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Chemical Composition, Sensory Evaluation and Shelf Stability of Chin-chin Enriched with Fish Protein Concentrate of *Oreochromis niloticus*

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Abstract

Fish Protein concentrate (FPC) from low value tilapia (*Oreochromis niloticus*) which would otherwise have been discarded, was used in certain proportions (0%, 5%, 10% and 15%), in addition to wheat flour, for the production of chin-chin in order to address the problem of inadequate intake of protein and to determine the acceptable proportion of FPC to wheat flour by consumers. Sensory (organoleptic) parameters of the samples were determined, and the results subjected to statistical analysis using ANOVA. Except taste, the samples were not significantly different ($p>0.05$) in the sensory attributes determined. There was also no significant difference ($p>0.05$) in crude protein, ether-extract, ash, moisture, and crude fibre content of the product. However, significant difference ($p<0.05$) was observed in the nitrogen free extract content of the treatments. The low value fish like Tilapia species can be used to improve the nutritional composition (especially the protein content) of foods high in carbohydrate and low in other nutrients. The species can also be used as a substitute for other additives that are proteins in nature. Results obtained also indicated that wheat flour can be substituted with low value fish powder up to 15% level. A notable increase in Fibre contents with a decrease in carbohydrate content in the chin-chin was observed.

Keywords

Flour, Chin-chin, Fish, Proximate Composition, Sensory Evaluation

1. Introduction

Fish is a major source of protein and its harvesting, handling, processing, and distribution provide livelihood for millions of people. Freshwater fish processing should assure best market quality, assure health safety of products, apply the most appropriate processing method, and reduce waste to the barest minimum. Food and Agricultural Organization of the United Nations [1] reported that, the contributions of fish and fish products to the Nigeria's socioeconomic wealth are huge when considered against the background of employment creation, income generation, provision of valuable animal protein with easy digestibility and cholesterol free, rural development and foreign exchange inflow through exploitation of shrimps and smoked fish. As such, aquaculture is one of the fastest growing food production sectors at global level with 9.6 percent per year in the last decade [1].

Al-jufaili and Opera [2] reported high incidence of fish losses as a major impediment to the realization of government approach towards increasing the contribution of the sector to the overall national economy. Fish is among the healthiest foods on the planet. It has a lot of important nutrients, such as protein and vitamin D. The fish has the world's best source of omega – 3 fatty acids, which are

incredibly important for the brain and body. Large quantities of fin fish/shellfish are thrown out of the landing site due to non-patronage by most people, which makes it uneconomical to preserve and bring them ashore [1].

Generally, all species of fish are good for health. They are high in essential nutrients which most people lack in sufficient quantity. These include iodine, high – quality protein and various vitamins & minerals. Consumption of fish may be greatly increased by making better use of the existing catch. These species can be upgraded by applying an appropriate technology, which combines it with flour to produce snacks, chin-chin or other products. This will be one form of value added which enriches the flour with valuable protein and at the same time making the less acceptable fish highly acceptable. [1].

The malnutrition, especially among children has long become a major health problem in Nigeria, it is widely believed that malnutrition and food shortage impede health, working efficiency, productivity and general economic progress of the people living in this country [3]. Also, most of the calorie requirements of the populace are met in the form of cereal grain such as rice, guinea corn and millet or root crops which are low in biological value. Since malnutrition has a deleterious effect on the health of people especially little children, pregnant women, and lactating mothers. Therefore, it was felt that incorporating a dried form fish protein concentrate (FPC) in a daily carbohydrate food such as ‘‘chin-chin’’, cake and fish pie could alleviate the problem, facilitate fish consumption, and alleviate malnutrition among this group of people. Researchers such as [4-7] have described the importance of light foods like ‘‘Chin-chin’’, snacks, pies, crisps etc. in cushioning the effect of hunger temporarily.

Tilapia is a culturable fish that tolerates a wide range of environmental conditions. However, it is known to breed excessively in ponds resulting in overpopulation. As a result of this, there is competition for food and space which leads to stuntedness of tilapia. This constitutes a problem to fish farmers because stunted.

Tilapia does not command good economic value in the market. It is essential therefore essential we learn how to maximize to make better use or this species by converting them to other forms of food such as snacks at a cost that the consumer will be able to afford and gladly pay for. Such fishes can be reintroduced into the human food chain after conversion into fish mince [3].

