 1=Dislike much.

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