2. Materials and Methods

2.1. Sample Collection and Preparation

Fourty (40) fresh fish samples of *Oreochromis niloticus* of 100g-200g each were purchased from fish, meat, and vegetables market (Sokoto Central Market). The flour and other ingredients needed for the ‘‘Chin-chin’’ were also purchased from the market. Located at N13°03.684” E 005°13.139” Elevation 281m height above sea level. The fish were humanely killed, de-scaled, de-gutted and thoroughly washed with clean water to remove blood stain and dirt, drain and then oven dry for (FPC).

2.2. Procedure for Fish Protein Concentrate (FPC)

The prepared fresh fish samples were weighed and arranged in oven dryer (SM9053), the drying was done at 60°C-70°C temperature for 12 hours as stated by [8], drying method on the functional properties of (FPC) from lizard fish. Then dried fish samples were weighed again to determine the percentage weight lost and pounded to powder by using a pestle and mortar, fish was further ground with Panasonic (MX-AC210S) electric blender to a very fine powder particle so as it allows a thorough mixture of flour and other ingredient.

2.3. “Chin-chin” Procedure

The sample was fried at the processing unit of the university which is located at N 13°07.774” E 005°12.258” Elevation 269m height above sea level. The ground fish powder was mixed with flour at the percentage of 0%, 5%, 10%, and 15% of (FPC) for all the samples respectively. The flour, sugar, butter, baking powder and the fish powder were mixed with little quantity of water based on the proportion above to make it into dough. The dough was rolled into a flat shape and cut into small size of about ½ inch, then fried in deep hot vegetable oil until it turns golden brown and the ‘Chin-chin’ was removed from the oil to drain, cool and finally packaged in high density polyethylene zip lock bags for storage.

2.4. Determination of Shelf Life

The sample was stored for a period of Eight (8) weeks to determine the shelf life. The samples were randomly taken and subjected to chemical analysis and the sensory evaluation from the first to eight weeks of storage period. The parameters used in determining the shelf-life quality are sensory attributes, proximate analyses, and TVB-N values.

2.5. Proximate Analysis

The proximate analysis of the sample was done at the Agricultural Chemical Laboratory. After the preparation of the ‘Chin-chin’ they were taken for analysis of moisture, fat, ash, fiber, and nitrogen free extract by the methods of [9]. The crude protein of the ‘Chin-chin’ was determined by Micro-Kjeldhal method.

2.6. Determination of Total Volatile Base-nitrogen (TVB-N)

TVB-N was determined based on an adaptation of the current official European steam-distillation method of [10]. 200 ml of a 7.5% aqueous trichloroacetic acid solution was added to 100 g of the sample; after homogenization, the mixture was centrifuged at 400 g for 5 min and then filtered

through a Buchner funnel using a Whatman no. 3 filter paper. Steam entrainment was performed using a Kjeldahl-type distillator: (Vapodest 2 Gerhardt or Buchi 320). 25 ml of filtrate were loaded into the distillation tube followed by 6 ml of 10%NaOH (the final operation is automatic on starting the Vapodest 2). A beaker containing 10 ml of 4% boric acid and 0.04 ml of methyl red and bromocresol green indicator was placed under the condenser for the titration of ammonia. Distillation was started and steam entrainment continued until a final volume of 50 ml was obtained in the beaker (40 ml of distillate). The boric acid solution turned green when alkalinized by the distilled TVBN which was titrated with aqueous 0.1 N sulfuric acid solutions using a 0.01 ml graduated micro burette. Complete neutralization was obtained when the color turned pink on the addition of a further drop of sulfuric acid. If n is the number of ml of sulfuric acid added, the TVBN content is 16.8 mg of nitrogen per 100 g of fish.

$$\text{TVBN} = \frac{\text{n x 16.8mg of nitrogen}}{\text{100 g}}$$

2.7. Sensory Analysis and Scoring Procedure

The sensory attributes of the chin-chin were determined by using simple hedonic tests as described by [12]. This was undertaken to determine the taste, odor, texture, and color of the samples. Taste panel of ten (10, 11) members was trained in scoring of the sample and scores at every two weeks' interval for the period of 8 weeks. The products were scored on a 5-point hedonic scale questionnaire, 8 – excellent, 6 – good, 4 – fair, 2 – poor and 0 – bad according to [13, 3, 11].

3. Results

The result of the experiment (Table 1) depict that the samples were not significantly different ($p>0.05$) in their crude protein, ether extract, ash moisture and crude fibre. However, Significant difference ($p<0.05$) was recorded only in the nitrogen free extract (NFE) content of all the treatments. It was observed that spoilage of fish product resulted from the action of enzymes and bacteria can be slowed down through the removal of moisture to increase the shelf life of the stored product. Total volatile base nitrogen (TVB-N) values of the samples are also reflected in Table 1.

The results of statistical analysis of the sensory (organoleptic) parameters for the experimental samples in Table 2 showed that the samples were not significantly different ($p>0.05$) in the (Odor, texture, and appearance) sensory attributes of the' chin-chin' produced from the different % inclusion rate of fish protein concentrate (FPC) throughout the storage periods of 28 days. on the data obtained from the panel members. But there was a statistically significant difference ($p<0.05$) in Taste of the chin-chin' product at 28 days of the experimentation, with a mean value of 5.29±0.34 and 7.86±0.14 respectively.

Table 1. *Proximate Composition of chin-chin product made from wheat flour and dry fish powder.*

Parameters	Treatments			
	Control 0% FPC	**5% FPC**	**10% FPC**	**15% FPC**
Crude Protein	19.08±0.25^{a}	21.75±3.59^{b}	20.00±6.96^{a}	20.75±7.19^{a}
Ether Extract	12.5±1.50^{a}	13.75±1.32^{ab}	15.50±0.29^{ab}	16.00±0.00^{b}
Ash	2.25±0.25^{a}	2.50±0.50^{a}	2.75±0.48^{a}	3.50±1.50^{a}
Moisture	7.50±0.96^{a}	6.75±1.44^{a}	7.75±1.44^{a}	6.25±0.63^{a}
N F E	47.00±12.03^{b}	46.0±7.78^{a}	48.00±4.06^{b}	47.25±4.09^{b}
Crude Fiber	11.00±3.70^{a}	11.75±3.92^{a}	8.75±3.92^{a}	11.25±3.77^{a}
TVB-N	3.00±0.00^{a}	4.00±0.01^{a}	4.01±0.00^{a}	4.02±0.01^{a}

Note: Means with same superscripts on the same row are not significantly different

Table 2. *Sensory attributes of the chin-chin made from different % inclusion rate of fish protein concentrate (FPC) of Oreochromis niloticus.*

Parameters	Treatments	Storage Period (days)		
		1st	**14th**	**28th**
Taste	Control	6.93±0.27^{a}	5.29±0.34^{a}	5.29±0.34^{a}
	5%	7.20±0.33^{a}	5.29±0.27^{a}	6.00±0.01^{b}
	10%	6.80±0.26^{a}	6.13±0.41^{a}	6.71±0.34^{c}
	15%	6.27±0.64^{a}	5.83±0.7^{a}	7.86±0.14^{d}
Odour	Control	7.33±0.25^{a}	5.43±0.25^{a}	5.43±0.25^{a}
	5%	6.93±0.43^{a}	5.14±0.28^{a}	6.57±0.39^{b}
	10%	6.67±0.42^{a}	5.73±0.33^{a}	7.29±0.40^{b}
	15%	6.67±0.37^{a}	6.15±0.66^{a}	7.29±0.27^{b}
Texture	Control	6.67±0.47^{a}	7.00±0.28^{b}	6.86±0.28^{b}
	5%	6.93±0.61^{a}	5.14±0.28^{a}	6.14±0.25^{ab}
	10%	5.87±0.46^{a}	5.47±0.31^{a}	5.29±0.40^{a}
	15%	6.67±0.42^{a}	5.54±0.56^{a}	7.00±0.28^{b}
Appearance	Control	8.00±0.01^{b}	6.00±0.36^{a}	6.00±0.36^{b}
	5%	7.20±0.33^{ab}	5.14±0.28^{a}	5.14±0.28^{a}
	10%	7.07±0.33^{a}	5.07±0.38^{a}	5.86±0.14^{ab}
	15%	6.93±0.33^{a}	5.62±0.78^{a}	6.43±0.23^{b}

Note: Means with same superscripts on the same row are not significantly different

4. Discussion

The moisture content determines the shelf life of the product. The range of moisture content for all the flour and (FPC) chin-chin samples was between 6.25% and 7.75% which is at the minimum limit of moisture content for flour [14]. Generally, there was a reduction in moisture content as the quantity of (FPC) incorporation increased. The decrease in moisture content obtained was similar to the trend and values reported by [15] for cookies produced from Sweet Potato-Maize Flour Blends (5.0-6.1%). [16], also reported similar results for soybean fortified Tapioca. The values gotten were within the range reported to have no adverse effect on quality attributes of the product [17]. [18] Reported that the lower the moisture content of a product to be stored the better the shelf stability of such products. Hence, low moisture ensures higher shelf stability of dried product.

Proteins are made up of amino acids, which perform different functions in the body, such as growth and repair of body cells and tissues, synthesis of hormones and antibodies [19]. The samples with the highest protein content were the 5% enriched fish dry powder (21.75%). Fats provide the most concentrated source of chemical energy and heat. They support certain body organs and help with the transportation and storage of fat-soluble vitamins A, D, E, and K [19]. The control sample (100% flour),

The fat content of the enriched samples and control ranged from 12.5 to 16.0%. There was no significant difference ($p > 0.05$) in the fat value of all samples. Sample (15%) had the highest value of 16.0%, while sample, 0% (control) had the least value of 12.5%. This result showed that there was an increase in fat content of the samples of about (21.9%) as the level of incorporating increased. The increase may be due to high oil absorption capacity of the dried fish powder enriched flour. [20] reported that low fat content in a dry product will help in increasing the shelf life of the sample by decreasing the chances of rancidity and also contribute to low energy value of the food product while high fat content products will have high energy value and promotes lipid oxidation.

Fat content values increased with increase in level of enrichment of fish protein concentrate, frying significantly increased the fat content of chin-chin made from all the samples. This suggests that for health-related purposes, the flour could be processed into a baked product rather than been made into a fried product. Alternatively, low cholesterol oil such as olive oil may be used in frying in place of ground nut oil. Above all, vegetable fats are essentially unsaturated which makes them more health-friendly than animal fat [19]. Crude fiber helps with the peristaltic movement of food substances during digestion. The enrichment of (FPC) decreased the carbohydrate content of the samples gradually. The Fibre content of the product decreased with increase in enrichment levels.

The ash content of all the chin-chin samples ranged from 2.25 to 3.50%. Sample (5% FPC) had the highest value of 3.50% and sample (100% wheat) had the least value of 2.25%. There was slight variation, but no significant difference ($p>0.05$) in ash content of enriched samples. This result showed that there was an increase in ash content of samples as the amount of (FPC) incorporation into chin-chin was increased. This result agrees with the observation of [21] on the incorporation of carrot pomace powder and germinated chickpea flour into biscuit (0.8- 1.2%). [22] also reported an increase in the ash content of enriched chin-chin as the proportion of modified starch substitution increased. Increase in ash content of enriched samples might be attributed to the high value of mineral content of the dried fish powder.

The result from the panel of judges shows that There was no significant ($P>0.05$) between all the treatments and all the samples were ranked between Good to Excellent in term of taste, odour, texture, and appearance. This may be due to the moderate proportion of the protein contents which appeal to the taste bud. This was followed by the control (no FPC inclusion) which also falls within good to excellent in term of taste, odour, and texture. But in terms of appearance control shows excellent in first day and remains good throughout the period of storage. This in line with the work of [23]. Sensory evaluation revealed that as the inclusion level of fish in flour exceeds 20% the appearance, taste and odor of the product tends to be rejected. Seevaratnam *et al* [24] reported a substitution of 10% for edible products to be highly acceptable and appreciable.

5. Conclusion

It can be concluded that the low value fish like Tilapia species can be used to improve the nutritional composition (especially the protein content) of foods high in carbohydrate and low in other nutrients. The species can also be used as a substitute for other additives that are protein in nature. Results obtained indicated that wheat flour can be substituted with low value fish powder up to 15% level. A notable increase in Fibre contents with a decrease in carbohydrate content in chin-chin was observed.

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